Yu (Aimee) Zhang
*Editor*

# Handbook of Mobile Teaching and Learning

Springer Reference

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With 233 Figures and 90 Tables

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# Preface

Mobile technologies have been used in higher education for many years. They provide good solutions for teaching and learning and make learning available anywhere and anytime. The aim of this handbook is to collect and share the knowledge and experience from the designers', developers', teachers', and students' views and provide suggestions and advice for future mobile teaching and learning programs. This book includes six sections: design, development, adoption, collaboration, evaluation, and future of mobile teaching and learning technology in education. It includes different projects and practices across different countries and different cultures. The book provides in-depth background information and cases studies in high-technology teaching and learning and future expectations for new technology in higher education. The variety of projects and programs running in different countries helps boost innovation and discussion in future projects and practices. It also provides guidelines for future design and development of mobile applications for higher education.

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# List of Terms

| Terms | Explanation |
|---|---|
| 3G | Third-generation networks, which are high-capacity radio access wireless networks providing enhanced data services, improved Internet access, and increased voice capacity |
| 4G | Next-generation cellular wireless access standards |
| ACCC | Australian Competition and Consumer Commission, the government body responsible for administering price caps related to Telstra and for regulating competition policy, anticompetitive conduct, or unfair business practices and enforcing the Competition and Consumer Act 2010 |
| ACIF | Australian Communications Industry Forum is an independent body established by industry to manage telecommunications self-regulation |
| ACMA | Australian Communications and Media Authority, which came into existence on 1 July 2005, is responsible for the regulation of broadcasting, radio communications, telecommunications, and online content |
| ADMA | Australian Direct Marketing Authority is the peak trade association representing the direct marketing industry |
| ADSL | Asymmetric Digital Subscriber Line, a technology used to transmit data at fast rates (between 16 kbit/s and 640 kbit/s up-stream; up to 8 Mbit/s downstream) |
| ADSL 2+ | Successor product to ADSL that raises the maximum data rate to 16 Mbit/s (downstream) or 1 Mbit/s (upstream) |
| AI | Artificial intelligence |
| AMPS | First-Generation Technology Advanced Mobile Phone System, a mobile telephone system predominantly based on analogue transmission |

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|---|---|
| AMTA | Australian Mobile Telecommunications Association is the national body representing the mobile telecommunications industry in Australia |
| Analogue | The term used to describe the continuously variable wave form nature of voices and other signals. A signal for which the amplitude (strength) and frequency (tone) varies continuously |
| Android | A popular smart phone OS from Google |
| App Store | Apple applications online store |
| ARPU | Average revenue per user. The ratio of service revenues in a given period to the average number of wireless subscribers in the same period. It is presented on a monthly basis |
| ASP | Application Service Providing, a service that enables enterprises to lease IT applications |
| Asynchronous | Interactions happen at different time |
| Bandwidth | Denotes the width of the frequency band used to transmit data. The broader the bandwidth the faster the connection |
| Base station | Part of the infrastructure essential for network operation, base stations contain the radio equipment which serves the "cell" |
| Blended-learning | A learning method combined with traditional face-to-face learning and online learning |
| Blog | A personal online journal |
| Bluetooth | A system which allows the inter-related communication between mobile phones and stationery devices (such as computers) |
| bps | Bits per second. Basic unit of measurement for serial data transmission capacity |
| Broadband | Broadband is a general term that refers to high-speed connections such as cable, ADSL, and satellite. For broadband services, Internet access is not time-based as it is an "always on" connection, the exception being the uplink for satellite |
| Capex | Capital expenditure. Accrued capital expenditures related to the expansion of the telecommunications infrastructure |
| Carrier | In very general terms, a carrier provides the physical infrastructure used to supply carriage services to the public |
| CDMA | Code Division Multiple Access is a type of digital mobile service that differs from GSM digital. CDMA replaced the analogue service |

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|---|---|
| Churn | The process of transferring customer accounts between service providers in Australia |
| CJV | Contractual joint ventures |
| Cloud computing | Delocalized resources and computing activities to an online server from a service provider |
| CND | Calling Number Display is a service that allows a caller's number to be viewed by the person receiving the call |
| Content Provider | A company that provides services to mobile phone users or network operators |
| CSP | Carriage service provider in Australia. Person supplying or proposing to supply certain carriage services, including a commercial entity acquiring telecommunications capacity or services from a carrier for resale to a third party |
| DCITA | The Department of Communications, Information Technology and the Arts in Australia |
| DE | Distance learning is learning activities via long distance |
| DGP | Directorate General of Posts of China |
| DGT | Directorate General of Telecommunications of China |
| DSLAM | Digital subscriber line access multiplexer is a piece of infrastructure at the exchange that allows for ADSL and a standard phone service to be provided on the same line |
| Digital | The representation of a signal in the form of a stream of binary numbers rather than as an analogue electrical signal |
| DVB-H | Digital Video Broadcasting – handheld, a transmission standard that enables users to receive digital TV channels on their mobile phones |
| ECS | Enterprise Communication Services |
| EDGE | Enhanced Data Rates for GSM Evolution, modulation on the air interface to enhance data rates in GSM (Global System for Mobile Communications) and TDMA (Time Division Multiple Access) networks |
| EJV | Equity joint ventures |
| ET | Emerging technologies include cloud computing, mobile technology, and new developed technologies |
| F2F or FTF | Face-to-face teaching and learning or traditional teaching |
| Generation Y | The generation born between 1982 and 1995 and is also known as Generation Why, Generation Next, the www generation, the Millennium Generation, or Echo Boomers |
| GHz (gigahertz) | One billion Hertz |

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|---|---|
| GPRS | General Packet Radio Service, technology allowing higher data transmission rates in GSM networks |
| GSAs | Global strategic alliances |
| GSM | Global System for Mobile Communications, global digital mobile communication standard |
| HCS | Home Communication Services |
| HCI | Human computer interface or user's interface (UI) |
| HSDPA | High Speed Downlink Packet Access, packet-based protocol that enhances data rates in UMTS networks and lifts transmission speeds into the megabit range |
| i-mode | A customized packet-based mobile service |
| ICT | Information and communication technology |
| ICV | International cooperative venture |
| IEEE | Institute of Electrical and Electronics Engineers |
| Interconnection | Term used to denote the connections between networks run by various providers, as regulated by the German Telecommunications Act |
| Internet/intranet | The Internet is a worldwide Internet Protocol (IP)–based computer network that has no central network management. By contrast, intranets are managed IP networks that can be accessed only by specific user groups |
| iOS | iPhone/iPad Operating Systems of Apple Inc. |
| IOT | Internet of Things |
| IP | Internet Protocol |
| IPTV | Internet Protocol television, a system where a digital television service is delivered using the Internet Protocol |
| ISDN | Integrated Services Digital Network, integrate telecommunications services such as telephone, fax and data communication in one single network |
| ISP | Internet Service Provider, an internet service provider offers various technical services that are required to use or operate Internet services, usually in return for a fee |
| IT Lab | IT laboratory |
| ITU | International Telecommunications Union |
| IVR | Interactive Voice Response, a service for mobile voice talk or other services |
| Java | An industry standard object-oriented language and virtual machine |
| Kbps | Kilobits (thousands of bits) per second |
| LCS | Local carriage service. This is where the access provider provides the wholesale or network elements of local calls, and the access seeker provides the retail elements such as billing |

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|---|---|
| M-commerce | Mobile commerce, generated after electronic commerce based on mobile network and wireless technologies (e.g., ring tones, icons, wallpapers, games, and premium SMS for reality TV voting and competitions) |
| Mbit/s | Megabits per second, unit of data transmission speed |
| MII | Ministry of Information Industry of the People's Republic of China |
| MISP | Managed Internet Service Provider |
| MMS | Multimedia Message Service allows the transmission of various media such as text, image, animations, video, and audio clips in a single message |
| MNE | Multinational enterprise |
| Mobile Internet | Mobile customers can gain wireless access to the Internet anytime and anywhere by using wireless terminals such as mobile handsets and mobile Internet terminals |
| M-learning | Mobile learning or m-learning is the learning activity on mobile devices or learning anytime and anywhere |
| Mobile Payment/Wallet | An integrated mobile payment service can be classified as remote payment and on-site payment, which provides customers with functions such as recharging, payment, and enquiries through RFID, WWW, SMS/MMS, etc. |
| Mobile TV | Mobile TV is expected to drive margins and 3G penetration for carriers. Popular forms of mobile TV are expected to be news clips, sport highlights, music video clips, and "mobisodes" (shows specially made for mobile handsets) |
| MPT | Ministry of Posts and Telecommunications of China |
| MSP | Managed Service Provider |
| Multimedia | Term used to denote the real-time integration of text with still images and graphics, video and sound |
| MLP | Multi-layer perception is a method used in computing intelligence to train the system |
| MTE | Mobile teaching environment |
| Naive Bayes classifier | A Naïve Bayes classifier is a simple probabilistic classifier based on applying Bayes' theorem |
| NN | Artificial neural networks are composed of interconnecting artificial neurons to mimic the properties of biological neurons |
| Number portability | An arrangement that allows subscribers of a telecommunications service to change carriers without having to change their number |
| Objective-C | Primary program language for iOS and MacOS software development |

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|---|---|
| Packet switching | A method of transmitting messages by subdividing them into short packets containing the data and a destination address. Each is passed from source to destination through intermediate nodes which direct each packet onwards, not necessarily by the same route. The packets are reassembled into the original message at the receiving end |
| PCS | Personal Communication Services |
| PDA | A personal digital assistant is also known as a palmtop computer or personal data assistant |
| Prepaid | In contrast to postpaid contracts, prepaid communication services are services for which credit has been purchased in advance with no fixed-term contract obligations |
| Polyphonic | Polyphonic ring tones vary in specification from phone to phone, but all polyphonic phones support the playing of more than one note together, so a ring tone is generally more musical |
| Postpaid | Subscriber that has a contract for the use of airtime. The client has no need of activating airtime, it is done so immediately |
| Premium Services | A carriage service or a content service using a number with a prefix starting with "190" in Australia |
| PTT | Push to talk (PTT) offers consumers the ability to talk to another individual or group without having to make additional calls |
| Real (or true) tones | Ring tones that are an extract from patented music |
| RF | Radio frequency |
| RIA | Rich Internet application with multimedia and interactive contents |
| Roaming | Roaming allows customers to use their mobile phones on other networks (other than the one for which they currently pay). Roaming can be national wide or international |
| SMS | Short Message Service (SMS) enables mobile phones to send and receive text messages |
| SOC | System on chip |
| Spam | Unsolicited marketing e-mail and SMS messages to mobile phones |
| Spectrum | The bandwidth of a communications system, expressed in terms of the frequencies it can carry |
| SWOT | Strengths, weaknesses, opportunities, and threats |
| Synchronous | Interactions happen at the same time |

| | |
|---|---|
| TDD modulation | Time Division Duplexing, a broadband transmission method where the sending and receiving channels use the same frequency but at different times |
| TDMA | Time division multiple access |
| TIO | The Telecommunications Industry Ombudsman (TIO) is a free and independent service for residential customers and small business in Australia that can help them resolve complaints about phone and internet problems |
| UI | User's interface, the designed page for users |
| UMTS | Universal Mobile Telecommunications System, third-generation international mobile communication standard |
| Value added services | Services provided over a public or private network which, in some way add value to the basic carriage services (such as storing and forwarding messages) |
| Virtual Private Network | A software-defined network offered by telephone carriers for voice and data communications among multiple sites. The network provides the appearance of a private network, except that it makes use of the public switched network rather than physically dedicated leased lines |
| VMNOS | Virtual Mobile Network Operators |
| VOIP | Voice over Internet Protocol, technology used to make telephone calls via the Internet |
| VDSL | Very high bit rate Digital Subscriber Line, a new technology used to transmit exceptionally high data rates (5 Mbit/s upstream, 50 Mbit/s downstream) |
| W-CDMA | Wideband Code Division Multiple Access, a technology for wideband digital radio communications of Internet, multimedia, video, and other capacity-demanding applications |
| Wallpaper | Wallpaper is the background of the mobile phone display |
| WAP | Wireless Application Protocol, a service for mobile internet access |
| Web 2.0 | A technology that use technology beyond the static pages of earlier Web sites. It is widely adopted in online teaching and learning |
| Wholesale | The business of selling services to third parties who in turn sell them to their own end users either directly or after further processing |
| WIKI | Wikipedia, a Web site for users to add and edit learning content |

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|---|---|
| WIL | Work integrated learning |
| WLAN | Wireless Local Area Network, wireless networks for mobile Internet access. The network can also connect multiple computers to each other or to a central information system, a printer, or a scanner |
| Wi-Fi | Wireless Fidelity, based on 2.5G technology |
| Wi-MAX | Worldwide Interoperability for Microwave Access, a telecommunications technology aimed at providing wireless data over long distances in a variety of ways, from point-to-point links to full mobile cellular type access. It is based on the IEEE 802.16 standard |
| WOS | Wholly owned subsidiary |
| WTO | The World Trade Organization (WTO) deals with the global rules of trade between nations. Its main function is to ensure that trade flows as smoothly, predictably and freely as possible |
| Xcode | Official integrate development environment for iOS and MacOS software programming |

# Contents

# About the Editor

**Dr. Yu (Aimee) Zhang** is the CEO and founder of the World Educators Mobile – WEMOSOFT. She was a Lecturer in the University of Wollongong School of Economics from 2009 to 2014. She has been teaching economics for more than 5 years. Her innovative teaching and learning with mobile technology received many awards and grants from the university and faculty. Her 5 years working experience in telecommunication industry as remote educational system designer, developer, project manager, and quality assurance manager in different companies also contributed to the cross-discipline innovations. Passionate in both teaching and mobile technology, she designed and developed the mobile application "Tutors in Pockets" for mobile teaching and learning for both IOS and Android mobile devices. She also collaborated with different universities and institutions on mobile projects in higher education teaching and learning.

## Section Editors

**Dean Cristol, Ph.D.** is an Associate Professor in the Department of Teaching and Learning in the College of Education and Human Ecology at the Ohio State University. His area of research is to establish and maintain university-school partnerships, professional development, and preparing people to teach and learn in twenty-first-century educational settings. Currently, he is using this research framework to integrate technology into learning contexts, specifically mobile learning and technology. He has researched in many educational settings, from large and small urban school systems in the United States to Mexican preschools, and works closely with governmental and nongovernmental organizations. His research is defined by ways to educate all children, especially disenfranchised children, by understanding why they are marginalized and discovering ways to overcome their lack of access to twenty-first-century educational contexts. He has participated in several national and state partnering grants; published his research in numerous international, national, and state journals; published several chapters in books; presented his research at several international, national, and state conferences; and sits on several journal editorial boards; currently; he is an associate editor for *Theory Into Practice*.

**Helen Farley** is an Associate Professor (Digital Futures) at the Australian Digital Futures Institute at the University of Southern Queensland. She is currently leading the USQ-led Collaborative Research Network (CRN) project with ANU and UniSA to develop a Mobile Learning Evaluation Framework. She is also the project lead of the OLT-funded "From Access to Success" project, which will develop Stand Alone Moodle that will enable electronic access to course materials and activities for those students without Internet access. Helen has many years' experience as an educator in Higher Education and as a researcher of educational technology. Her research interests are focused around the use of mobile technologies and virtual worlds in Higher Education.

**Jun Hu** was awarded a Master of Computer Science with Distinction from University of Wollongong (Australia) in 2008 and a Bachelor of Computer Science and Software Engineering from Beijing Information Science and Technology University (formerly known as Beijing Information Technology Institute, P.R. China) in 2001. From 2001 to 2003, he was a development manager at Tsinghua Tongfang Co., Ltd. (Beijing, P.R. China). Then he led the research and development department at Beijing Oriental Caesar Technology Co., Ltd. (Beijing, P.R. China) from 2003 to 2005. From 2005 to 2006 he was the group leader of the wireless application team at Techfaith Wireless Communication Technology Co., Ltd. (NASDAQ: CNTF, Beijing, P.R. China). From 2008 to 2010, he worked at Information Technology Services (ITS), University of Wollongong (NSW, Australia). Since late 2010 he is a computer systems officer at Faculty of Engineering and Information Sciences, University of Wollongong (NSW, Australia). He developed various software including distance cybereducation system, short messaging service system (SMS), multimedia messaging system (MMS) on personal digital assistant (PDA), interactive applications and games for Wireless Application Protocol (WAP) website, and Java 2 Platform, Micro Edition (J2ME), Android and iOS devices. Now he is providing professional services to satisfy the teaching, learning, research, and administration requirements from Faculty of Engineering and Information Sciences, University of Wollongong. His research interests include multimedia, artificial intelligence, and pattern recognition.

**Angela Murphy** is a Postdoctoral Research Fellow at the University of Southern Queensland, Toowoomba. She is currently working on a 3-year USQ-led Collaborative Research Network (CRN) project with ANU and UniSA to develop a Mobile Learning Evaluation Framework. This project will develop resources to support leaders and practitioners implement sustainable and transferable mobile learning initiatives within multiple higher education contexts. Angela has more than 8 years' experience in project management, research design, and analysis and has managed a number of large-scale projects across multiple industries in the corporate, government, and academic sectors.

**Dr. Kshama Pandey** has been working as an Assistant Professor in the Faculty of Education, Dayalbagh Educational Institute (Deemed University), India. From 2002 to 2008 she was senior research fellow at the University of Allahabad, India. From 2008 to 2011 she has worked as a Lecturer in the Department of Teacher Education, at Ewing Christian College, Allahabad. She has done M.Ed. from University of Allahabad and held a postgraduate degree in Hindi Language. She has been awarded her D.Phil. degree from University of Allahabad. Her doctoral work relates to the Human Rights and Consciousness. Her research interests include ICT-Based Education, Innovative Learning Pedagogy, and Human Rights and Peace Education. Her area of research is to prepare the students for a techno-oriented society without uprooting them from their values and cultural moorings.

She is an editorial board member of two international journals, "*European Journal of Applied Social Science Research*" and "*Independent Journal of Management & Production*," Brazil, and member in review committees of another three journals. She has also secured a best paper award in a national seminar for the research paper entitled *Video Game Playing Pattern and Spiritual Belief Among Adolescents*. She has participated in several national and state collaborating grants, published her research in numerous international and national journals, published several chapters in books with international repute, and presented her research at several international and national conferences. Currently, she is working as convener of one thrust area "ICT-Based Education" of SAP Project by UGC and chief editor of an internationally edited book, *Handbook of Research on Promoting Global Peace and Civic Engagement through Education*.

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# Part I

# Design of Mobile Teaching and Learning in Higher Education

# 1 Design of Mobile Teaching and Learning in Higher Education: Introduction

Yu (Aimee) Zhang

**Abstract**

Mobile technology is changing everyone's life and the way people learning too. It has been recognized as one of the most important innovations that influenced teaching and learning. Scholars found there are still several problems in mobile teaching and learning, which including technical learning, digital content development, curriculum design, education for both teachers and learners, IP protection, and stable of networks. To fulfill a real "anytime" and "anywhere" mobile learning, it needs many efforts and collaborations. The following chapters will present the design towards a successful mobile teaching and learning program through literacy, experience and case study.

Technology is changing everyday and influencing everyone's life. It also changed some traditional industries, including higher education industry. With the penetration of mobile technologies and mobile devices, mobile teaching and mobile learning (m-learning) have been very popular in every country. Scholars found there are several problems facing mobile teaching and learning: how to change the traditional teaching curriculum and materials into digital contents, how to design a good content that suits mobile devices and mobile teaching methods, how to improve the interactive and communication functions on mobile programs, how to educate senior educators to use mobile technologies in their teaching, how to protect IP and confidential information online, how to keep stable networks and signals during using, and how to engage students in learning function instead of playing games.

To design a good educational mobile curriculum or program, it is important to understand students' needs and requirements as well as the technologies available. Some traditional materials are easily to be changed into digital contents. However, some practical lessons are not suitable for mobile teaching. For example, acupuncture and rescue breathing may need more on-site observation and practice.

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Even with the developed digital contents, not all contents are suitable for mobile teaching. For example, a 4 GB video class on mobile devices with 3G connection could be very costly and slow. A long PDF with thousand words is hard to read on small screens too. Besides these, the length of study design, disconnection of signals, and the safety of contents should also be taken into account when designing a good mobile teaching program.

A good designed mobile learning program needs many works and tests from the curriculum designer, the application developer, and the learners. Mobile technologies have many special merits, such as social connections, interactive functions, and mobility. Some good attributes of mobile technology, for example, the multimedia supports and interactive attribute, can engage students in self-motivated learning or help students with special needs. Researchers believe that mobile technology can assist learning process, increase students' interests and efficiency in learning, engage students in discussion and searching for new information, enhance performances, assist special learning or personalized learning, and lead to lifelong learning. But in the current stage, mobile learning is still limited by available technologies to achieve the real "anytime and anywhere" learning, such as stability and broadband of mobile signals, high cost of connection fees, and safety issues. Therefore, the mobile learning programs should be used to complement the face-to-face learning methods in current stage, which is called blended teaching and learning.

After reviewing the literature on traditional learning methods, online learning development, and newly developed mobile learning programs, some authors summarized and suggested for mobile learning designs in the following chapters. Some discussed the advantages and disadvantages of mobile learning. Some designed the framework of mobile teaching and learning for curriculum design. Some found new methods to assist learning with current technologies. Some discussed the possibility of adopting new technologies or devices in teaching and learning in the future. These reviews and suggestions are from a variety of disciplines and different countries. Different views and practices are compared. They also discussed the challenges facing future mobile learning methods. They will shed light on future mobile learning designs and guide the future mobile teaching curriculum designs. Educators, designers, and mobile developers will be benefited from these chapters.

Dr. Aimee Zhang introduced the development of mobile technology with its strength and limitations in ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning". The advantages and disadvantages of mobile teaching and learning from the literature and empirical studies were discussed. The history of mobile technology development was introduced in this chapter, which gave an overview of the development of mobile learning with these technologies change. It suggested some important determinants for a good mobile learning program from a designer's view. The designer and educator should be equipped with technical skills and knowledge to design suitable digital curriculum and contents for mobile teaching and learning. Not all digital contents suit mobile learning due to current hardware and broadband limitation. On the other hand, learners are different from different countries, different cultural backgrounds, and different generations. Different countries have different situation, cultures, and mobile devices market shares. Empirical studies were conducted in Australia and China. The results showed very different market shares of mobile devices in Australian students and Chinese students. The levels of adoption of mobile learning were also different. The chapter also discussed, from the learners' view, what should be implemented to engage the learners and enhance the learning effects. In the end of the chapter, the limitation and barriers for mobile learning programs were discussed and some possible solutions were proposed. The future design for mobile teaching and learning was also highlighted.

In ▶ Chap. 8, "Mobile Learning: Critical Pedagogy to Education for All", Dr. Kshama Pandey and Neetu Singh from Dayalbagh Educational Institute discussed the challenges for mobile learning program design in India. Mobile technologies and mobile learning developed very fast in India from 1995 to 2014. The different conceptions of mobile learning were discussed in this chapter. The meaning of mobile learning was also discussed, including the mobility of technology, mobility of learners, and mobility of learning. They believe that mobile learning has good quality appearance on learning processes and performances. Six broad theory-based categories of activity in mobile learning are discussed in this chapter. Some different researchers and practitioners from these theories were listed. They also summarized the theories and the pedagogies that support the use of mobile phones in distance education. The benefits from mobile learning were also discussed from literacy and practices. Some critical issues for pedagogy design for mobile learning were proposed in this chapter. In the end of the chapter, the mobile development and government goal in India were discussed. The future expectation of mobile learning in India and expected market growth were also introduced. The chapter shed light on future design of mobile learning in a macroeconomic view and highlighted the importance of mobile learning to India and other countries.

Dr. Deanne Cranford-Wesley, from Davenport University, United States, discussed the mobile curriculum design in ▶ Chap. 5, "Designing a Mobile Applications Curriculum: Overview". This chapter gives an overview of mobile curriculum design for computer science discipline and other disciplines. It discussed the technology change and mobile technology development from technical point of view. The chapter emphasized the importance of adopting multiple pathways in mobile learning designs. Multiple security objectives are also important in online or mobile learning. He argued that an educational institution that offers a mobile applications curriculum should also consider selecting a textbook that maps closely to the learning objectives of a certification exam in mobility. Six different mobile certifications that are available in the market were also discussed and compared in this chapter. In the end of this chapter, it indicated that an educational organization should establish a culture of highly trained technology professionals for mobile learning.

In ▶ Chap. 14, "Transformation of Traditional Face-to-Face Teaching to Mobile Teaching and Learning: Pedagogical Perspectives", Dr. Jan Turbill shared her rich knowledge and experience with every educator. The traditional face-to-face teaching method is very familiar for every teacher. It was the major teaching method 15 years ago. Students were very active in class, communicated with teachers, and learned from each other. They read a lot of books and notes to learn new knowledge and skill. However, the new generation came to university with their mobile devices and did their reading, searching, and learning all on their mobile phones or mobile tablets. Where learning methods are changing, teaching methods should be changed too. Dr. Turbill faced the challenge of designing and developing online curriculum from the traditional teaching materials. The project was very successful and got many teachers and tutors involved. Students were asked to bring some background knowledge, beliefs, and views about that which they are about to learn (*My Personal Theory*) that underpin their existing knowledge, attitudes, and actions (*My Theory in Practice*). This was challenged and informed by new information, ideas, and input (*The Theories of Others*) and new actions and practices (*Theories of Others in Practice*). All of these dimensions were put together to develop the online model. It reviewed the literature of traditional face-to-face learning and introduced the transformation from traditional teaching to high technology teaching and learning. It also compared the different perspectives of learning design and advantages from both learning methods. The structure of online course designed by Dr. Turbill was very impressive and helpful for future online and mobile curriculum design.

Dr. Jan Turbill, Dr. Michael Zanko, and Dr. Bonnie Dean had introduced their empirical projects for teachers' professional development in ▶ Chap. 11, "Mobilizing PD: Professional Development for Sessional Teachers Through Mobile Technologies". The chapter introduced two professional development programs at the University of Wollongong in Australia. The chapter discussed where professional development is heading: from traditional modes of delivery toward a practice-based focus. It also reviewed literature on ways of supporting sessional teachers at Australian universities. It highlighted the new opportunities for engaging teachers through mobile technologies. They emphasized the importance of building technical professional skills for teachers at the institutional level and addressing individual sessional staff needs. A practical flexible teachers' training module adopted in the University of Wollongong was introduced in the chapter. Technical skills and professional knowledge on online or mobile technologies are vital for mobile teaching and learning. It is important for institutions and staffs to have the same goal and training plan for new challenges. This chapter shed light on future mobile curriculum design and implementation through skill development and technology training.

Keith Brophy addressed one of the most challenging questions for mobile learning in ▶ Chap. 7, "Gamification and Mobile Teaching and Learning". Gamification is introduced in the chapter. The planet is now spending more than three billion hours a week gaming. People are seeking and finding engagement, motivation, fulfillment, and social bonding in and through the structured world of games. Gamification is the application of game concepts and other mechanisms in nongame contexts and activities. Gamification is already prevalent in many educational projects. The primary goal of gamification within the educational project was to motivate and engage students. The gamification strategies can promote new methods of exploring and interacting with the information, helping students build on previous learning outcomes as they tackle new problems and build critical system design and thinking skills. Codeacademy platform, Mozilla Open Badges, Classcraft platform, and Quest to Learn (QTL) are introduced in this chapter. The chapter discussed the balance between gamification and learning functions in mobile teaching and learning design. It argued that gamification strategy needs to suitably align with the desired learning outcomes. The benefits and drawbacks were also discussed in the chapter. The chapter indicated that the social and collaborative aspects of gamified systems will allow students to increasingly interact and learn from each other. It also agreed that mobile devices will further enable a continuous connection between students and allow for creative and innovative project.

Dr. Cassey Lee proposed and discussed new business models for e-commerce teaching and learning in ▶ Chap. 3, "Business Models for Mobile Learning and Teaching". He believed that an important issue that needs to be addressed in mobile teaching and learning is the financial aspect of offering and accessing mobile learning services. e-Commerce business models can provide some insights for financially sustainable mobile teaching and learning. This chapter reviewed the concept of mobile learning and teaching as well as the technology involved. It also surveyed the types of business models and related them to mobile learning services. It proposed the key factors that are important for financially sustainable delivery of mobile learning services. It shed light on the sustainable plan to design and develop a mobile teaching and learning project in higher education and other industries.

In the chapter ▶ "Applying Open-Book-Open-Web Assessment In Postgraduate Accounting Subject: Flipping Test", Dr. Angela Liu, Dr. Lina Xu, and Dr. Corinne Cortese from the University of Wollongong extend the notion of the "flipped" classroom to subject assessment. They adopted a "flipped" approach to encourage collaborative learning, foster student engagement, and develop students' critical thinking skills in a postgraduate accounting subject. The "Open-Book-Open-Web" format was adopted in all assessments, including the final exam. They reviewed the peer-learning research in accounting education and focused in six streams: studies which consider student involvement via peer learning, research into ways of reducing or avoiding dysfunctional conduct in group and team processes, the impacts of peer learning on student performance, student satisfaction with the peer-learning process, examples of successful peer-learning case studies, and literature reviews of collaborative learning approaches. They discussed the solutions of using mobile technology in learning and assessment. The feedback from students was very positive. They believe that flipped classroom enhanced the student experience. They also found the international students are benefited from the flipped class. In the end of the chapter, they argued that by adopting the flipped class, the pressure to memory material is reduced, marking a significant improvement in the potential for deep learning. This chapter highlighted the importance of the role of the teacher in the context of peer-based learning approaches. Their findings and empirical results from empirical studies shed light on future development of mobile educational programs and applications for learning and assessment.

In ▶ Chap. 4, "Design Considerations for Mobile Learning", Jason Haag and Peter Berking discussed how mobile technologies can help assist the learning process for special mobile curriculum design. The chapter reviewed the literature and discussed what mobile technology and what mobile learning is. They indicated that learners are different today, turning to leveraging mobile devices for support and self-directed learning. The traditional subject and curriculum are created with analysis, design, development, implementation, and evaluation framework. But with the increasingly widespread adoption of mobile technology, a paradigm shift is taking place, offering new opportunities for improving performance and augmenting skills. The authors argued that the curriculum design for mobile learning should be different to the traditional frameworks. The current gaps in design knowledge for educators, instructors, and instructional designers are important for this process. The chapter adopted a learner-centered design in mobile curriculum design. Touch and mobile behaviors are important factors to be taken into account in mobile learning design. They argued that the key factor in determining the utility and success of a mobile learning solution is the ability to satisfy its users. Therefore, to achieve this goal, the designers of interfaces for learning should be encouraged to work closely together with the instructional designers. Different-sized screen or capacity of hardware of different mobile devices also required different users' interface design to enhance the learners' experience. The different mobile learning on different mobile devices is categorized and compared in the chapter. Spaced learning is also introduced and emphasized in the chapter. After reviewing the learning theories and conceptual frameworks, the authors believe that mobile technologies and devices offer the most potential for the rich, contextual, and contemporary mobile learning design opportunities. Their discussion opened a door for a new framework for mobile curriculum design for future mobile learning programs.

Dr. Oscar R. Boude Figueredo and Dr. Jairo A. Jimenez Villamizar from La Sabana University discussed the difficulties that facing teachers in mobile teaching design and implementation in ▶ Chap. 6, "Framework for Design of Mobile Learning Strategies". The previous theoretical and empirical works on mobile teaching and learning are reviewed in this chapter. A model for mobile learning is designed as part of this project, including six stages: recognition, analysis, identification, bases, design, and implementation. The authors emphasized the importance of the teachers' awareness of the educational process with mobile devices and the limitations and benefits of mobile learning. The educators, designers, and teachers contributed great efforts to this project. Their findings and suggestions shed light on future design and development of mobile learning framework and program.

In ▶ Chap. 10, "Mobile Learning and Engagement: Designing Effective Mobile Lessons", Kimberly Vincent-Layton from Humboldt State University shared a real case study of mobile teaching and learning practice: Scavenger Hunt Mobile Lesson on Motivational Appeals. This practice adopted the mobile lesson template proposed in this chapter, which includes: Assignment Name, Goal, Learning Outcomes, Materials/Resources, Instructions, Assessment, Weighting of the

Assignment, Submitting Assignment for Evaluation, Time Commitment, Deadline, Feedback Expectations, Examples, and Technology Considerations (Challenges/ Solutions). The author argued educators should play a vital role in developing mobile lessons to support authentic learning with collaboration and critical thinking as well as increasing student engagement. In the end of the chapter, the author suggested to expand mobile learning to include collaboration across courses and curriculum in higher education.

Dr. Bibhya Sharma and Dr. Anjeela Jokhan studied the use of short message to support teaching and learning in ▶ Chap. 13, "Use of Short Message Service for Learning and Student Support in the Pacific Region". The geographical spread of the member countries generated special needs for mobile teaching and learning in higher education in the university. After studying the mobile subscribers' growth rate and mobile devices in the region, short message notification service was introduced into the mobile learning model in 2011. The comments received from students are positive. The short message service is designed to link with MOODLE (Modular Object-Oriented Dynamic Learning Environment), which is widely used as online learning platform in the university. The short message service also provided services for different departments in the university: Campus Life, Student Administrative Services, Campus Directors, Marketing Office, and Emergency Working Group. In the end of the chapter, the authors indicated that mobile learning has contributed to teaching and learning in the University of the South Pacific and prevailed in the whole Pacific region. This chapter shared the multiple dimension use of short message services in teaching and learning from another perspective. It brought new ideas of how to broaden the use of mobile technologies in higher education to assist teaching and learning process.

Dr. Teresa Cardoso and Renato Abreu discussed the use of mobile technology in Open University in ▶ Chap. 9, "Mobile Learning and Education: Synthesis of Open Access Research". The Open University is very popular now to encourage an open knowledge to public learners in different countries. Many individual learners have been benefited from the open resources and courses. Mobile technologies and mobile devices allow learners to study from distances and respond to different situations of their daily life. This chapter introduced the characteristics of mobile learning, its particular types and environments, a SWOT (strengths, weaknesses, opportunities, and threats) analysis on mobile learning, students and teachers' perceptions and practices on m-learning, and the determining factors that are considered important in the use of mobile devices and in the acceptance of mobile learning. A total 15 journals and databases (for mobile or online education) and their impact factors are compared. The results showed that teachers showed an almost total lack of motivation on promoting mobile learning. Researchers believed that teachers' training and policy supports are important for mobile education. The authors also indicated that m-learning is a research area with a recent past, a dynamic present, and a promising future. The findings from this study shed light on future development and design of mobile open knowledge framework for learners all over the world.

The authors from this section shared their views and experience of mobile teaching and learning design. The method of mobile teaching and learning is very different in different countries and universities. It is influenced by many factors: the geographical location, available technologies, mobile devices that have been adopted by majority of learners, costs of mobile usage in different countries, the goal of institutions, and skills of designers and educators. The different views and frameworks designed by different authors from different countries brought new ideas of design and development of mobile teaching and learning programs. Just as one design is not suitable for all mobile phones and tablets, one mobile learning design is not suitable for all countries and associations. But some of these practices may provide good suggestions of general rules for mobile teaching and learning designs. The knowledge and experience shared by the authors are invaluable. They also open a door for future cross-country learning system design and skills training for designers and educators.

# Characteristics of Mobile Teaching and Learning

# 2

Yu (Aimee) Zhang

## Contents




**Abstract**

Mobile technology has been developed very fast in the last decade. It had been introduced in education for many years. Regarded as the trend for new generation of teaching and learning in education, it has attracted much attention in recent years. Universities and schools developed and implemented new applications and digital contents for mobile teaching and learning in different disciplines and subjects. However, some academics have argued that mobile teaching and learning should be distinguished from online learning that we have adopted for many years in education because of its own characteristics and functions. The special characteristics for mobile devices and technologies should be noticed before adopting mobile technology in any project or subject. Firstly, a mobile device has its own limitation on hardware, software, and connection compared with traditional computers, although the gap has been diminishing. Secondly, the frequency of usage of mobile devices and the length for usage each time are different compared with learning on fixed computers. Thirdly, the cost of mobile network and quality of



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connection are different from Internet access via computer, which also limited learning activities on mobile devices. Mobile learners also have their own characteristics. Online survey results from university students in different countries also provide profound findings on future mobile learning program design. Mobile technology is the future for higher education. How to avoid the potential risks in adopting mobile technology in teaching and learning should be taken into account. In the current stage, blended learning is still a suggested learning method.

## 1 Introduction

Mobile teaching and learning (M-learning) has been a hot keyword in education in recent years because of the dramatically increasing penetration rate of mobile devices globally. Educators in universities and schools have studied and tried to understand the motives and advantages of mobile learning compared with traditional learning methods and electronic learning (Fraga 2012; Evans 2008). Some of them developed, adopted, and assessed their mobile application in practical courses and gave comparable results in their studies. These studies shed light on the development or adoption of mobile technology in the future. However, mobile learning is also criticized by its lack of real "anytime" and "anywhere" due to technical limitation and lack of understanding in mobile learners when designing a mobile learning curriculum (McCombs 2010). These arguments are true in the current stage. Mobile technology is not "perfect" yet to be used to replace traditional teaching and learning. Therefore, instead of using M-learning as a substitute for traditional teaching, it should be adopted as a complement method to assist traditional learning methods. The first characteristic of mobile devices is anytime and anywhere (McCombs 2010; Peng et al. 2009; Cumming et al. 2013). The second characteristic is the flexible access (Mishra 2013). Students use mobile phones in smaller time slots, such as waiting for friends or on a bus (5–10 min). How to make good use of these smaller time slots? A good designed application should fit into this gap and assist student learning using small time slots. Section 2 compared mobile teaching and traditional learning from a literature and empirical basis. The characteristics of mobile devices and mobile learners are discussed in Sect. 3. Primary survey is conducted in both Australia and China and provides profound findings. Section 4 summarizes the mobile learning characteristics and discusses how to design a good mobile learning program. The last section concludes the findings of this study and proposes for future mobile learning.

## 2 Traditional, Online, and Mobile Learning

The skills, knowledge, and expectations of students today are changing (Alley 2009; Fraga 2012; Prensky 2001; Oblinger and Oblinger 2005). Firstly, the new generation is also known as technical generation, which was growing with all the electronic devices and technologies or so-called digital natives (Prensky 2001).

They have the nature in understanding those technologies compared with their precedents. They are also more innovative and more efficient in learning (Oblinger and Oblinger 2005). Ten years ago, people preferred to stay in libraries for hardcopy books. But today, students are reading electronic materials anytime and anywhere with their mobile devices. The traditional designed educational materials and system cannot meet the needs of new generations (Prensky 2001). Secondly, as more and more students travel around the world and study in different countries, they also communicate more with friends from different cultural backgrounds. They have a very good understanding of different cultures and how to learn from each other. Books are translated into different languages, and knowledge has broken the border of nations. The cross-country and multiple-language backgrounds also help develop very good understanding of globalization and critical thinking skills. In a word, students today are different and ready for different learning methods and technologies. The traditional teaching methods should also be changed to suit the different needs of students. Although the face-to-face (FTF) learning has some irreplaceable advantages, such as facial and body language in communication, emotional transfer, and active experience (Stewart 2011; Lewin 1948; Kolb 1984), online teaching and mobile teaching have been the hot keywords in all educational institutions and will be the trend in the future. At May 2013, 11.19 million people had a smartphone and 7.5 million people accessed Internet via their mobiles phone in Australia (ACMA 2013). Many universities and schools have implemented mobile devices and infrastructures to facilitate mobile learning in class. With its fast development, mobile learning also encountered some problems.

Today, M-learning still has some barriers to provide a real seamless learning experience on mobile devices anytime and anywhere (Doug et al. 2009; McCombs 2010; Williams 2009). The lack of Internet access in some remote regions, lack of continuity of mobile data transfer between high buildings, and the different qualities of mobile signals in different areas are still the technical barriers to reach real anytime-and-anywhere mobile learning. Besides this, the high costs of mobile data access (3G or 4G) and different mobile rates in different states and countries are also increasing the difficulties of adopting efficient mobile learning. Before the conclusion of the characteristics of mobile teaching and learning, it is important to review the development of mobile technologies and how it changed people's lives in the past. Figure 1 shows the development of mobile technologies from 1 to 4G and how it enriched people's daily mobile activities (Table 1).

With the enhancement of capacity on mobile transfer, more applications with fabulous effects and functions have been implemented. They also provided great opportunities for better mobile learning experience and practices. Five years ago, mobile learning practices were still limited by the five-line contents on each screen. And no multimedia contents were available on mobile phones. WAP access was still the major method for mobile Internet access usage 3 years ago. But the large touchscreens and high pixel solutions have provided similar using experience on mobile devices as on computers. The gaps between learning on mobile devices and learning on computers are much smaller today. The higher capacity of data transfer on mobile devices also provided better communication and interaction experience

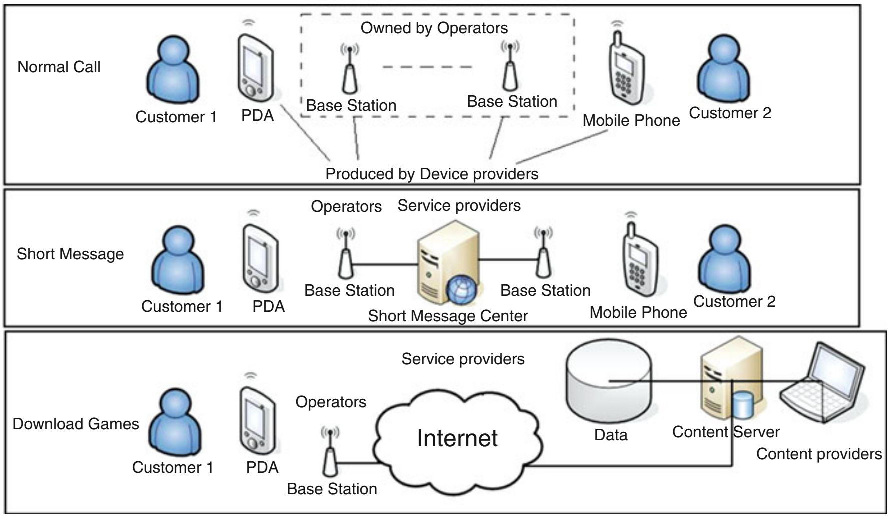


**Fig. 1** Scenarios of mobile teaching and learning (Source: Zhang 2012a)

**Table 1** The development of mobile technologies, from 1 to 4G

| Generations | Major characters | Major standards and protocols | Capability | Sample of usages |
|---|---|---|---|---|
| 1G (1980–1990s) | Analog communication | AMPS | Simple communication | Mobile call |
| 2G (1990s–current) | Digital communication | TDMA, GSM, PDC, CDMA one, Wi-Fi 802.11b | Limited data services | Fax, short message, social network |
| 2.5G (1990s –current) | Wideband and medium speed data | CDMA one, GPRS, WiFi802.11 g | Medium speed data transfer | WAP, MMS, file sharing |
| 3G (2000s–current) | Broadband and high speed data | CDMA 2000, WCDMA, HSDPA, WiFi802.11n, WiMax | 144 Kbps (in car), 384 Kbps (walking), 2 Mbps (indoor) | Video conference, streaming video, application shops |
| 4G (future) | Global roaming and higher speed | 802.16 m, LTE, developing standards | Objective: 1 Gbps | Future innovations |

Source: Zhang (2012a)

with mobile learning, which greatly enhanced the mobile learning practices. More innovations and methods are adopted in mobile teaching and learning. The decreasing costs of mobile access and data transfer also increased the mobile penetration rate.

## 3 Characteristics of Mobile Devices and Learning via Mobile

Mobile devices have experienced very rapid changes from 2000 to 2014. While today mobile devices are still used primarily for voice and text message communication, people increasingly also use them to send pictures, listen to music, record video, watch TV, play games, surf the Internet, check email, manage their schedules, browse and create documents, and more. Surveys of mobile phone users show that consumers view the benefits of mobile sectors as saving money, saving time, and providing useful information (Friedman 2007). Wireless networks are a pervasive technology that is changing the way people work and play (Williams 2009). The development of the mobile technology is changing day by day. Additionally, mobile services and data services offer potential for new patterns of teaching and learning. One of the advertised advantages associated with 4G is being always connected (Kumar et al. 2010). However, some barriers still exist to achieve the real anytime and anywhere with mobile devices (McCombs 2010).

### 3.1 Anytime and Anywhere?

Does the mobile learning achieve anytime and anywhere now? Not necessarily. In the main campus of University of Wollongong, WiFi covers the whole campus. However, it is required to login to use the WiFi service in campus with UOW username and password. And it is required to relogin if you transfer from a building to another building because of the different WiFi coverage. Therefore, if a student moves between buildings, the WiFi connection will disconnect automatically. Inside or behind some buildings, the 3G signal is not available either due to the poor signal that has been blocked by buildings. A service staff admitted that mobile connections are not stable in Wollongong region. Even in big cities, the signals are usually poor or unavailable in basements of high buildings, in carts of subways, or between high buildings. There are many areas that have been blocked for mobile signals for medical or security reasons too. Besides these problems, the mobile handsets sometimes disconnect WiFi and use 3G automatically without notice by users (users can close 3G data and cellular network in settings, but very small amount of users do it). If video learning is running during the time, it will be very costly (as in Australia, less than 1 h video transferring will cost about 200 AUD via 3G). In conclusion, it is far from achieving the real anytime-and-anywhere access with current technology and services.

To design a better experienced mobile learning system or application, it is important to notice the difference of mobile learning compared to online learning or traditional learning. One possible solution to this is to change the structure of mobile learning system into online and offline parts. For example, Tutors in Pockets for Economics study (see ► Chap. 19, "Tutors in Pockets for Economics") had only online design for the first version. Students must download all the figures with a mobile signal connection through WiFi or cellular network to view the contents. In the second version, it has been improved to both online and offline design. Students can view all the contents once the app has been installed. It only needs connection to server when there is new content to update. The advantage of this improvement is students can achieve learning with or without mobile signal. But the initial download size is much bigger from the first version.

### 3.2 Characteristics of Mobile Learning

Not like online learning, mobile learning also has its own characteristics. Peng et al. (2009) argued that the fast developed mobile learning still lacks theoretical framework and indicated that mobility is the major difference between mobile learning and online learning. However, there are many other characteristics of mobile devices and mobile learners that need to be considered when designing a good mobile learning program.

First, mobile access has its own limitation on the size of contents. Some of the social media platforms have more restriction on each content uploaded (see ▶ Chap. 25, "Mobile Education via Social Media: Case Study on WeChat"). Videos are good resources for online learning but may be cumbersome and inefficient on mobile devices. Transfer of video contents will be very slow or costly if the user is connecting with 3G. It may be hard to read the subtitles on a small screen too. Very small amount of users would like to hold the mobile devices for hours to view a video (why not on a TV or computer?). The smaller the contents and the easier for using, the more likely the user will have better learning experience and will adopt the mobile learning method. Second, the different size of screens may need better fitness to device for users. If the content is fixed in its length and height, it may be unreadable on some mobile devices and leave some users inaccessible. The size and font of words are also important to fit in different screens. Therefore, different test machines are essential for quality assurance needs in mobile learning project. Third, the pattern of mobile usage is usually very small time slots when waiting for people, on transportation, or having rest. Therefore, the most successful mobile games are usually small games that give flexible length of play. Mobile learning is similar to this. Students usually access learning materials for 5–10 min (see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning"). The designed mobile learning system should also be flexible for learners. Last but not least, the costs are always one of the most important factors that affect usage of mobile learning tools.

The cost of mobile access is always high (Oblinger and Oblinger 2005), although the cost has been decreased gradually during recent years. One reason for this is the nature of collaboration among different providers in the mobile telecommunication market. This can be explained in the figure below. Figure 1 shows some scenarios of access to phone call, short message, and Internet via mobile phone or mobile devices.

As shown in Fig. 1, the initial mobile education was started focusing on the voice communication function. With the development of new technology and hardware, mobile education has experienced the using of short message notice, broadcasting function of mobile devices, and real-time multimedia education. Not only did the teaching contents get enhanced, but so did the functions and methods for knowledge delivery.

The cost of building basic infrastructures for mobile communication was very high. Operators will address the cost through service fees from service providers and end users. Service providers and content providers add value to the service to develop and provide variety of services and applications for end users. Customers have to pay operators, service providers, and content providers to access any mobile service. On the other hand, the fast developed technologies and new hardware and software also add costs for each party in the scenarios, which is finally paid by customers. It is expected that the price for mobile access will be lower in the future. Even the only free accessed courses are not really free. In the current stage, mobile access is still costly in terms of hardware purchasing, network connection, and maintenance of the hardware and software. Although the costs are sometimes "invisible" to users (until the bill arrives), the slower loading process or influence playing process may also reduce usage and download rates.

To reduce the accessing costs of mobile learning, it is important to develop suitable contents for mobile teaching and learning (Alley 2009). The size of content, readability of words, fitness to different-sized screens, and colors adopted are also important factors that should be considered when designing suitable contents for mobile teaching and learning. Besides these, providing flexible access and freedom for learners are also important for a good mobile teaching and learning program.

## 3.3 Differences in Mobile Learners and Mobile Learning

Mobile learners also have different expectation and pattern of mobile device usage compared to others. Rennie and Morrison (2012) summarized some characteristics of Millennial (born since 1982) from previous empirical studies. The new generations are more multitask preferred, multimedia preferred, and teamwork preferred (Oblinger and Oblinger 2005). But they also have shorter attention spans, poorer text literacies, cavalier attitudes to quality of sources, and lack of reflections (Rennie and Morrison 2012). Students are different today (see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning"). Mobile learners also have their own characteristics. Learners usually use mobile phones for smaller time fragments compared with computers. If a study process is interrupted several times, it may have negative effects on its experience and results. Therefore, big and long materials are not suitable for mobile teaching and learning. They should be separated into smaller parts to provide more flexible access and study on mobile devices. Different students from different countries or culture backgrounds may have different understanding and adoption level for mobile learning.

To understand better the using pattern of students on mobile devices and mobile learning programs and the differences between Australian and Chinese students in mobile learning, a survey was designed and conducted in both Australia and China

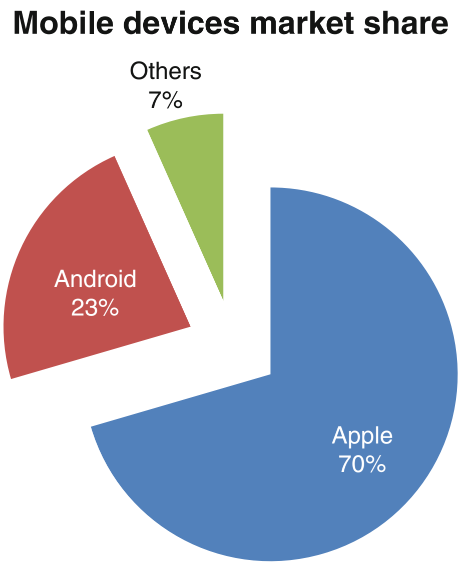


**Fig. 2** Australian mobile devices market share (Source: Data collected for this study)

(see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning"). The first survey was conducted in three universities in China from June to July 2013. The sample is from 183 undergraduate and postgraduate students in three different provinces (Beijing, Anhui, and Jiangxi). The second survey was conducted in University of Wollongong in September 2013. The total sample is 54 students from first year undergraduate macroeconomics tutorials, in which a mobile learning application – Tutors in Pockets – was introduced. Some interesting patterns of mobile adoption are identified.

As shown in Fig. 2, the result of survey (in Appendix A) showed the results from Australian mobile learners. Apple devices dominated Australian market in higher education. A total 74 % of students were using Apple mobile devices, and 24 % of students were using Android devices. The other mobile devices accounted for only 7 % of the market in Australia.

As shown in Fig. 3, Chinese market (in Appendix B) is shared by many hardware competitors. Apple mobile device only accounted for 24 % in the Chinese students' sample group. Android device accounted for 34 % in the survey results, and 42 % of the mobile devices are from other hardware producers (such as Xiaomi mobile phone in China) (Table 2).

Majority of them use mobile phones in lectures and tutorials (65 %), when meeting friends (70 %), waiting (94 %), or walking or on transportations (85 %). And 59 % use mobile phone when they are having food, and 41 % use mobile phone when working (in Appendix A). In China (in Appendix B), most students use mobile phone after class (67 %) or waiting (52 %). Very small amount of students (20 %) will use mobile phone in class, meeting friends (20 %), or working (6 %).

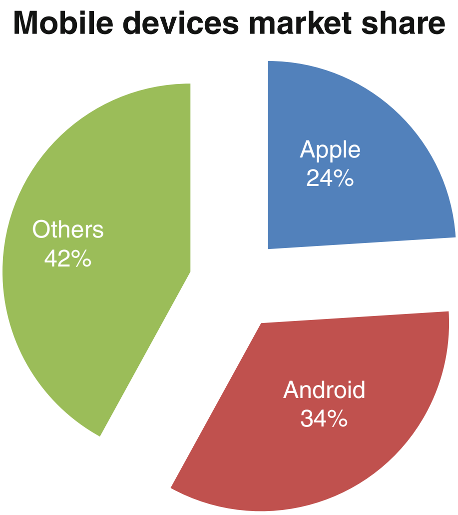


**Fig. 3** Chinese mobile devices market share (Source: Data collected for this study)

**Table 2** Differences on the usages of mobile devices by Australian and Chinese students

| Australian students use mobile | Percentage (%) | Chinese students use mobile | Percentage (%) |
|---|---|---|---|
| In lectures and tutorials* | 65 | In class* | 20 |
| Meeting friends | 70 | Meeting friends | 20 |
| Waiting | 94 | Waiting | 52 |
| Walking or on transportations* | 85 | After class* | 67 |
| Having food* | 59 | At home* | 48 |
| Working | 41 | Working | 6 |

*Note: the questions were adjusted to suits different cultures in different countries
Source: Data collected for this study

And 48 % of students use their mobile phone at home. In terms of the usage pattern for mobile devices, Australian students use mobile phones more than Chinese students. They use mobile devices more than Chinese students. One possible reason is the requirements of using mobile devices and applications in class or as a tool for new information and articles. Most teachers in China still have negative attitudes toward mobile devices in class. Another difference between Australian and Chinese university students are part-time jobs. Most Australian students have part-time jobs after class. However, Chinese parents usually pay tuition fees and living fees for students during their study and require them to focus on study instead of seeking for part-time jobs (Fig. 4).

When it comes to mobile learning, Australian students (in Appendix A) prefer Google (91 %), E-learning from university website (57 %), Youtube (55 %), and Wikipedia (34 %). Tutors in Pockets was introduced to the sample group and

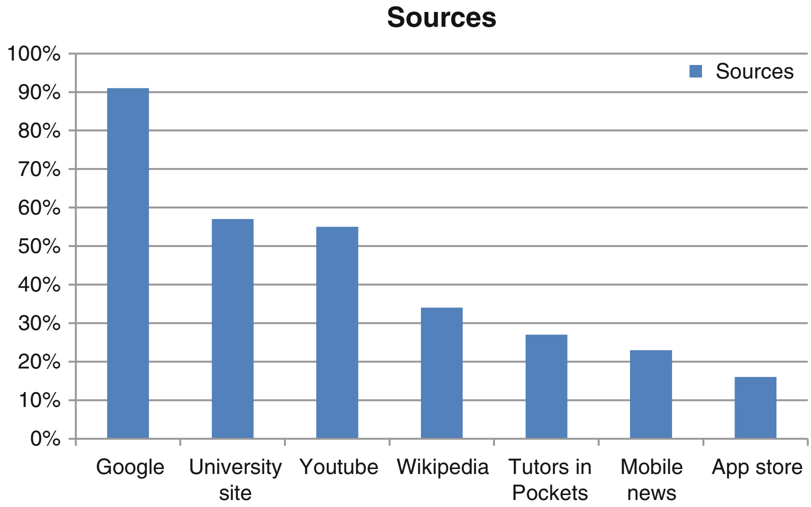


**Fig. 4** Sources of mobile learning in Australia (Source: Data collected for this study)

adopted by 27 % of total students. Some of them also access mobile news (23 %) and download applications in iTunes or Google Play for learning (16 %). Most of the social media in Australia are blocked or semiblocked (Google is available in Hong Kong, but the redirect searching reduced using significantly, and Baidu is more popular in China) (Zhang 2012a). The social media used in the Chinese markets are very different from all the other countries (see ▶ Chap. 25, "Mobile Education via Social Media: Case Study on WeChat"). However, the numbers of subscribers of social media platforms (Weibo and WeChat have more than 600 million registered users in February 2014) and growing rates in China are always on the top of the lists because of the huge population base. Therefore, the questions in China were adjusted to suit students learning in China. As in Appendix B, online learning still dominates (61 %) in China due to university requirement. But interactive learning (16 %), mobile learning (9 %), and multimedia learning (12 %) are still under development.

As shown in Fig. 5 above, the length of mobile learning is similar in Australia and China (in Appendixes A and B), ranged from 0 to 8 h per day. Three Australian students indicated that they use mobile phone 24 h a day and 7 days a week. The average learning time on mobile device is 40–50 min per day for both Australian and Chinese students. It is a natural time length for all students.

As shown in Table 3, in terms of expectation and benefits of mobile learning, the results are slightly different in Australia and China (in Appendixes A and B). Learning efficiency, anytime and anywhere, and utilizing the small time slots are still the top benefits brought by mobile learning methods. Most Australian students appreciate the flexible learning anytime and anywhere from mobile learning

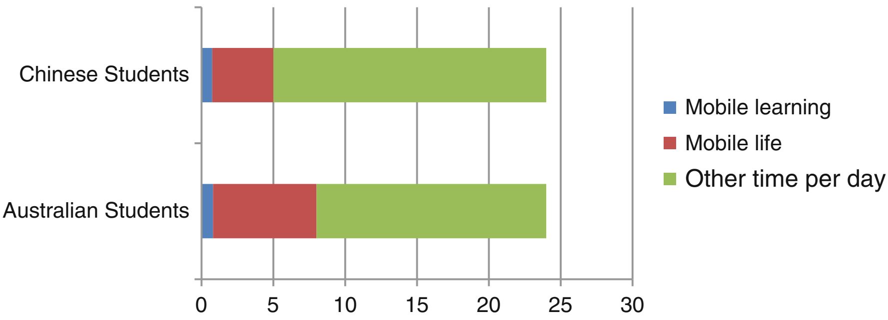


**Fig. 5** Length of mobile learning (Source: Data collected for this study)

**Table 3** Expectation and benefits from mobile learning by Australian and Chinese students

| Expectation and benefits from mobile learning | Australian (%) | Chinese (%) |
|---|---|---|
| It increased my learning efficiency | 38 | 52 |
| It helped me study anytime and anywhere | 56 | 41 |
| It helped me study utilizing the small time slots (e.g., waiting for bus) | 32 | 54 |
| It helped my lecture/tutorial study | 38 | 22 |
| It made me feel interested in this subject | 26 | 17 |
| It engaged me in a discussion with other students or teachers | 9 | 12 |
| It increased my performance in this subject | 26 | 12 |
| Others (including no difference) | 15 | 8 |

Source: Data collected for this study

(56 %), and majority of Chinese students appreciate more the utilization of small time slots for mobile learning (54 %). Mobile learning can increase learning efficiency (38 % by Australian students and 52 % by Chinese students). Australian students use mobile devices in class (38 %) to help their understanding and misconception problems, while only 22 % Chinese students use their mobile devices in class. There had been a long-term discussion on whether students should be allowed to use mobile devices in class. However, with new technology and more digital contents and resources available, mobile devices will play a more important role in class. Mobile learning also increased students' interests in learning concepts (26 % in Australia and 17 % in China). It contributes to in-class discussion and subject performance too. One important issue that one should be aware of is the nonbenefited student group from mobile learning methods (6 % in both Australia and China). To give equal access to all students and provide inclusive learning opportunity for all students, that some students have no mobile phone, no smartphone, or no skills or interests in using mobile devices should be taken into account.

This study captured the latest students' pattern of mobile device usage, characteristics, and expectation on mobile learning and their differences from different cultural backgrounds. The findings provide profound information and understanding on mobile learners and a good source for future mobile learning design and development.

## 4 Design for Mobile Learning

Although many empirical studies have found mobile learning has positive influence on learning performance (Williams 2009; Hwang and Chang 2011; Evans 2008; Doug et al. 2009; Cheon et al. 2012; Bredl and Bösche 2013), the developed mobile learning programs are very different in terms of course design, target group, learning methods, and implementation environment. To design a good mobile learning program, designers should consider the different characteristics of mobile devices and mobile learners as discussed above. Small in size, easy to use, and flexible learning contents are key features for such program. Interactive functions and social communication are also believed to be important to engage students and increase long-term memory. Discussion between students and communication with teacher help the students to understand better the materials and apply the knowledge in real cases. The feedback from students also helps in improving the teaching curriculum. Teaching should be a dynamic and innovative process.

Mobile technology is believed to bring more potentials and possibilities into education. Real-time exchange rate, interactive management activities, communication and cowork online, and combination of policies can be brought into class anytime and anywhere. Prensky (2001) suggested new contents for the new learners combining "legacy" and "future" contents should be designed and developed for all subjects at all levels. He indicated games are good methods in teaching new generation. However, just like the game-based learning, mobile learning is faced with a dualism between knowledge transfer and gamification. Too strong gamification is argued to be negative to learning process, but too much guidance will inhibit creativity (Bredl and Bösche 2013). Mobile learning cannot be success itself. A good teacher and good instruction design with inspiring contents are vital for a successful mobile learning program.

Mobile technology provides another opportunity for flexible personal learning for different groups in the same classroom (Hsu et al. 2013; Kukulska-Hulme and Traxler 2005). It breaks the restriction on learning potentials and provides individual discovery experience. To implement differential teaching, a well-designed and developed flexible pedagogy and course contents are also important. Designers should not be limited by traditional PDF, readings, forum, or online vote but utilize the interactive and communicative functions on mobile devices (Holotescu and Grosseck 2011; Oblinger and Oblinger 2005). This also required a good understanding on different types of hardware and software as well as new developed technologies in telecommunication industry.

As more and more international students are seeking for higher educational degrees in other countries, the number of international students in most developed countries increased dramatically (see ▶ Chap. 35, "Cross-Country University Collaboration Barriers and Solutions"). Challenges of how to engage students from different cultural backgrounds, how to encourage both high-performance student groups and low-performance student groups in the same class, and how to help disadvantaged students in class came up. To solve these problems, new teaching methods based on advanced technology and innovation should be adopted in teaching and learning (Kennedy et al. 2013; Zhang 2012b). Many innovations took place in the class to enhance the method for a continuous learning (see ▶ Chap. 53, "Advanced Image Retrieval Technology in Future Mobile Teaching and Learning"). Different students have different preferred learning methods. However, practice case study is the most preferred learning method for both local and international students (Zhang 2012b). More realistic case studies that approach the student experiences and life help engage them into group discussion. The more contributions they can provide to a group, the more engagement of the students in future participation. Therefore, a well-designed and developed content is important for either face-to-face teaching and learning or mobile learning.

Educators should be equipped with not only rich knowledge in the teaching area but also latest research findings, new technologies, new ideas, different methods, real case studies, and great passion for teaching. Mobile teaching and learning is the trend for the future. As indicated by Prensky (2001), "if Digital Immigrant educators really want to reach Digital Natives – i.e., all their students – they will have to change."

## 5 Future Directions

Mobile teaching and learning has been the trend for modern higher education (Evans 2008; Fraga 2012). Many universities and schools are designing and developing teaching programs on mobile devices (see ▶ Chaps. 19, "Tutors in Pockets for Economics", and ▶ 21, "Adoption of Mobile Technology in Higher Education: Introduction"). Apple, Google, Microsoft, IBM, and most of the major companies have provided different solutions for online and mobile learning. A well-designed mobile learning program should focus not only on the quality of content but also the characteristics of mobile devices and mobile learners.

This study collected primary data from Australia and China to understand better students' pattern of mobile usage, mobile learning, and their expectations on mobile learning. Some interesting findings are identified. Students prefer blended learning methods and real case studies (see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning"). The new generation can adopt mobile learning faster and better than the old generation. However, they have shorter attention spans and lack of text literacy. Students from different countries and cultural backgrounds also have different preferences and expectations on mobile learning. Mobile technology can provide the flexible contents to meet the needs from different student groups.

Educators and designers are important in new content design and development to meet the needs for mobile learners. A well-designed flexible and extendable structure is important for mobile learning program. Many mobile learning programs did not take the step from in-class prototypes to off-the-shelf products (Bredl and Bösche 2013; see ▶ Chap. 19, “Tutors in Pockets for Economics”). The designers and teachers are limited by technical supports, funds and energies. They could benefit more students and individuals in the world. New emerging technologies will meet the gap and solve current technical and content problems in the future. Blended-learning is still a preferred method in current stage.

## 6 Cross-References

- ▶ Adoption of Mobile Technology in Higher Education: Introduction
- ▶ Advanced Image Retrieval Technology in Future Mobile Teaching and Learning
- ▶ Cross-Country University Collaboration Barriers and Solutions
- ▶ Mobile Education via Social Media: Case Study on WeChat
- ▶ Student Feedback in Mobile Teaching and Learning
- ▶ Tutors in Pockets for Economics

## Appendix A: Survey from Australian Undergraduate Students

**When do you usually use your mobile phone/devices?**

| # | Answer | | % |
|---|---|---|---|
| 4 | Having foods | | 59 % |
| 1 | In lectures or tutorials | | 65 % |
| 7 | Meeting my friends | | 70 % |
| 2 | Studying at home/ library | | 76 % |
| 3 | Waiting | | 94 % |
| 5 | Walking or on transportations | | 85 % |
| 6 | Working | | 41 % |

**What brand of mobile device(s) you are currently using?**

| # | Answer | | % |
|---|---|---|---|
| 1 | iPhone or IOS devices | | 74 % |
| 2 | Mobile devices with Android systems | | 24 % |
| 3 | Others (Please specify) | | 7 % |

**Which applications or websites you usually access when you study on your mobile phone?**

| # | Answer | | % |
|---|---|---|---|
| 1 | Google | | 91 % |
| 2 | Wikipedia | | 34 % |
| 3 | Youtube | | 55 % |
| 4 | E-learning site from university | | 57 % |
| 5 | iTunes U or Google Play applications | | 16 % |
| 6 | On-line news | | 23 % |
| 7 | Tutors in Pockets | | 27 % |
| 8 | Others (Please indicate) | | 5 % |

**How long you use your mobile phone to study per day?**

| Min Value | Max Value | Average Value |
|---|---|---|
| 0.00 | 8.00 | 0.73 |

**Do you think the mobile application have positive influences on the following aspects of your study?**

| # | Answer | | Response | % |
|---|---|---|---|---|
| 1 | It increased my learning efficiency | | 13 | 38 % |
| 2 | It helped me study anytime and anywhere | | 19 | 56 % |
| 3 | It helped me study utilizing the small time slots (e.g. waiting for bus) | | 11 | 32 % |
| 4 | It helped my lecture/tutorial study | | 13 | 38 % |
| 5 | It made me feel interested in this subject | | 9 | 26 % |
| 6 | It engaged me in a discussion with other students or teachers | | 3 | 9 % |
| 7 | It increased my performance in this subject | | 9 | 26 % |
| 8 | Others (Please specify) | | 5 | 15 % |

## Appendix B: Survey from Chinese Undergraduate Students

**Did you try any of these studying methods after class?**

| # | Answer | | Response | % |
|---|---|---|---|---|
| 1 | Online study | | 89 | 61 % |
| 2 | Interactive study | | 24 | 16 % |
| 3 | Mobile study | | 13 | 9 % |
| 4 | Multimedia study | | 18 | 12 % |
| 5 | Others | | 3 | 2 % |
| | Total | | 147 | 100 % |

### What mobile phone (system) are you using

| # | Answer | | Response | % |
|---|---|---|---|---|
| 1 | IOS | | 35 | 24 % |
| 2 | Android | | 50 | 34 % |
| 3 | Nokia mobile devices | | 28 | 19 % |
| 4 | Motorola | | 8 | 5 % |
| 5 | Others | | 26 | 18 % |
| | Total | | 147 | 100 % |

### When do you usually use your mobile phone?

| # | Answer | | Response | % |
|---|---|---|---|---|
| 1 | At home | | 71 | 48 % |
| 2 | On the way or waiting for bus | | 76 | 52 % |
| 3 | In class | | 29 | 20 % |
| 4 | After class | | 99 | 67 % |
| 5 | Doing part-time job | | 9 | 6 % |
| 6 | Having party with my friends | | 30 | 20 % |
| 7 | Other time | | 9 | 6 % |

### The average length of your mobile study is:

| Min Value | Max Value | Average Value |
|---|---|---|
| 0.00 | 8.00 | 0.60 |

### What would you think mobile learning would help?

| # | Answer | | Response | % |
|---|---|---|---|---|
| 1 | Increase learning efficiency | | 76 | 52 % |
| 2 | Study anywhere and anytime | | 60 | 41 % |
| 3 | Utilise smaller time slots to study | | 80 | 54 % |
| 4 | Increase my searching and learning in class | | 33 | 22 % |
| 5 | Increase my interests in learning | | 25 | 17 % |
| 6 | Engage me in discussion with students and teachers | | 18 | 12 % |
| 7 | Increase my performance | | 18 | 12 % |
| 8 | No difference to me | | 9 | 6 % |
| 9 | Others | | 3 | 2 % |

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# Business Models for Mobile Learning and Teaching

3

Cassey Lee

## Contents



**Abstract**

E-commerce business models are important to ensure the financial feasibility of mobile teaching and learning services. Key elements of business models value propositions, revenue model, market opportunity, competitive environment, competitive advantage, market strategy, organizational development, and management team. Other considerations include competition between mobile device platforms, network effects, and mobile broadband pricing.

## 1 Introduction

The advent of the Internet has had a tremendous impact on how we access information and participate in educational and commercial activities. Teaching and learning have been transformed in the process. Students and teachers (and researchers) regularly access the Internet to gather information that are required to complete tasks and assignments. In most colleges and universities, instructors

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utilize the Internet-based platforms to distribute teaching materials, receive assignments, and grade student activities. The "public good" mature of information also ushered in the provision of free access to university course materials such as those available at the Massachusetts Institute of Technology's (MIT) *OpenCourseWare* website. More recently, massive open online courses (MOOCs) have emerged. Setups such as *Coursera*, *Udacity*, and *edX* offer free online courses to thousands and millions of students globally.

Aside from these developments, the medium of teaching and learning has also evolved. These changes have taken place partly due to technological change and infrastructure upgrades. In particular, broadband mobile has become increasingly important. The electronic communication and productivity devices have also evolved. These have interacted in a mutually reinforcing manner to provide more opportunities for mobile teaching and learning. Mobile learning (m-learning) can be defined as "the provision of education and learning on PDAs/palmtops/handhelds, smartphones and mobile phones" (Traxler 2009, p. 3). Mobile learning involves "learners who carry the mobile devices and move around with them," while the term "mobile teaching" facilitates and supports mobile learning (Kukulska-Hulme and Traxler 2005, p. 25). Today, notebooks, smartphones, and tablets provide an improved platform for more effective mobile teaching and learning.

An important issue that needs to be addressed in mobile teaching and learning is the commercial or business aspect of offering and accessing mobile teaching and learning services. The viability and sustainability of mobile teaching and learning services depend on the extent to which sufficient revenues can be generated to meet the cost of running these services. E-commerce business models can provide some insights into factors that are important for financially sustainable mobile teaching and learning services.

This essay aims to provide a brief survey of e-commerce business models and, from this, draw some insights for mobile teaching and learning. The outline of the essay is as follows: Section 2 will briefly discuss the concept of mobile learning and teaching as well as the technology involved. Section 3 will survey the types of business models and discuss how they are related to mobile learning services. This will include a discussion of key factors that are likely to be important for financially sustainable delivery of mobile learning services. Section 4 concludes.

## 2 Mobile Teaching and Learning: Concept and Technology

What are mobile teaching and learning services? From the learner's perspective, mobile learning takes place when learners access knowledge through mobile devices. This can take place either through learning from mobile educational material (didactic learning) or through interactions with other mobile learners and teachers (discursive learning) (Kukulska-Hulme and Traxler 2005, p. 26). Mobile learning can be a substitute for face-to-face learning by replacing the physical

**Table 1** Characteristics of mobile devices

| | Low mobility | Medium mobility | High mobility |
|---|---|---|---|
| **Low computational power** | | | Mobile phone |
| | | | E-book readers |
| | | | PDAs |
| **Medium computational power** | | Tablet | Smartphone |
| | | Netbook | |
| **High computational power** | Laptop | Notebook | |

Source: Author

classroom experience with learning through mobile devices at a distant location or at a different time (recorded instructions and documents). It could also complement face-to-face learning via the use of mobile devices to deliver content within a classroom lecture environment and when they are used to operationalize student project collaborations.

In terms of technology, the most commonly used mobile devices include personal digital assistants (PDAs), e-book readers, mobile phones, smartphones, tablets, and laptops. One way to differentiate these mobile devices is in terms of their mobility and computational power (Table 1). The mobility of a device relates to the easy with which the device can be physically carried around. This will depend on its weight and size. Mobile phones are considerably smaller in size than tablets, but their smaller screen size also limits their usability for mobile learning to some extent. Note that a mobile learning device is sometimes defined in a way to include only handheld devices. This definition would exclude laptop, notebook, and netbook computers (Adkins 2011).

Another dimension of mobility is access to the Internet – whether a device has Wi-Fi capabilities and/or broadband telephony capabilities (3G, 4G, plus). This dimension constraints learners' access to the Internet which is a key component of mobile learning.

Another dimension of mobile devices is computational power – defined by the computational capabilities of the processors in mobile devices. This is an important aspect of mobile devices as it determines the range, the size, and the speed at which tasks can be carried out by the devices. At the low end of the spectrum would be e-books which have possibly the lowest computational power among mobile learning devices with only basic functions – text display and Wi-Fi for downloading e-books and documents. At the higher end would be applications that may require a minimum computational power such as those involving mathematical and statistical computation. To some extent, the computation-intensive routines can be carried out at a remote server linked to an application. Example includes the *Wolfram Programming Cloud* and the *Wolfram Alpha*.

The quality of mobile processors can also impact power consumption. Thus, mobile processors and the capacities of batteries jointly determine the capability of a mobile device. This, in turn, is likely to affect the software and functionalities of mobile devices.

The differences between the various types of mobile devices have been blurring over time. For example, there are hybrid products today combining tablet and notebook functions. This has been drive by technological improvements in both mobile processors and battery technology. These and other technological changes such as broadband mobile communications have the landscape for mobile learning services. The advent of 4G, for example, has meant that 4G-enabled mobile learning devices can access information at higher speeds albeit at a higher cost as well. Whether commercially feasible and sustainable mobile learning services are possible is explored next via a discussion of business models.

## 3 Business Models for Mobile Teaching and Learning

What are business models and why are they important? Laudon and Traver (2010, pp. 2–4) define a business model as “a set of planned activities designed to result in a profit in a marketplace.” In the context of e-commerce, the business model would “use and leverage the unique qualities of the Internet and the World Wide Web” to achieve profitability (ibid, pp. 2–4). Thus, business models help ensure financial sustainability of e-commerce products and services. This is achieved by identifying key elements that are important for the success of a business. These factors include value propositions, revenue model, market opportunity, competitive environment, competitive advantage, market strategy, organizational development, and management team. How this can be applied to mobile teaching and learning services is summarized in Table 2.

An exploration of the key elements of the business model relevant to mobile teaching and learning services clearly requires an understanding of the nature of such services as well as the technologies involved. We explore each of the elements and what they imply for mobile teaching and learning services.

In terms of **value proposition**, mobility and convenience are clearly key selling points for mobile teaching and learning services. Mobile learning services can be delivered to learners (of which student is a subset) at their convenience. This is particularly convenient for learners who are unable to attend face-to-face lecture and tutorial sessions. For those able to attend face-to-face learning sessions, mobile learning services could provide complementary and supplementary learning services outside the classroom environment. The availability of high-speed mobile broadband services is likely to enhance the value of such services.

A number of **revenue models** may be useful for developers and providers of mobile teaching and learning services. Potential revenue models include:

- Advertising revenues – in which mobile learning services are distributed free of charge to learners in exchange for strategically placed advertisements in mobile teaching and learning spaces/sites and materials
- Subscription – in which a fee is charged to learners who would like to access the contents of a given mobile teaching and learning service for a given period of time

**Table 2** Key elements of e-commerce business model for mobile teaching and learning

| Elements | Key questions |
|---|---|
| Value proposition | Why would students use and/or pay for mobile learning services? |
| Revenue model | How can the seller generate sufficient revenues to ensure an acceptable rate of return on investment in mobile learning services? |
| Market opportunity | What is the market place for mobile learning services? |
| Competitive environment | Are there direct and indirect competing products in the market place? |
| Competitive advantage | Are there any advantages that can be levied to make the mobile learning services competitive in the market? |
| Market strategy | What plans can be made to promote the mobile learning services in the market? |
| Organizational development | What type of organizational structures is useful to implement the business plan? |
| Management team | Can a good set of executives with relevant experiences and qualities be identified and hired? |

Source: Compiled by author-based framework provided in Laudon and Traver (2010)

- Sales – in which a one-time fee is charged to learners interested in purchasing the mobile learning services. Such services could be unbundled which allows learners to purchase the set of learning services that are of particular interest to them

Two or more of the above revenues could be used, resulting in the application of hybrid revenue models that help maximize revenues for the mobile learning service providers. An important consideration in selecting the optimal revenue model(s) is its/their impact on revenues over the product cycle. There are also risks associated with destruction of product cycles before service providers can maximize revenues from their mobile learning products. This is due to obsolescence arising from new and superior products introduced by competitors in the market.

There are already significant **market opportunities** for mobile learning services. Most educational organizations and institutions have already incorporated some degree of e-learning services that are accessible through mobile devices. These range from basic approaches such as course websites and online course materials to more sophisticated distant learning programs. Publishers are already offering e-books that can be read with mobile devices. These services are being offered by companies such as *Amazon.com* either on a purchase or rental basis. There are clearly more market opportunities for mobile learning services with interactive activities.

The **competitive environment** of mobile teaching and learning services is such that whichever type of services are offered there are bound to be competing services. If one were to design and promote a tablet application for the teaching and learning of a particular subject, its competitors would include other mobile learning services ranging from traditional e-books to more comprehensive learning portals offered by universities and textbook publishers. The set of competitors are also likely to change with technological changes in hardware and software for mobile teaching and learning. These changes are likely to be even more rapid than the traditional brick and mortar teaching and learning environment. Thus, the product life cycle of mobile teaching and learning services can be very short.

Against this backdrop and in order to compete against these services, the **competitive advantages** of using mobile teaching and learning services need to be clearly identified. These include advantages arising from access to unique resources (knowledge, talent) that are not replicable by other firms. Such advantages translate into first-mover advantages by being the first to introduce the product in the market. However, digital products run the risk of being easily replicable by second movers in the market. One way to minimize such risks is by incorporating elements that cannot be easily replicable such as interactive communities above the critical mass, regular (content and system) updates, and large network effects.

Converting competitive advantages into actions that maximize profits requires a **market strategy**. This will entail planning for market entry, service adoption, and market share expansion. For mobile teaching and learning services, there are many possible points of entry depending on which market is being pursued as well as the available technology for such services. For the student-consumer market, application (app) stores are likely to be an important approach to entering the market. The vertical integration between hardware market (e.g., iPhone) and software distribution market (e.g., iTunes) may narrow down available channels for the distribution of mobile learning devices.

The successful implementation of the market strategy is, in turn, likely to depend on the quality of human resources (**management team**) and organization (**organizational development**). The various elements are in fact interdependent as the decisions on human resource and organizational development depend on the business strategies adopted (Baron and Hannan 2002).

## 4 The Evolution of Technology and Market Structure: Implications for Business Models in Mobile Teaching and Learning

The markets for devices that are suitable for mobile teaching and learning have obviously undergone rapid and tremendous changes since they first appeared in the 1990s. Primarily driven by technological change, these changes are often reminiscent of Schumpeterian “creative-destructive” processes in which new products emerge to make obsolete and replace existing products in the market (McKnight et al. 2002). Such processes are particularly intense in markets driven by information technology. In assessing the business model of teaching and learning services, it is crucial to examine some of the market and industry factors that, though sometimes exogenous, have significant impact on the sustainability of these services. These factors include the competition between mobile device platforms, network effects, and mobile broadband pricing.

### 4.1 Competing Mobile Device Platforms

One issue that makes such the competition and market processes even more complex in the case of mobile teaching and learning devices is the coexistence of many competing operating system (OS) platforms for mobile device applications. At present, major mobile device platforms include iOS (Apple), Android, and Windows. The market share of the various mobile device platforms is important as it affects the market size or the number of potential users of mobile teaching and learning services. This is especially relevant if mobile teaching and learning service providers have to choose to deliver its services through a limited number of platforms.

To put this in perspective, it is perhaps useful to examine the current market share for OS platforms for mobile devices such as smartphones, which is summarized in Table 3. Android-based smartphones have become increasingly dominant in the market since 2011. Today, the market share of Android-based smartphones has exceeded 80 %.

How do market shares affect mobile teaching and learning service providers? When such service providers can only offer their services using a given platform and to ensure maximum uptake of such services, developers of mobile teaching and learning applications will need to choose one or more of the dominant OS platform(s). In the case of smartphones, given the current market shares, this would be either Android or iOS.

However, the market shares of OS platforms may be different for other types of mobile devices such as tablets (Table 4). While Android's market share is still higher than iOS's market share in the tablet market, the iOS is more dominant in niche markets such as the education sector. It has been reported that the iOS's current market share in the US education sector is close to 94 % in 2013 (source: http://www.cnet.com/news/apple-ceo-weve-locked-up-94-of-education-tablet-market/). Thus, the mobile teaching and learning service providers would need to carefully identify the relevant targeted education market for their services and chose the appropriate OS platforms that would maximize their revenues.

### 4.2 Network Effects

The reason for choosing a particular OS platform is network effects. The attractiveness of adopting or using a given mobile teaching and learning application is likely to be proportional to the numbers of existing adopters of the application. This effect is particularly strong for applications that incorporate interactive functions (with other users/learners). Examples include social media platforms such as *Facebook* and message applications such as *Tango* and *WhatsApp*. The nature of network effects associated with a given mobile teaching and learning application is clearly related to the functions incorporated in the application.

In delving deeper into the question of network effects and the economic value (attractiveness) of a given mobile teaching and learning application, it may be

**Table 3** Market shares of smartphone OS, 2011–2014 (percent)

| OS platforms | 2011 Q2 | 2012 Q2 | 2013 Q2 | 2014 Q2 |
|---|---|---|---|---|
| Android | 36.1 | 69.3 | 79.6 | 84.7 |
| iOS | 18.3 | 16.6 | 13.0 | 11.7 |
| Windows phone | 1.2 | 3.1 | 3.4 | 2.5 |
| Blackberry | 13.6 | 4.9 | 2.8 | 0.5 |
| Others | 30.8 | 6.1 | 1.2 | 0.6 |

Source: IDC, http://www.idc.com/prodserv/smartphone-os-market-share.jsp

**Table 4** Market shares of tablet OS, 2012–2013 (percent)

| OS platforms | 2012 | 2013 |
|---|---|---|
| Android | 45.8 | 61.9 |
| iOS | 52.8 | 36.0 |
| Windows phone | 1.0 | 2.1 |
| Others | <0.1 | 0.3 |

Source: Gartner, http://www.gartner.com/newsroom/id/2674215

useful to look at the different types of network effects. Swann (2009) discusses three types of network effects, namely, Sarnoff's law, Metcalfe's law, and Reed's law. Sarnoff's law is applicable when the value of a network ($V_S$) is proportional to the number of members (users/learners) in the network (N):

$$V_S = cN$$

where c is a constant. This is relevant to a mobile teaching and learning service in which learners are only connected to a teacher individually and not to each other.

In Metcalfe's law, the value of a network ($V_S$) is proportional to the square of the number of members (users/learners) in the network (N):

$$V_M = cN^2$$

Here, each member is able to communicate to other members using the same mobile teaching and learning service. Thus, this is applicable to teaching and learning services that enable learners to interact among themselves.

Finally, in Reed's law, the value of a network ($V_R$) is proportional to the exponent of the number of members (users/learners) in the network (N):

$$V_R = c2^N$$

where $2^N$ is the number of subsets that can be formed. This law is relevant for mobile teaching and learning services that allow for group formation among learners.

What these three laws of network effects imply is that mobile and teaching services that allow for greater interactions between learners are likely to have greater commercial value. This is a crucial consideration for the design of

**Table 5** Mobile device application market: users, applications, and revenues (2013)

| | Google (Android) | Apple (iOS) | Microsoft (Windows) |
|---|---|---|---|
| No. of users (millions) | 900 | 600 | 12 |
| No. of apps (thousands) | 800 | 1,250 | 160 |
| No. of developers (thousands) | 150 | 235 | 45 |
| No. of downloads (in billions) | 48 | 50 | 0.65 |
| Paid to developers (USD, millions) | 900 | 5,000 | 100 |
| No. of apps per developer | 5 | 5 | 3 |
| No. of downloads per app | 60,000 | 40,000 | 4,062 |
| Revenue per download (USD) | 0.018 | 0.100 | 0.154 |
| Average revenue per app (USD) | 1,125 | 4,000 | 625 |
| Average revenue per developer (USD) | 6,000 | 21,276 | 2,222 |

Source: Louis (2013)

applications for mobile teaching and learning. For teachers choosing what applications to use, the network effects' issue is further complicated by the fact that application developers will maximize revenue by choosing OS platforms that have the most users/learners.

## 4.3 Distribution Channels

An important decision for mobile teaching and learning service providers is how to best distribute their services. Here, market structure issue can impact the business models for mobile teaching and learning, i.e., in the area of the distribution channels for mobile teaching and learning applications. Mobile device and OS platform suppliers have become increasingly vertically integrated with downstream segments of the industry. For example, today, iOS applications are distributed entirely through Apple's iTunes while Google has offered their own distribution channel, namely, Google Play for Android applications. The prevalence of distinct distribution channels for the different OS platforms has important implications.

These distribution channels have their own pricing/profit-sharing formulas. As a result, market share dominance may not necessarily translate into higher revenues for developers of mobile applications (Table 5). Even though there are more downloads for Android applications compared to iOS, the latter's average revenue for developer is significantly higher. Even though the commercial success of a mobile learning application is likely to depend mostly on the application's design, the business model adopted has to take into consideration the existing application distribution structure.

## 4.4 Mobile Broadband Pricing

The market environment for mobile broadband services is another important factor that can influence the commercial viability of mobile teaching and learning services. In particular, the prices of mobile broadband services affect the adoption and utilization of mobile teaching and learning services. In this regard, there are significant differences in the prices and affordability of mobile broadband services in developed and developing countries (ITU 2014).

The higher prices and lower affordability of mobile broadband services in developing countries could constraint opportunities for mobile teaching and learning services in these countries. The mobile teaching and learning services in these countries could be confined to simpler and less broadband-intensive services. This would preclude the use of medium such as video recordings. In contrast, mobile teaching and learning services in more developed countries could embrace a wider range of technologies.

This digital divide in mobile teaching and learning could be further deepened by differences in broadband spectrum available in developed and developing countries. At present, the LTE (4G) penetration is still low in many developing countries compared to developed countries.

## 5 Future Directions

Mobile learning and teaching has become increasing important with advances in mobile computing and communication devices as well as progress made in broadband wireless infrastructure. While these developments have provided tremendous opportunities for developers of mobile teaching and learning services, careful attention needs to be paid to the commercial aspects of such applications to ensure their financial viability and sustainability.

The framework developed for e-commerce business models provides a useful guidance on how to achieve the goal of financial feasibility for mobile teaching and learning services. Key elements of this framework include value proposition, revenue model, market opportunity, competitive environment, competitive advantage, market strategy, organizational development, and management team.

The providers of mobile teaching and learning services will also need to take into account changes in the market and industry level. This relates to the ever-changing share of the various market shares of mobile devices platforms such as Android, iOS, and Windows. The distribution channels for applications based on each of these platforms are also likely to influence the decisions of mobile teaching and learning service providers. A key consideration would be how the functionalities of mobile teaching and learning services (as embedded in applications) relate to network effects. Another factor that is likely to affect the design and application of mobile teaching and learning services is the availability and affordability of mobile broadband services. The digital divide in mobile broadband services between developed and developing countries has major implications for the provision of mobile teaching and learning services.

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► Characteristics of Mobile Teaching and Learning

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# Design Considerations for Mobile Learning

# 4

Jason Haag and Peter Berking

## Contents



**Abstract**

For good reasons, the instructional design practices for classroom environments and e-Learning have been largely limited to the cognitive domain. With the increasingly widespread adoption of mobile technology, a paradigm shift is taking place, offering new opportunities for improving performance and augmenting skills (in addition to knowledge transfer). But how is curriculum design and instructional design for mobile learning any different? Traditional course offerings replaced with or augmented by mobile technology may actually follow many of the same instructional design frameworks or processes in alignment with the widely accepted phases of ADDIE (Analysis, Design, Develop, Implement, Evaluate). But what other types of m-Learning can or should be considered during design? What are the current gaps in design knowledge for educators, instructors, and instructional designers? The answer to these important questions requires a solid understanding of mobile device affordances as well as considerations from two key domains of research and

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practice: Learning Sciences and Human-Computer Interaction (HCI). This chapter will cover these considerations with the goal of helping readers establish an informed design strategy for m-Learning, rather than relying solely on prior instructional design experience.

## 1 Introduction

As with many past technological innovations, instructional designers and educators have quickly adopted mobile technology with the inevitable benefit of understanding its pedagogical merits. With the growing popularity of interactive apps, engaging touchscreen interaction, and immediate access, it's no surprise that mobile technology has ascended as a top priority of many education and training programs around the world. The mobile device and app platform model has undoubtedly created new opportunities for improving education, training, and performance in formal learning settings but has also drastically changed the way many people work and live on a daily basis.

Instructors, educators, and instructional designers are quickly adopting mobile technology in their learning environments, but strategic design considerations and proven pedagogical practices have not been systematically documented. This misfortune can be attributed to the lack of a universal acceptance of what types of devices are agreed to be "mobile" as well as what types of activities are commonly understood and accepted as "mobile learning (m-Learning)."

### 1.1 What is Mobile?

When a popular technology like mobile receives so much public attention, development teams often begin with focusing too narrowly on the technology itself, rather than the requirements or learning needs. Ideally, the learning outcome should be the primary driver for making design decisions. However, being familiar with the capabilities of the different types of handheld devices that learners use may also introduce new ideas and might even help to appropriately narrow the scope of a mobile learning initiative. For now, there is no right or wrong answer for what types of devices are considered to be truly "mobile" as perceptions and technology will continue to change and evolve. The focus should be on how mobile technology can add the most value to the learning context. If there are no obvious benefits or justification for using mobile technology to enhance learning or performance, then it is conceivable that a business case analysis or cost-benefit analysis could be pursued. A cost savings benefit could possibly serve as a secondary driver for designing and developing a mobile solution.

Mobile device screen sizes as well as several other form factors collectively introduce many considerations and implications for a mobile learning design strategy. Think about the minimum sizes of text and graphics for various mobile-device sizes, preferences for touching or interacting with different device types, designing for keyboard use, dealing with loss of connectivity, screen glare, and behaviors of smartphone users vs. tablet users. All of these concerns may influence how organizations determine what devices they will include or exclude from their list of targeted mobile device types.

While there are success stories that leverage basic features such as text messaging, today's mobile devices that have a touchscreen and advanced hardware capabilities seem to offer the most potential for rich mobile learning experiences. In addition, smartphones and tablets are becoming so prevalent because they are typically more affordable and portable than laptop computers. A survey conducted by the Advanced Distributed Learning (ADL) Initiative in 2013 asked 831 respondents from the education and training community which mobile device they use most often for learning (Berking et al. 2013). The results heavily implied a focus on smartphones and tablets for mobile learning, with the highest responses reported at 61 % for tablets and 29 % for smartphones.

The education and training communities both have internally mixed opinions on whether a laptop should qualify as a mobile device. Laptops were once considered too heavy and not small enough to be truly mobile. However, the recent convergence of laptops with tablets into a hybrid device by some manufacturers could make this concern even more difficult to address. For example, designing learning content for a tablet has much more in common with a laptop or desktop computer than it does for a smartphone. However, the individual usage of these devices is much different. There is also an increasing number of design implications related to hardware expansion capability differences between mobile devices as the market continues to evolve. Nonetheless, the purpose and scope of this chapter will be focused on smartphones and tablets as the preferred types of mobile devices used for mobile learning.

## 1.2 What is Mobile Learning (mLearning)?

The true potential of mobile learning (hereafter referred to as "mLearning") should not be merely described as learning content delivered or accessed on a mobile device. It should be viewed as a way to augment the learner by providing access to both learning content and support information, anytime and anywhere. Therefore, both the learners and devices of today as well as the future should be considered to provide a more flexible view of mLearning. Unlike other learning technologies, mLearning is unique in that it can accommodate both formal and informal learning in collaborative or individual learning modes, and within almost any context. Consider the following working definition of mLearning:

> Leveraging ubiquitous mobile technology for the adoption or augmentation of knowledge, behaviors, or skills through education, training, or performance support while the mobility of the learner may be independent of time, location, and space.

This definition allows for a growing number of mLearning scenarios as well as future device capabilities and types. This definition also lends itself to support both education and training in traditional learning environments as well as performance support scenarios. Mobile learning should not be merely viewed as a replacement, an alternative, or a new addition to existing education or training delivery methods. It should be thought of as a complementary way to augment or enhance environments that already support learning.

There are many other macro-level implications and considerations for mLearning from a development, implementation, or evaluation perspective. It is beyond the scope of this chapter to describe or cover these. In this chapter, the focus is on answering the question, *What unique considerations are relevant to the instructional design of mLearning?* The chapter will begin with how the traditional views of curriculum and instructional design can be rethought to support the performance of the learner. Readers will learn about these critical considerations for mLearning design based on the aforementioned distinctions and descriptions the authors candidly provided for the terms “mobile” and “mobile learning (mLearning).”

## 2 Performance Support in Curriculum and Instructional Design

In formal learning environments around the world, the key tenets of “what should be learned” and “how it should be organized” are traditionally addressed through the processes of curriculum and instructional design. However, a prevailing uncertainty among educational technology researchers today is whether or not mLearning introduces a discontinuity in traditional design principles for curriculum and instructional designers. The 2013 ADL mLearning survey (Berking et al. 2013) of education and training professionals inquired whether the instructional design process for mLearning is any different from the instructional design process for traditional eLearning. Sixty-six percent of the respondents from this study agreed that it does offer some discontinuity.

Perhaps the most significant impact of mLearning on overall curriculum and instructional design is a paradigm shift from planned instruction to performance support. Performance support is the discipline that harnesses informal learning and makes it intentional (Gottfredson and Mosher 2011). This is simply due to the “anytime, anywhere” nature of the mobile platform, where users can access information and support materials at the point of need. As MIT professor and artificial intelligence pioneer Seymour Papert (Motivateus.com 2014) said, “*You can’t teach people everything they need to know. The best you can do is position them where they can find what they need to know when they need to know it.*”

Learners are no longer constantly tethered to their desktop or portable laptop computer to support learning but are more frequently turning to leveraging mobile devices for support and self-directed learning. A 2012 Pew Research survey (PEW 2012) found that 86 % of smartphone owners have used their devices in the previous 30 days to perform at least one “just-in-time” or performance support activity. Performance support is now often used in education, training, and workplace settings when learning is complemented or enhanced by on-demand information assets and electronic aids. The previously mentioned survey on mLearning (Berking et al. 2013) revealed a high level of confidence in performance support as an optimal approach for delivering mLearning. Towards Maturity (2014) found in their 2013 survey that "accessing support at the point of need" was the top driver for mLearning (80 % of respondents listed it as such, above such factors as "improving employee engagement"(79 %) and "improving communication between individuals"(77 %)).

Mobile device use inherently increases the tendency for learners to engage in self-directed learning and stimulate their cognitive curiosity beyond classroom walls (Traxler 2007). Self-directed learning is commonly understood as a universal goal of higher education. Determining the most effective conditions for improving the performance of the learners in both higher education and training environments is often considered by instructional designers and educators as one of the most critical yet challenging undertakings.

The role and focus of performance support in education and training is generally increasing, and there is also a clear distinction in education when compared to its purpose in a training environment. The distinction is directly related to the intended outcome and whether it is supporting a workplace task or a formal learning task. Typical learning outcomes are commonly aligned with memorization, understanding principles or concepts, applying rules, or acquiring high-order cognitive skills or problem-solving abilities. These types of learning outcomes all require different forms of instructional support and strategic planning. There are two distinct types of performance support: one is designed to offer support for workplace tasks at the point of need (defined by time, place, and context); the other is designed to support the learning process itself, usually in an academic setting (i.e., electronic study aids for a class). The former is often blended with instruction (classroom or eLearning), and the latter is inherently blended.

Performance support alone, or a blended version of it, has the potential to significantly alter curriculum design; what were once sequences of formal courses or modules can now be catalogs of performance support materials; what were once sequences of classroom activities can now be self-directed learning activities guided by on-demand information. In some cases, the classroom or online portion of a blended learning module is relegated to merely training on what performance support resources are available and how and when to use them. Assuming there is a clear value proposition for incorporating mobile technology, the teachers, instructors, or instructional designers need to determine if the learning activity is truly dependent upon the learner and device being mobile. If it is not, and the activity is only minimally enhanced by mobile technology, then it may not be necessary to tie it too closely to the learning objectives.

## 3 Learner-Centered Design

A key factor in determining the utility and success of an mLearning solution is the ability of that solution to adequately satisfy its users. Instructional designers should consider establishing user experience goals for their solutions so the learners find them usable, engaging, and motivating. In both the mobile and web development professions, experience design and interaction design are often closely aligned to a usability philosophy of considering the quality of touchpoints and user engagement within a software application experience.

Ironically, designers of interfaces for learning are often not instructional designers, but they should be encouraged to work closely together. User experience and interaction designers often apply principles of usability whereas the instructional designers apply theories of learning. These theories of learning should be conveyed to the interaction designer before they can be leveraged for mLearning design. Consequently, the principles of user experience and interaction design should be equally conveyed to the instructional designer. Often, the focus of a user-centered design is to support task completion, whereas effective learner-centered design will help to reconstruct the experience around the learner. Combinations of both user-centered and learner-centered practices are often required in order to design and develop a useful mLearning solution.

Learner-centered strategies also usually target independent learners with a need to think critically and solve problems. As mentioned earlier, performance support is emerging as a key design strategy for mLearning but also supports learner-centered design strategies. In the higher education setting, this might take the form of the scenario mentioned in the previous section, where it complements the classroom experience or, in some cases, guides self-directed learning. For classrooms augmented by mobile technology, the design of the mLearning solution must integrate closely with the core texts, curriculum guide, class objectives, and other materials related to the class. Similarly, workplace performance support materials should align with existing training or workplace tasks. Ideally, a learner-centered design strategy must give the users a compelling reason to access the support materials. Quinn (2011), an author of several books and articles on mLearning design, presents performance support as a form of learning augmentation and provided the following items for consideration in a learner-centered design:

1. Motivational examples – presented before and after a formal course to reinforce the need to learn the material
2. Extending learning processes
   - Reconceptualization – providing new concept representations
   - Recontextualization – new contexts of application as examples
   - Reapplication – more practice
3. Connecting with feedback
4. Supporting learner preferences – presenting material in the medium, time, format, etc. preferred by the learner
5. Contextual opportunities – adding value by tailoring learning to specific locations or times

What other factors could influence a learner-centered design strategy? To answer this question, consider thinking about how people touch, hold, perceive, and interact with their mobile devices. A deep understanding and analysis of the target audience's usage patterns and the device affordances will heavily inform the design. These factors will be examined next.

### 3.1 The Sense of Touch and Mobile Behaviors

Mobile devices provide a context in which haptic interfaces are playing an increasingly important role (MacLean 2008). The emotional and social significance of touch for humans is undeniable. It is deeply rooted in early human physiological and psychological development from the time of embryo development all the way through adulthood (Nicholas 2010). Today's mobile user typically expects full control over a mobile interface and receives sensory information prompts in a manner that is usable in his or her current context. Touchscreen and sensor-based inputs such as swipes, taps, pinches, screen rotation, and vibrations seem to increase motivation, engagement, and the authenticity of a simulated environment on mobile devices. However, there is little research on exactly why mobile touchscreen interfaces are so engaging and motivating in both collaborative and individual learning environments. According to the 2013 survey on mobile learning from ADL (Berking et al. 2013), touchscreen interaction was also selected as the top area of mLearning design that educators and training professionals were most interested in better understanding.

What role does touch interaction play in tactile cognition and learning on mobile devices? Tactile learning is the process of acquiring new information through tactile exploration (Nicholas 2010). Research studies on tactile information processing in humans have revealed that people can actually be trained to absorb a large amount of information by using their sense of touch. There are also obvious benefits inherent in mobile apps that provide an optimized-for-touch experience. According to research on mLearning in the classroom (Ciampa 2014), materials, quizzes, and games made available via mobile apps also provide opportunities for exploration, repeated self-assessment, and instant feedback. The instant feedback to student responses was an appealing form of incentive compared to prior classroom practices of grading and providing feedback by hand, long after a concept had been taught and possibly forgotten.

Neglecting to consider HCI and touch interaction behaviors when designing mLearning can actually lead to missed learning opportunities if users are subjected to poor interface and interaction design decisions. While high-quality content and instructional design are important, clean graphics and visual design help attract learners to interact with the interface and content. Fortunately, for the most part users are at the mercy of the mobile device manufacturers and operating systems (OS). They have already made many of the inherent user interface design decisions for apps to work within their mobile OS. However, there is still some responsibility for graphic design and interface elements in mLearning, leaving room for error, and even more so if mobile user behaviors are also not taken into consideration or tested for in advance.

Past research on mobile behaviors has focused primarily on smartphones while educators and instructional designers have directed much of their focus to delivering mobile learning on tablets without a deep understanding of the ergonomics and

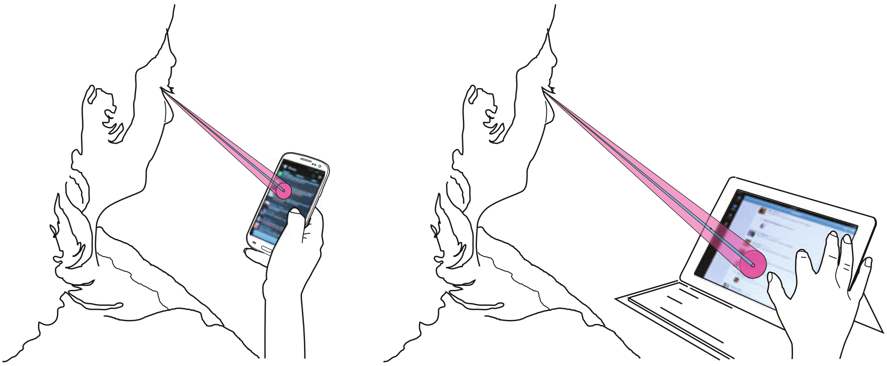

**Fig. 1** A tablet on a surface is much further from the user than smartphone in the hand so text and graphics must be much larger from Hoober and Shank (2014)

behaviors of use. A recent survey report published by (Hoober and Shank 2014) titled "Making mLearning Usable: How We Use Mobile Devices" revealed how people hold and when they use mobile devices. The survey revealed the ways people use smartphones and large tablets are substantially different. People use phones almost entirely in several possible hand combinations, and largely on the move while standing or walking. People use tablets much more often while sitting, and with the device in a stand, attached to a keyboard, or set on a table. Users also often change the way they hold their smartphone or tablet, switching from one to two hands and changing the orientation, different for typing vs. reading. These findings have huge implications for readability and mLearning design (Fig. 1).

These findings also point to the fact that the larger tablets with 9–11 in. screens are being used very similarly to laptops. In addition, the wide range of hand combinations when using smartphones is further increased if left-handed vs. right-handed use is taken into consideration. These insights reinforce the importance of HCI and learner-centered design considerations in an mLearning design strategy (Fig. 2).

It may not be possible to address all of the attributes of both tablets and smartphones without encountering a substantial amount of distinct differences such as accommodating user interaction preferences, screen sizes, and user behaviors. These differences alone would require exponentially complex considerations for each device type and form factor. Therefore, it is imperative that organizations wisely decide on which devices should be part of their mobile strategy, and this decision should be informed by their learners' behaviors but also by their access to and expectations of mobile technology.

## 3.2 Device Capabilities and Affordances

As a result of the excitement surrounding mLearning in recent years, many educators and instructional designers mistakenly ask "where do I start in deciding which mobile technology to use?" Faced with the overwhelming array of choices, many

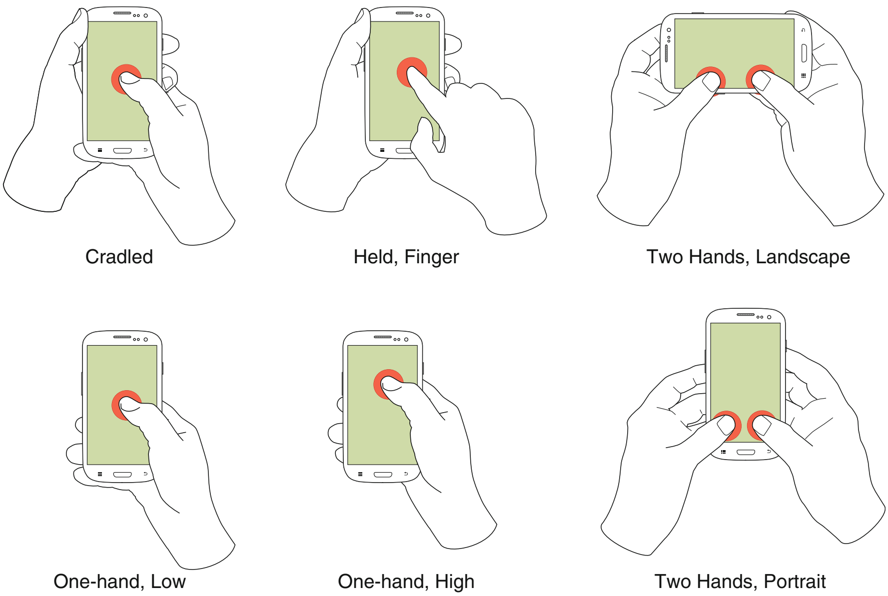


**Fig. 2** The way we hold our mobile devices from Hoober and Shank (2014)

start in an arbitrary way, selecting a technology (especially a new one that has emerged as the flavor of the month) that seems to be a fit for their need and finding a way to make it work for them (e.g., augmented reality). A less risky approach is to define the problem to be solved and then examine mobile technologies systematically, pointing to specific device capabilities and affordances. This can be tricky, because most mobile technologies were not invented solely for learning and do not come with a manual of how to use them explicitly for learning.

Psychologist James J. Gibson in his 1977 article "The Theory of Affordances" first introduced the term "affordance." Gibson (1977) defined affordances as all "action possibilities" latent in the environment, objectively measurable and independent of the individual's ability to recognize them but always in relation to agents and therefore dependent on their capabilities. An affordance in general terms is therefore a quality of an object, or an environment, which allows an individual to perform a specific action or ability. The term has been further evolved by Norman (1988) for use in the context of HCI to indicate the easy discoverability of perceived action possibilities. The key to understanding affordances is to identify the underlying capabilities and then describe the affordances those capabilities provide for learning applications, as an intermediary step to eventually identify the learning strategy to be employed. Raw capabilities of the device are therefore the enablers for affordances. However, learners may not always have equal access to the same capabilities depending upon their device type, connectivity, security, privacy, and other technological or environmental challenges. Equal access to specific device capabilities is a critical factor and consideration influencing the flexibility and richness of mLearning design options. These types of considerations should be identified during the analysis phase of an mLearning project so that they might be appropriately addressed during the design phase.

Affordances are important to recognize for the design of mLearning because smartphones and tablets exhibit unique features and qualities that allow individuals to perform a specific action. Each affordance is enabled by the portability of the device, coupled with a specific capability of the device. In many cases the affordance is based on the combination of both hardware and software capabilities. For example, the camera is a capability of many smartphones and tablets. The hardware for the camera alone does not provide a unique capability. When the camera hardware is combined with a software application (App), then such affordances as capturing video and images, augmented reality, Quick Response (QR) code reading, or content image analysis are made possible. When thinking more deeply about capabilities and affordances for mLearning, consider the following table in Fig. 3 below.

## Augmenting and Contextualizing

Instructional designers and educators often lack clarity regarding the impact that a learner's physical location has on his or her learning. An analysis of what parts of context are important for effective mLearning practices and how they can be used is of major importance. *Augmenting* and *Contextualizing* might possibly be two of the most powerful affordances to be considered for mLearning design.

Mobile device capabilities such as the Global Positioning System (GPS) sensors, geolocation, and camera scanning provide mLearning designers with the ability to know the real-world geographic position as well as the physical place where learning can occur. Augmenting provides an enhanced view of the real world by overlaying sound, graphics, text, video, and GPS information. Contextualizing provides opportunities to improve learning through adding more meaning or contextual support. How can this impact mLearning design strategy? Consider situated learning (Lave and Wenger 1991), where such learning is situated in a specific context or takes place within a particular social and location-based environment. Situated learning is possible in mLearning today through the affordance of contextualizing. For example, consider the following examples: field trips, location-based guides, nature studies, museum tours, collaborative field activities, on-the-job training, and performance support. All of these types of learning scenarios are especially enhanced by improving nearby context information because they may depend on a specific location.

Mobile augmented reality is one example of mLearning that sometimes combines the affordances of *Augmenting* and *Contextualizing*, providing designers with a way to enhance both the user's context and real-world situation at the same time. This combination of augmenting and contextualizing might explain why augmented reality has grown substantially in recent years and penetrated other markets outside of the learning space.

| Affordance for Mobile Learning | Device Capabilities |
| --- | --- |
| **Accessing:**<br>On-demand access to information, courses, performance support or refresher knowledge.<br>Examples: search knowledgebases, job aids, reference, dictionary, Wikipedia, courses, voice search, social media | • touch screen<br>• internet browser<br>• connectivity<br>• microphone |
| **Augmenting:**<br>Overlaying still imagery, audio, or video over real world objects or setting in support of or during a contextual learning activity.<br>Example(s): augmented reality, scavenger hunt, museum tours, language learning | • camera<br>• GPS<br>• internet connectivity |
| **Capturing (audio):**<br>Documenting or recording auditory content in support of or during a learning activity. | • microphone<br>• speakers<br>• digital storage |
| **Capturing (imagery or video):**<br>Documenting or recording visual content relevant to learning activity. | • camera<br>• microphone<br>• digital storage |
| **Communicating (messaging):**<br>One-way, two-way or group messaging as part of an informal or formal learning activity.<br>Examples: group collaboration, instructor/student discussion and chat | • SMS<br>• MMS<br>• chat apps<br>• microphone |
| **Communicating (voice):**<br>Two-way, or group discussion as part of an informal or formal learning activity.<br>Examples: group conference, meeting, focus group | • voice call<br>• voicemail<br>• speaker<br>• microphone |
| **Contextualizing:**<br>Notifications and linked interactions sent by transmitters or tags attached to objects using proximity or location sensors to provide a context-aware or location-aware content in support of or as part of a learning activity.<br>Examples: iBeacons, QR Codes, scavenger hunt, mobile tours, games, and interactive stories | • Bluetooth<br>• GPS<br>• NFC<br>• RFID<br>• Wi-Fi<br>• camera |
| **eReading:**<br>Accessing and reading documents on multiple devices anytime, anywhere in support of or as part of a learning activity. | • text zoom<br>• text highlighting<br>• notes |
| **Media Playing:**<br>Accessing media anytime, anywhere in support of or as part of a learning activity.<br>Example(s): YouTube, Kahn Academy, Webinars | • image<br>• video<br>• audio<br>• internet connectivity |
| **Notifying / Reminding:**<br>Event triggers, instant reminders, and alerts that illicit immediate responses or deeper engagement with a learning activity.<br>Examples: spaced repetition/learning, flash cards, language learning | • connectivity<br>• touch screen<br>• push notification service<br>• calendar |

**Fig. 3** Affordances for mobile learning

### Spaced Learning

In addition to providing contextually relevant information or augmentation, mLearning is ideal for providing enhanced retention by leveraging Spaced Learning (aka spaced repetition). Spaced Learning is a learning technique that incorporates increasing intervals of time between subsequent reviews of previously learned material in order to exploit the psychological spacing effect. Spacing can involve a few repetitions or many repetitions. This is one of the examples provided in Fig. 3 above as a result of the notification/reminder affordance. Providing only textual and general information in mLearning without repetition, no matter how elegantly it is presented, will usually not result in long-term knowledge transfer or performance improvement for most learners. While repetitions are good for retention in learning, spaced repetitions have been proven to be the most effective. And longer spacings tend to produce more long-term retention than shorter ones (Thalheimer 2006).

This spacing is effective both on the level of the initial content presentation as well as refresher/reminder education or training (to prevent knowledge decay of information that one seldom uses). Findings from Thalheimer (2006) reveal that the amount of practice and intervals in between depend on a number of factors including how complex is the skill, how often the opportunity occurs, and how important is competence or performance. Thalheimer, W. (2006) reports that

> The spacing effect is one of the most reliable findings in the learning research, but it is, unfortunately, one of the least utilized learning methods in the learning field.

Instructional designers have had this information for a long time – over 100 years, in fact. Hermann Ebbinghaus proved it in 1885 with what he called The Forgetting Curve. Figure 4 below is an adaptation of Spaced Learning to include practice and test depictions by Quinn, C. (2011).

This effect suggests that "cramming" (intense, last-minute studying) the night before an exam is not likely to be as effective as studying at intervals in a longer time frame. Repetitions at increased time intervals strengthen connections in the brain and counteract the process of forgetting. For improved retention, an mLearning solution could optionally provide repetitive practice to mastery to ensure that the facts, processes, and concepts are internalized for later recollection and use. Consider how spaced or timed, relevant learning could be beneficial to your learners. Mobile devices provide the capabilities that easily leverage the affordances of notifications and reminders that can harness the power of Spaced Learning.

## 4 Learning Theories and Conceptual Frameworks

As previously mentioned, mLearning does not simply amount to a different mechanism for delivering content to learners; it represents an emergent way of thinking that implies a paradigm shift and requires new design strategies informed by sound underlying learning theories. Although mLearning design does not necessarily require new models, the mobile devices and the learning theories they support are

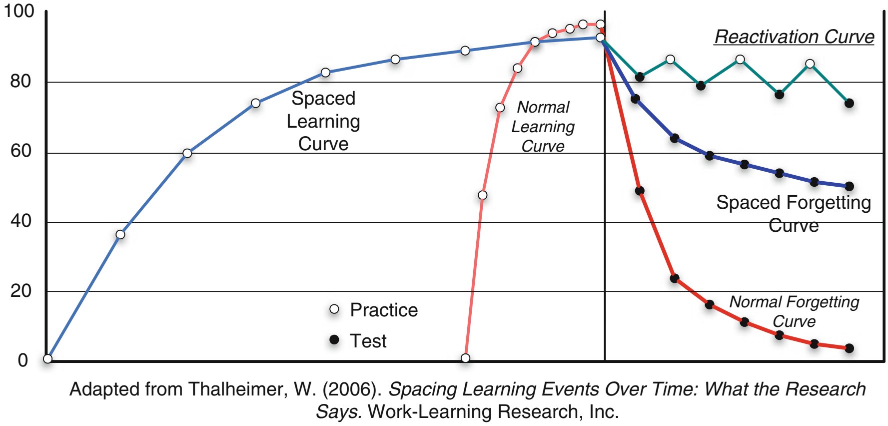


**Fig. 4** Spaced practice by Quinn, C. (2011) (Adapted from Thalheimer 2006)

sufficiently unique that special considerations are warranted during the design process. Conceptual frameworks can also provide opportunities for these considerations by providing guidance for thinking about new concepts and approaches in the design context. Instructional design models such as ADDIE are generally focused on helping lead the designer, objectively, without premature bias toward a particular solution, to choosing the appropriate learning technology and instructional strategy. Robust ID models are intended to stand the test of time and are agnostic to particular technologies and design strategies. However, it is not unusual for instructional designers to combine existing process models with other models, frameworks, or theories.

Learning theories are critical to mLearning design because they directly inform choices of learning strategies and can ultimately influence other steps in the ID process. Constructivism is generally recognized as one of three main schools of thought in learning theory, based on the work of Piaget and philosophers like Vygotsky. In the past, it has been underutilized in learning experience design because of limitations of the learning environment or technology. However, it is now enabled significantly by the mobile platform, occupying a potentially equal seat at the learning design table along with the two other traditionally relied-on learning theory schools of thought, Cognitivism and Behaviorism.

Constructivism holds that learners "construct" knowledge and meaning from interactions with other people and their environment; meaning is therefore unique to each individual. New information is assimilated into the learner's mental schema filtered through existing knowledge and experiences. Constructivist learning focuses on creating appropriate learning environments, with authentic representations of real challenges and tasks that learners can interact with and construct meaning from. This learning theory is especially relevant because mLearning enables learners to communicate, analyze problems, and participate in learning activities in a real-world context. In fact, learners can analyze problems on the spot in real time without having to return to the classroom.

Constructivism is also often equated with informal learning. Depending on the definition of the latter, there is significant overlap, but they can be differentiated by the fact that informal learning connotes freedom of choice on the part of the learner to determine what activities they are going to engage in to meet the learning objectives; by contrast, constructivist learning environments (CLEs) may be constrained to a finite range of choices (i.e., learners "discover" the solution to a problem by examining the given options that are engineered into the system). There are no unique design considerations for mobile CLEs except that the affordances of the mobile device need to be taken into account; CLEs, more than behaviorist or cognitivist experiences, really can benefit the most from mobile technology, since they are often conducted in the field, leveraging the many different data capture and communication features of mobile devices.

Conceptual mLearning design frameworks (as opposed to learning theories) might also be investigated during the analysis phase while developing an instructional strategy. However, they can inform mLearning design mostly only in indirect ways; they are meant to suggest a heuristically based intellectual orientation when approaching design problems. They are on the opposite end of the spectrum of algorithmic, cookbook-style design process models such as Dick et al. (2014). Although abstract and high level, these models can be used as an evaluation rubric for a given design, in terms of determining whether it adequately accounts for all aspects shown in the model. MLearning content and applications should be designed with special consideration for existing learning theories, and conceptual frameworks can be leveraged for stimulating creative thinking and planning. Several mLearning frameworks have been proposed, but many are uniquely aligned with a specific use case. The following frameworks are more generalized and might serve as a starting point for designers new to approaching design challenges in mLearning.

## 4.1 A Framework for M-Learning Design Requirements

This conceptual framework by Parsons et al. (2007) was conceived prior to the advent of modern smartphones and tablets, but it still provides a valuable resource on the systematic planning for mLearning experience design. The framework addresses generic mobile environment issues, context issues, learning experiences, and their individual or collective learning objectives (Fig. 5).

## 4.2 The Framework for the Rational Analysis of Mobile Education (FRAME) Model

Koole (2009) presents a model for describing mLearning as "a process resulting from the convergence of mobile technologies, human learning capacities, and social interaction." It addresses contemporary pedagogical issues of information overload, knowledge navigation, and collaboration in learning." Using this Venn diagram and

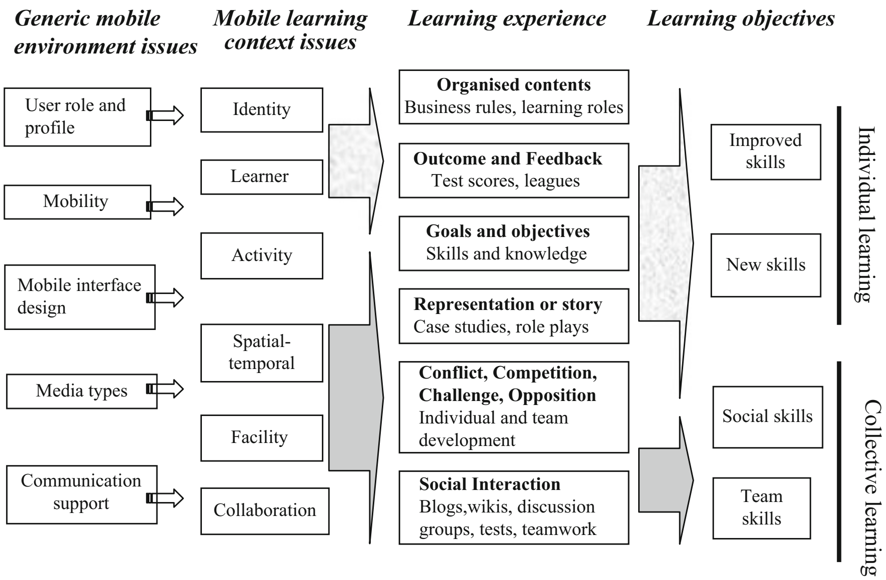


**Fig. 5** A framework for M-learning design requirements

the explanation Koole provides on each circle and intersection area, a high-level informal checklist can be generated to comprehensively guide one's design thinking in these particular areas (Fig. 6).

## 4.3 Park's Pedagogical Framework

Park (2011) used Moore's (2007) transactional distance (TD) theory as the basis for a conceptual framework for mLearning. Transactional distance refers to the immediacy and structure of communication between instructors and learners. This led to his categorization of four types of mLearning by Park (2011):

1. High–transactional distance socialized m-learning
2. High–transactional distance individualized m-learning
3. Low–transactional distance socialized m-learning
4. Low–transactional distance individualized m-learning (Fig. 7)

Park (2011) also discusses how this framework can be leveraged by instructional designers to understand how mobile technologies can be incorporated into their design strategy more effectively. The framework's practical use would rely on categorizing the characteristics of desired learning activities as well as the inherent properties of a particular mobile technology and matching them to one of the four types.

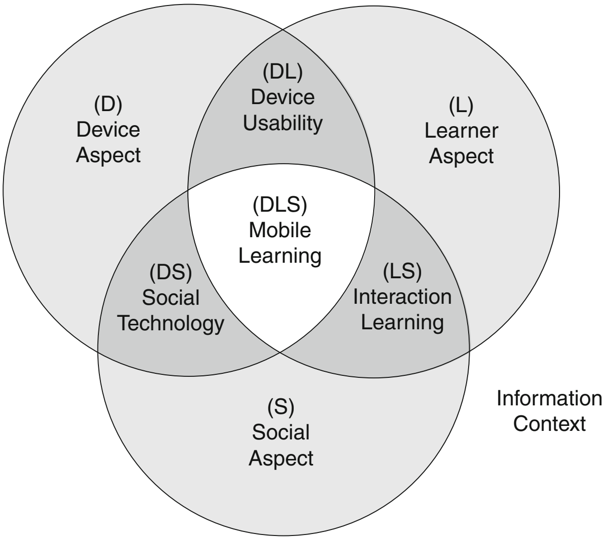


**Fig. 6** The FRAME model

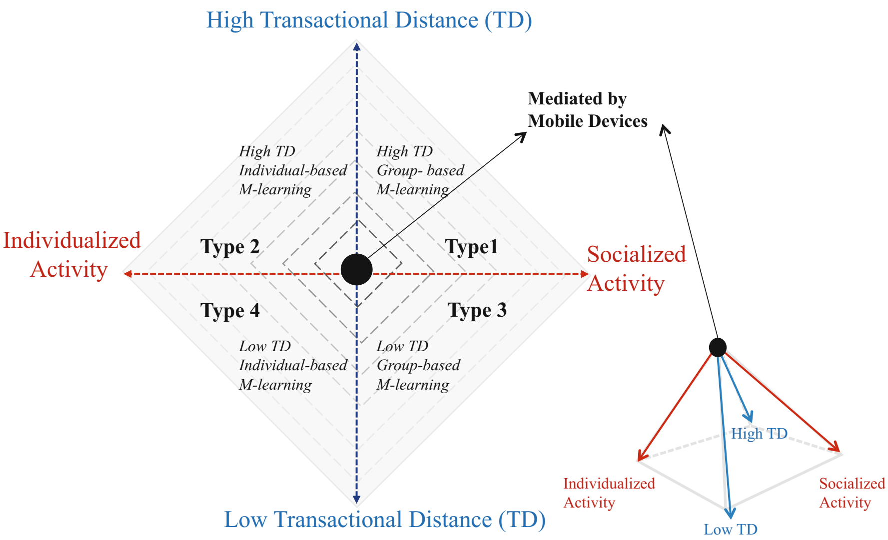


**Fig. 7** Park's pedagogical framework

## 4.4 The M-COPE Framework

This framework by Dennen and Hao (2014) provides a useful tool for encouraging educators to consider the requirements for incorporating mLearning into their instructional strategy. The M-COPE framework consists of five key elements:

Mobile, Conditions, Outcomes, Pedagogy, and Ethics. Each of these elements provides a set of considerations to be made about a particular learning context. It was developed to help instructors make informed decisions during the design process when creating both new learning activities and applications or when incorporating mobile resources into existing nonmobile activities. The authors of this framework believe that instructors will benefit from this framework by prompting them to recognize learning needs and constraints while following established ID process models.

### 4.5 Mobile Training Implementation Framework (MoTIF)

This framework is focused on exploring the intersection of multiple design and research methods by following a Design-Based Research (DBR) approach. The framework suggests using an integrated master flowchart of processes, decisions, and considerations for the entire instructional design process, specifically including and highlighting elements that optimize it for mobile learning. The objective to define and refine a design decision support framework includes consideration of the motivational, contextual, pedagogical, and performance support aspects of mobile learning.

## 5 Create, Convert, or Capitalize?

Perhaps one of the least complicated mLearning decisions for educators and instructional designers is determining whether they need create something entirely new, convert existing learning materials, or capitalize on current mobile apps. Creating a new mLearning solution can quickly become costly and time consuming, and there are significant technical concerns when it comes to cross-platform development. Before rushing to create a new mLearning solution, designers might consider capitalizing on the popularity current App Store catalogs from Apple, Google, and Microsoft. The popular “there’s an App for that” slogan trademarked by Apple holds true for the other mobile platforms as well. Often, the mLearning need can be addressed by an existing app or a combination of apps. For example, several augmented reality browser apps are freely available today and are already being used to meet mLearning needs in education, training, and performance support. If existing apps or mLearning solutions can be leveraged, it might also be more cost effective to utilize them rather than creating a new capability from scratch. If existing apps don’t completely fulfill the mLearning requirements, then reviewing them might at least help expose educators and instructional designers to new design ideas.

Alternatively, leveraging HTML and the web might provide another option for mLearning design for situations where learners might not have access to the same mobile platforms or apps. The one thing every mobile device has in common is that they all have web browsers that support HTML. While targeting a mobile web approach might address concerns with cross-platform access, it will limit mLearning design strategies that wish to target the advanced capabilities of mobile devices (e.g., sensors, camera, push notifications).

In the case of revisiting instructional strategy due to a mobile conversion requirement, conceptual frameworks from Park (2011), Koole (2009), and Berking et al. (2014) that emphasize the analysis phase might also be considered. If the analysis phase is ignored, the learning or performance problem may never be addressed and money and resources might be wasted either on a problem that doesn't exist or the wrong problem altogether. It is at this point in the process when appropriateness of mLearning as a solution should be justified.

If existing learning materials are being converted to mLearning, the Analysis phase has presumably already been completed. However, in light of the unique design considerations for mLearning, an audit would be needed of the existing content and strategy, to ensure that the content and approach is still appropriate for mobile. Mobile conversion usually requires more than chunking the content down into much smaller units, accounting for the reduced screen size, etc. In fact, it often requires a careful analysis of existing learning materials or courses before converting them to a mobile format. It has been proposed that many designers and developers are creating new mobile content and converting existing courses by only resizing them to account for the smaller screen and user interface differences. Survey and interview respondents from ADL's mobile learning survey report (Berking et al. 2013) agreed that this is often the case and results in poor usability and learning outcomes.

An important consideration when addressing conversion to a mobile format is that the learning content should be reduced to much smaller discrete units than in a classroom or desktop eLearning course, with preferably 2–3 min for each unit or module. The attention span, readability (on a small screen), and previously mentioned mobile behaviors reinforce this advice. Where and how these design changes are to occur is also a primary concern in the analysis phase when following an instructional design model. Such questions as the following should be considered:

- Can the information be made more concise?
- Should information be sequenced in the same way?
- Should the students be assessed differently?
- Should objectives be reevaluated?
- Is the seat time too long for mobile instructional materials?

## 6 Future Directions

This chapter provides key considerations for the design of mLearning. It is difficult to design for all of the different characteristics of both smartphones and tablets. However, the scope was specifically limited to these devices as they offer the most potential for the rich, contextual, and contemporary mLearning design opportunities today. The contents of this chapter heavily relied on both the Learning Science and Human-Computer Interaction (HCI) domains in order to identify the unique considerations applicable to the instructional design of mLearning as well as describe potential gaps in general mobile design knowledge.

When possible, it can be a powerful mLearning design strategy to incorporate performance support materials in both education and training settings. However, the most effective mLearning solutions often take both practice to mastery and performance support into account while focusing on how mobile technology can add the most value to the learning context. Learner-centered design considerations should be at the top of the list of any mLearning strategy. These considerations are often deeply connected to deeper aspects of user experience design, mobile behaviors, and access to mobile device affordances.

The existence of learning theories and conceptual frameworks provides guidance and opportunities for leveraging mLearning epistemologies. Finally, most mLearning design decisions will eventually lead into production considerations of creating, converting, or leveraging existing materials. All of these aforementioned considerations are relevant to and will ultimately result in an informed set of design requirements for any mLearning strategy, whether it is for education, training, or human performance purposes.

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# RETRACTED CHAPTER: Designing a Mobile Applications Curriculum: Overview

5

Deanne Cranford-Wesley



## Contents



**Abstract**

As technology transforms higher education, changing the way that people conduct business, communicate, and learn, schools, colleges, and universities must accommodate and transform how curriculum is delivered and what programs should be delivered.

In years past, reformed conceptions of teaching, learning, and education, as well as new practices, policies, and organizational settings, for teacher learning, have been introduced by educational researchers and reformers. Reviewing these new concepts and practices have transformed learning for teachers, research groups, collaboration, and higher learning. Collaborative partnerships and professional communities in higher learning have taught us that the organizational conditions are essential to the development of instructional support and design of cutting-edge programs to align with current technologies.

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As technology changes the way people communicate, conduct business, and learn, colleges and universities across the country strive to provide engaging, current, and individualized learning environments using mobile applications that can be utilized on mobile devices such as tablets, iPhone, and Android and wearable technology to support collaborative education and distance learning and support the Internet of Everything. With these devices in the hands of students, faculty must provide education for a growing and diverse population of anytime, anywhere access to educational resources and applications. As the managing of education in a changing society is increasing pressure on organizations, colleges, and universities to provide and accommodate network access in a secure environment, there is an urgent need for skilled mobile technologist to provide the support, design, and security needed to support current and emerging applications on mobile devices. Students must also learn to design mobile applications for mobile learning and wearable technology. Students must also be skilled at providing secure coding on these devices.

The growing use of mobile, smart devices in the consumer market has also forced the software engineering community to quickly adapt development approaches of mobile applications. The combination of computing power, access to handheld devices, and ease of application transferable to market has made mobile devices the new computing platform for businesses, education, and independent developers. However, the growth of this new computing platform has outpaced the development of mobile applications. What is mobile technology? It is impossible to attribute one fixed meaning to the concepts of mobile learning. To fully understand this concept, it is critical to consider the relationships between each of the words used to describe mobile learning. The use of this foundation to understand mobile learning presents a vast challenge because there are many words and terms, which have been used to define and explain mobile learning as a miracle in the design of mobile application curriculum in education. Is there a need for mobile application curriculum? This chapter gives an overview of the need for mobile curriculum in education and explores the rationale for implementing mobile applications technology curriculum and examines what content is suitable for a mobile applications curriculum.



## 1 Introduction

As of January 2013 in the United States, Android made up 52.69 % of mobile device operating systems and Apple iOS accounted for 34.9 % (Statcounter 2013). Apple iOS had the lead 18 months earlier. In the summer of 2011, Android has steadily taken over the market from iOS as the most popular mobile operating system with all other platforms, like Windows Mobile, Symbian, and BlackBerry, accounting for less than 13 % combined (Statcounter 2013). Mobile devices include smartphones and tablets, both of which have become very popular among consumers. In 2013, consumers will purchase 1.2 billion mobile devices, surpassing personal computers as the most common method for accessing the Internet (Lookout 2013). These devices will not only be used for mobile devices which are the fastest growing computing platform, with an estimated consumer usage of 1.75 billion in 2014. Nearly two-fifths of all mobile phone users worldwide will use a smartphone at least monthly in 2014. As the rate of mobile users continues to increase, mobile phone users are rapidly switching over to smartphones as devices become more affordable and 3G and 4G networks advances continue to evolve.

Smartphone users currently account for a majority of mobile phone users in 10 of the 22 countries and are expected to increase in 16 countries worldwide. Mobile devices and applications are quickly becoming as important and widely utilized in the organization as personal computers and traditional business applications. The workplace has expanded beyond the office and even the home to wherever the user happens to be traveling. Students, faculty, and individuals alike also expect to communicate, collaborate, and access their important work or school applications and data from anywhere and on whatever device they choose.

As technology changed the educational landscape in terms of how information is delivered and to whom; the speed of access to information, and the many options for the delivery of information also changed (Truluck 2005). Programs and curriculum in higher education must also change. Therefore the development of an information technology model curriculum which would deal with topics considered essential, but do not seem to fit any specific knowledge unit. Mobile curriculum fits this definition. Because new technologies and different learning platforms have emerged, i.e., distance learning and new education systems like mobile education have become increasingly popular, the need for mobile applications increased. Mobile devices represent an intense withdrawal from traditional computing platforms as they no longer represent a "static notion of context, where changes are absent, small, or predictable." Rather, mobile devices are highly personalized, and its environment must be continuously monitored, thereby making mobile applications fundamentally context aware (collectively time aware, location aware, device aware, etc.), thus what is currently called the smartphone.

Mobile devices are very important in the business, education, and governmental entities. As the needs for mobile application use increase from students, educator, designers, and entrepreneurs, the need for anytime, anywhere applications also increases. As the need to work more efficiently and faster is a necessity, the increased use of mobile devices has emerged a need for a new mobile education path. This path must be deliberate and evolve as the technology industry continues to develop.

Mobile education is defined as any service or facility that supplies a learner with general electronic information and educational content that aids in the acquisition of knowledge regardless of location and time (Chen and Kinshuk 2003). Research and reflections on mobile learning should stimulate multidisciplinary and interdisciplinary thinking and methods in education. They should facilitate our understanding of outdated concepts and rigid assumptions about learning and what it may be in a society that has changed, from a technology point of view. A mobile application pathway is essential in college curriculum. As these pathways are developed, they should also include a security component as mobile applications can pose a real vulnerability to a device.

Mobile devices, including bring your own device (BYOD) and corporate-issued devices, all pose new problems for technology professionals who do not quite know how to handle the problem yet. A recent study of technology security professionals revealed 68 % of them have no way of identifying known mobile device vulnerabilities on their networks (Tenable-Security 2012).

As of January 2013, only 1.2 % of the devices on the market had the latest version (Platform Versions 2013). The previous version only accounted for 9 % of the market. The two most popular versions on the market are 2011s Ice Cream Sandwich (29.1 %) and 2010s Gingerbread (47.6 %). Adding to the problem of older versions of software in the market are delays in updating or patching operating system software. Research suggests that the time it takes for half of the Android users to update their software was 8–10 months and the likelihood they would buy a new. Contrary to how the Android platform works is the Apple iOS platform. The Apple operating system is not open and is controlled by Apple. Only one manufacturer makes devices for the platform and there is no fragmentation of the operating system (Mansfield-Devine 2012c). In contrast to Android's fragmented OS with many versions still on the market, Apple claimed that over 80 % of iPhone and iPad users had the latest iOS as of June 2012 (Mansfield-Devine 2012a). Other security benefits from Apple are that users are forced to download apps from the Apple's App Store and there are no allowable third party markets.

The popularity of smartphones and tablets poses new threats and issues for the enterprise. These threats from mobile devices are in the form of malware. Malware is a rapidly growing problem for mobile devices as forecasts predict that people will download 70 billion apps in 2014 (Lookout 2013). During the calendar year of 2012, Lookout (2013) estimates 18 million people will encounter Android malware. Android malware is on the rise at much higher rates than is Apple iOS. TrendMicro (2012) reported an increase from 1,000 Android malware samples in 2011 to 350,000 in 2012. The number of high-risk malicious malware applications for Android in just 3 years is significant compared to the 14 years it took the personal computers to reach those numbers (TrendMicro 2012). Android now exceeds personal computers for malware attacks in the United States (Mansfield-Devine 2013). Just over 99 % of all malware detected in 2012 was written for Android, with less than 1 % from the other operating systems (Kaspersky 2013). These statics support the rationale in the urgent need for higher learning institutions to develop a mobile curriculum to teach students how to design and secure mobile applications and how to identify vulnerabilities in various iOS.



## 2 Designing a Mobile Application Curriculum That Translates to Certifications for Students

An education that a computer science student must receive today must prepare them for the current workforce and the workforce of tomorrow. The education that a student will receive should be holistically designed to include technical concepts, application of the concepts, management skills, collaboration, and soft skills (including patients, work ethic).

Educational institutions are now increasing its efforts to design a more robust and comprehensive mobile applications courses and programs to meet the needs of the mobile industry; and the course content must equate to the skill needed in industry to build a pipeline of skill workers.

In building any curriculum, course, or program, one must follow some guidelines; in a report written by the Joint Taskforce for Computer Science (2013), the guiding principles in designing a computer science curriculum are as follows:

- The curriculum should be designed to provide students with the flexibility to work across many disciplines.
- The curriculum should be designed to prepare graduates for a variety of professions, attracting the full range of talent to the field.
- The curriculum should provide guidance for the expected level of mastery of topics by graduates.
- The curriculum should provide realistic, adoptable recommendations that provide guidance and flexibility, allowing curricular designs that are innovative and track recent developments in the field.
- The curriculum should be relevant to a variety of institutions. Given the wide range of institutions and programs (including 2-year, 3-year, and 4-year programs; liberal arts, technological, and research institutions; and institutions of every size), it is neither possible nor desirable for these guidelines to dictate curricula for computing. Individual programs will need to evaluate their constraints and environments to construct curricula.
- The size of the essential knowledge must be managed.
- The curriculum should be designed to prepare graduates to succeed in a rapidly changing field.
- The curriculum should identify the fundamental skills and knowledge that all computer science graduates should possess while providing the greatest flexibility in selecting topics.
- The curriculum should provide the greatest flexibility in organizing topics into courses and curricula.
- The development and review of computer science must be broadly based. (Participation from many different constituencies including industry, government, Curriculum, and the full range of higher education institutions involved in computer science education). It must take into account relevant feedback from these constituencies.

Many educators believe that the same basic principles are valid for designing a mobile application curriculum.

## 3 Design Characteristics

In an introductory mobile applications course, the decision must be made on what content should be in the course, important concepts that are relevant to the subject taught may not be able to be taught from day one. Many topics will not appear in the first course and must be pushed back, which may lead to nontechnical students not getting these topics. There are tradeoffs, but one must consider the essential concepts that should be taught in and introductory class that can be further developed in the next course for students moving forward in the technical program and the appropriate topics for those nontechnical students.

In designing a mobile curriculum, there must be multiple pathways into and through the introductory sequence and must have different entry points. Having multiple pathways into and through the introductory course sequence can help to better align the students' abilities with the suitable level of coursework. It can also help create more flexibility with articulation between 2-year and 4-year institutions and smooth the transition for students transferring from other colleges or programs.

Programming and computing are increasingly becoming more important to nontechnical majors in other fields. Courses for these nonmajors may or may not be distinct from courses that lead to years of computer science study. Additionally, having multiple pathways through introductory courses may provide greater options to students who choose to begin taking courses in computer science late in their college programs.

Programs in technology always needed adequate computing resources, both for students and faculty. The needs of technical programs often extend beyond traditional infrastructure (general campus computing labs) and may include specialized hardware and software and/or large-scale computing infrastructure. Having adequate access to such resources is especially important for project and capstone courses. Also, the institutions need to consider the growing need of computing devices (e.g., smartphones, tablets) that can be used as a platform for coursework.

## 4 Components of the Design

Computer science students need to understand the importance of secure software application development, particularly techniques to maximize application integrity and minimize the threat of reverse engineering. Sample topics include standardized libraries, cross-platform toolkits, vulnerability testing, automated code, logic, quality assurance, secure communication, secure data, and secure storage. Mobile devices must support multiple security objectives. These can be accomplished through a combination of security features built into the mobile devices and additional security controls applied to the mobile devices and other components of the enterprise IT infrastructure. The most common security objectives for mobile devices are as follows:

- Confidentiality – ensure that transmitted and stored data cannot be read by unauthorized parties.
- Integrity – detect any intentional or unintentional changes to transmitted and stored data.
- Availability – ensure that users can access resources using mobile devices whenever needed.

**Table 1** Sample course mobile curriculum (Source: Wesley 2014)

| Sample course | Course credit | Program of study |
|---|---|---|
| Introduction to prog/logic | Three credit hours | Computer information system |
| Principles of security design | Three credit hours | Computer information system |
| Programming mobile design | Three credit hours | Computer information system |
| Introduction to security | Four credit hours | Computer information system |
| Mobile web design | Three credit hours | Computer information system |
| Mobility design | Four credit hours | Computer information system |
| Scripting | Three credit hours | Computer information system |



Students should have foundational concepts in security and concepts of risk, threats, vulnerabilities, and attack vectors, to name a few. Students must understand these concepts and must be able to apply the knowledge. The below sample design could be utilized to create a well-rounded program choice (Table 1).

Mobile technologies have been experiencing unprecedented growth and evolution, with no slowdown in sight, forcing management to rethink everything from infrastructure design to the details of integration with wired and wireless networks, and mobile certifications are following suit. Therefore, an educational institution offering a mobile applications curriculum should consider selecting a textbook that maps closely to the learning objectives of a certification exam in mobility. A certification credential certifies that you have the knowledge and skills required to compete in the global economy. The student will not only leave the educational institution with a degree but also a certification, a certification that says to the employer "I have the skills you seek."

CompTIA Mobile App Security+ is the first of two new mobile-centric certifications by CompTIA. The second will be the CompTIA Mobility+, a certification that is designed to validate an IT professional's skills for integrating, deploying, and managing a mobile computing environment. Both certifications were developed by the IT industry to meet workforce needs. Businesses perceive high value in accommodating mobile devices for their employees, but balancing end user expectations with IT requirements for reliability and security is a major challenge for many organizations. The CompTIA Mobility+ certification covers the knowledge and skills required to understand and research capabilities of various mobile devices and aspects of over-the-air technologies. This examination is suited for those individuals familiar with the operating system (IOS), software developer's kit (SDK), and principles of secure application development.

## 5 Certification

There are many mobile certifications on the market; for the purpose here, six of these certifications are listed, but the chapter will discuss in detail two that the author is most familiar with. Cisco Certified Network Professional Wireless, Citrix Certified Professional-Mobility (CCP-M), Aruba Certified Mobility

Professional (ACMP), VMware Certified Associate (VMCA), Workforce Mobility, and CompTIA Mobility Mobile App Security+ and Mobility+.

The CompTIA Mobile App Security+ certification covers the knowledge and skills required to securely create a native iOS or Android mobile application while also ensuring secure network communications. Students also learn how to create secure applications. This certification will allow a potential student to differentiate themselves as an applications developer and show integrity and commitment to keeping applications secure. Employers are confident that the students have learned and mastered fundamental skills in developing secure applications for Android and iPhone.

The CompTIA Mobile App Security+ can validate a developer's understanding of key security principles, features, and application programming interface (APIs) of the Android or iOS platforms. Android is an open source platform, meaning the underlining programming code is made public, but with some restrictions. This allows device manufactures, carriers, and others to modify the software, which gives them more flexibility in creating cutting-edge applications. The openness of the platform and the tools made available from Google encourage developers to write applications and also lead to quicker development. Applications developed from Android can be quickly submitted and made available on the Google market.

In order to prepare to pass the exam, one must have prerequisite knowledge of Objective-C programming (for the iOS exam) and Java programming (for the Android exam), plus SDK, structured query language (SQL) coding, mobile and app security essentials, and encryption implementation for the exam's specific operating system platform.

The CompTIA Mobile App Security+ exam tests a candidate's knowledge and skill regarding:

- Security principles, secure development life cycles, and threat models
- Security features of software development kits and APIs
- Service and network security
- Data security and implementing encryption
- Application hardening and reverse engineering
- Secure coding practices

The CompTIA Mobile App Security+ certification exam is now available worldwide. The exam is designed to validate that mobile application developers have the skills to securely create a native iOS or Android mobile app while also ensuring secure network communications and backend Web services available in an iOS edition and an Android edition. Candidates only have to pass one of the editions to become certified. The exam is ideal for individuals with a minimum of 24 months of mobile application development experience, including mobile application developers, software developers, network security developers, and application management developers. Careers in this field include but are not limited to the following:

Mobile application developer/software
Developer application

Development manager
Network security developer

The CompTIA Mobility certification exam is also available. The CompTIA Mobility+ certification covers the knowledge and skills required to understand and research capabilities of various mobile devices and aspects of cloud technology. This exam covers mobile device management, troubleshooting, security, and network infrastructure. It identifies IT professionals who can deploy, integrate, support, and manage a mobile environment while ensuring proper security measures are maintained for devices and platforms to mitigate risks and threats. Potential employers recognize the certification provided and know that the students can perform the desired task. Students can differentiate themselves as skilled in mobility issues. Mobile technology expert is ranked as fourth in the hottest IT careers list for 2014, according to InfoWorld. Potential careers include but are not limited to mobility engineer, network administrator, and mobility architect security administrator. This exam would only enhance a student's competitive advantage in seeking a career choice. There are no prerequisites for the exam, but it is recommended individuals have 18 months of experience in a mobile environment.

## 6 Future Direction

Mobile devices, including smartphones and tablets, enable users to access data anytime, anywhere. In 2013, individuals purchased 1.2 billion mobile devices, exceeding personal computers as the most common method for accessing the Internet. Mobile devices are the fastest growing computing platform, with an estimated consumer usage of 1.75 billion in 2014. Smartphone adoption is expected to continue on a fast pace through 2017. Nearly two-fifths of all mobile phone users worldwide will use a smartphone at least monthly in 2014. The growth of this new computing platform has outpaced the development of mobile applications.

Institutions find themselves in need of robust and practical mobility curriculum to train the current and future workforce with skills needed to program secure mobile transmissions and mobile devices. As education, business, and government continue to see the increased need in bring your own device(BYOD). The rise in technology labor associated with installing, administering, and supporting devices will continue to increase above 90 %. The rise in the purchase of smartphones totaling 62 % of the mobile market has helped create a new career pathway. The Internet of Everything has taken society by storm and also created a need for a skilled workforce. The need for skilled mobile professionals is greatly desired. Therefore, higher learning institutions must design mobile curriculum that will build a pipeline of skilled mobile professionals.

As bring your own device and mobility initiatives become a common occurrence in education, in the industry, and in the health arena, there is a critical need for skilled mobile technologist including the need for mobile application development (Babb and Abdullat 2012). The direction that educational institutions must follow is very clear: students must be trained for a career in computer science, specifically in mobile design, to address the workforce needs of today and the workforce needs of tomorrow.

A current and comprehensive course content is imperative to provide a skilled pipeline. The need for computer science professional will continue to grow by 50 %. Threats on government, business, and individuals will continue to increase, creating a need for more skilled technologist and mobile professionals.

Lastly, technology organizations are seeing a niche in the market for security software specifically designed for mobile operating systems. Ensuring that student received current content and practical applications in mobility courses will allow for a stable pipeline of technology professionals in the workplace presently and in the future. Security of these mobile devices is a major concern for organizations. The two leading mobile operating systems (OS), Google's Android OS and Apple's iOS, both have security concerns as do the mobile applications and the major application markets. "Bring your own devices where employees supply their own equipment for work-related purposes" can cut costs for organizations, but failing to address security can significantly increase those costs.

The major advantages of mobile learning include greater access to appropriate and timely information, reduced cognitive load during learning tasks, and increased interaction with other people and systems. It may be argued that network mobile devices can help shape a culturally sensitive learning experience that can offer additional and, possibly, more powerful means of encoding, recall, and transfer. In addition, it is very important to consider the development of learning objects as well as the recognition of learning styles, cognitive processing, and motivation of learners (Koole and Ally 2001). There is an immediate need to develop mobile curriculum to meet the needs of the industry and education. It is imperative that the curriculum be designed to address the skills currently needed and the skills that may be transferrable to unknown skill needs of tomorrow. Education entities must establish a culture of highly trained technology professionals that can address the mobility skills gap.



## 7 Cross-References

► Characteristics of Mobile Teaching and Learning
► Design Considerations for Mobile Learning
► Design of Mobile Teaching and Learning in Higher Education: Introduction
► Development of Mobile Application for Higher Education: Introduction

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# Framework for Design of Mobile Learning Strategies

# 6

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## Contents



**Abstract**

In the current peak of development and implementation of mobile applications in educational settings, it is becoming an urgent matter to propose pedagogical approaches that address the complex educational dynamics for mobile teaching and learning. Previous studies have suggested different models to implement mobile technologies in educational settings. However, few of them recognize the specific reality of an educational setting and the difficulties that must be assumed by teachers in mobile teaching design and implementation. Consequently, this book chapter examines theoretical and empirical work of previous proposals in order to develop a framework of M-learning aimed at teachers who want to innovate their learning environments using mobile devices. To this end, a theoretical and empirical validation of the proposed model in order to design a framework that addresses practical aspects of the

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context of teachers without forgetting the pedagogical use of mobile technology was conducted. Finally, the results and conclusions of this proposed model are expected to contribute in the construction of an educational model for mobile technology integration.

## 1 Introduction

It is well known that since the last decade and thanks to the information and communications technology (ICT) revolution, society undergoes a transformational process that has modified the way we relate, work, organize, and learn (Marcelo 2001). It is a society characterized by its network structure (Castells 1997), plus the abundant and permanent circulating information, where knowledge is flexible, fluid, and in constant expansion and movement (Hargreaves 2003). But, above all, it is a society that demands citizens with new competences and skills. These can enable them to be active part of it, as well as to manipulate and update knowledge, to learn continuously, and to adequately choose data. In addition, this networking society also demands citizens capable of adapting to the quick social, cultural, and production transformations, whether material or knowledge type, highly based on ICT development and implementation in every daily sphere.

In order to face the historical and social traits of each time, society has made education responsible for the formation of future citizens. However, different from preceding centuries, for the first time students have more abilities than their professors for accessing, manipulating, and transforming data. This situation is generating a school revolution and a rushed race in which many teachers have done their best for incorporating the most recent information and communications technologies for not appearing to be behind their pupils. Nevertheless, quite often they do not know how to do it, and many of them quit their attempts since they perceive the process is not as simple as it appeared to be in countless accessed blogs and websites.

But the dilemma with this “race” is that the teaching exercise cannot be seen as such. It must not exist a tension among teacher, students, and resources. On the contrary, the relation between teacher and students should be seen as an aggregate of efforts in which the students’ skills are headed to a joint work. And the teacher becomes a strategist who sees his students’ potential and links it to the available resources according to an adequate strategy that serves defined goals. The students technological affinity makes them keen on teaching models that day by day involve more digital technologies and develop into useful means for innovating the teaching practice. Under this premise, the M-learning may be seen as a model of this joint work of ICT with teaching practice. M-learning includes the use of mobile devices – very popular among students – access possibilities, data management, and mobility that might broaden variety and the very same conception of activities that can be done by the teacher.

In order to understand these possibilities and the practical reality of the M-learning, it is necessary to be thoroughly clear about its conception, implications, and implementation as learning framework. Hence, this article has done an analysis of different theoretical proposals (Sharples et al. 2005; Parsons et al. 2007; Liu et al. 2008; Mohammad et al. 2007; Nordin et al. 2010; Ozdamli 2012), in order to recognize the diverse factors and elements that must be accounted for when conceiving M-learning experiences. These proposals and their results provide an important basis of the present work for designing ICT-mediated learning environments. Additionally, they contribute to the analysis developed here to formulate a procedure that may be used by any teacher or education institution for designing more significant mobile learning strategies.

The departure point is the theoretical frame of M-learning and its implications; secondly, the previous works presented by the authors are taken as reference frame. The next section presents the conceptual elements used and the proposed framework, to finish presenting some conclusions and proposals for future works.

## 2 Mobile Learning

In order to understand the implications of mobile learning, first of all it is necessary to acknowledge what the diverse authors who are working on this topic say about it. For some of them (Caudill 2007; Pinkwart et al. 2003; Mostakhdemin-Hosseini and Tuimala 2005; Georgiev et al. 2004; Keegan 2001), M-learning can be seen as an extension of the E-learning because it is an E-learning supported on mobile devices (Quinn 2000). For some other authors, it is a support of the in-classroom processes (Wang 2004; Mutlu et al. 2005; Walsh 2010).

Nevertheless, for the present work M-learning is much more than the abovementioned, coinciding with Sharples et al. (2005), who proposes that in order to understand M-learning, it must be acknowledge that the learning process exceeds the physical frontiers of the classroom and the education institution. Likewise, it should be understood that students learn anytime, anywhere, when they go or are somewhere, taking an idea or resource from the context and relating or applying it to other contexts, or relating previously acquired knowledge to present processes (Sharples et al. 2005).

Thus, designing M-learning experiences firstly implies the teacher awareness on the education process nature, based on mobile devices, and the identification of their limits as well as their multiple benefits (Parsons et al. 2007; Liu et al. 2008; Mohammad et al. 2007; Nordin et al. 2010). Finally, the teacher must reflect on his teaching practice and the learning experiences he wants to encourage in his or her students, plus the relationship among the benefits he hopes to acquire facing the effort he must do. In a nutshell the quid lies on acknowledging and understanding the weaknesses and strengths that may rise when incorporating mobile learning strategies (Motiwalla 2007; Ellis 2003) as the product generated from the permanent reflection on the educational practice of the teacher.

## 3 Model Design

The model here proposed is part of a research project focused on design mobile learning strategies. However, at the early stages of the project, it was necessary to formulate and validate a new model because the existing models, by themselves, did not respond to the needs of the project. Then, this is the followed process:

First, a review of previous studies that have discussed and designed mobile learning strategies was conducted (Sharples et al. 2005; Parsons et al. 2007; Liu et al. 2008; Mohammad et al. 2007; Nordin et al. 2010; Ozdamli 2012). The conclusions of the review, in light of the project needs, pointed that although each of the proposed models contributes significantly to the process of designing M-learning strategies, those contributions are wide-ranging from a conceptual stand. Consequently, these models failed to connect with the particular necessities and expectations that can be found in different educational contexts. In other words, these models did not take into account that any teacher must be able to reflect on his pedagogical exercise that, in turn, generates a mobile learning strategy design significant for the educational context.

Secondly, the process followed by the authors for designing ICT-mediated learning strategies and environments was contrasted against the processes proposed by Sharples et al. (2005), Parsons et al. (2007), Liu et al. (2008), Mohammad et al. (2007), and Nordin et al. (2010), for designing mobile learning strategies. This contrast's findings evidenced that the present framework proposals as well as the designing process used by the authors were supplementary, so it was better to design a new unified framework.

Next, a new model of mobile learning strategies that unifies the theories of the main proposed models was designed. Additionally, it offers teachers a clear process departing from recognizing the nature of M-learning and carrying it to the design of an M-learning strategy capable of supporting or supplementing his teaching practice.

Afterwards, the framework was validated by a board of eight experts on integrating ICT to teaching processes attached to the Academy Technology Center of La Sabana University. The proposed framework was presented to these experts, and they were asked to assess it from the process they would follow when designing ICT-mediated learning strategies, as well as in light of their experience on integrating mobile devices in academic processes. This validation's results were useful for adjusting some aspects of the framework regarding the elements that needed to be considered in each of the stages, as well as these stages' names.

Finally, based on the theoretical validation, a practical validation took place departing from three different scenarios. The first one was done through designing the mobile learning strategies that were used in the research with junior school students coming from two educational institutions of the municipality of Chía, Cundinamarca State, Colombia. The second one was the model used for university teacher training on designing mobile learning strategies, thus encouraging the proper use of these devices in academic processes. The last one was used for training students of master's in computer science in mobile learning strategies design, as topic of the course *Teaching and Learning in the Knowledge Society*.

## 4 Model Background

For developing the present framework, a review of the previous proposals aimed at guiding the structural features of this framework, as well as assessing its range and relevance according to the M-learning concept presented in this chapter, was conducted. The final result was a grounded and updated proposal that includes an inductive analysis on the incorporation of mobile devices under a pedagogical strategy. The contribution is a detailed elaboration of the process that permits the reflection on the different stages of the M-learning project development from an educational and nontechnological perspective. It is important to highlight that the evolution of M-learning models has made their way from the technological problem-solving viewpoint more than from an educational perspective. Some proposed systems outline designs focused towards the technological process of information systems that allow sending data and the needed infrastructure for developing these processes like the models of Kinshuk (2004) and Barker et al. (2005), which in spite of it are taken into account due to significant technological implications. As described in detail by Maniar and Bennet (2007) and Yong et al. (2010), there still are several restrictions that must be accounted for with mobile devices when analyzing M-learning like screen size and resolution, storage, bandwidth, processing speed, and battery life, plus interoperational and standardization software aspects.

In addition, there were found models focused on the adoption and attitude facing new technology, for example, Shih's Mobile Learning Model (Shih and Mills 2007) that considers mobile devices as elements that may motivate students. This model is based on a motivational design under the use of collaborative discussions and interactions on mobile devices. The sequence is built as a cycle where activities are developed to generate motivation, relevance, satisfaction, and trust in the developed processes. Likewise the Technology Acceptance Model (Davis 1989), which has been accepted for diverse M-learning experiences (Ha et al. 2007; Yong et al. 2010; Liu et al. 2010; Suki and Suki 2011), is focused on technology adoption departing from considering some variables such as: perceived usefulness, perceived ease of use, attitude, behavioral intention, and actual usage, which are key points for learners adopting technology in a learning environment.

Besides the motivational aspects, some other models are organized according to their function in the learning environment. As already mentioned, it could be taken as support of the learning activities. For Lan and Sie (2010), the M-learning is a learning model that enables students to obtain learning resources anywhere and anytime through communications, mobile devices, and the Internet. These authors claim to have found, in an experience review, diverse learning activities supported by mobile devices that include "(1) improve communication and collaborative interaction, (2) provide more learning opportunities for geographically dispersed persons and groups, (3) encourage active learning, (4) enhance learner's feedback process, (5) emphasize time on task, and (6) acquire content quickly" (p. 723).

However, beyond the particular aspects about using mobile devices in a learning environment, it is necessary to analyze an M-learning model in light of the very same teaching practice complexity, the generated interactions, and the institutions', individuals', and resources' roles, as well as the distinctive features entailed by taking learning out of the classroom under the "anytime anywhere" learning model. Taking into account this characteristic, Parsons et al. (2007) designs a model that includes four perspectives: "generic mobile environment issues, learning contexts, learning experiences, and learning objectives" (p. 1). Taking this model into practice, it is able to evidence the significance of design and context when implementing an M-learning model and to describe in detail elements of each of the perspectives that must be observed when designing mobile learning environments in all their stages.

In his proposal of generating an M-learning theory, Sharples et al. (2005) go a little deeper into the meaning and sense of the "coming to know" process, starting from analyzing the link learning – technology for which they depart from a reflection process that allows them to differentiate what is "special" in the mobile learning compared to other learning activities. This point turns out to be the core aspect to understand the need of generating an M-learning model as well as to assess time, space, communications, data, and technological interactions that go under changes in such a model. In addition, they ponder to consider the amount of learning processes that occur out of the formal educational scenarios. Particularly, focusing in those interactions where students engage with their surroundings to create impromptu learning spaces anywhere they are. This finally entails the need of a learning theory that takes into account the current practices that generate successful learning and that considers the ubiquitous use of technology. It ends up to be an M-learning theory based on the learning analysis "as a cultural-historical activity system, mediated by tools that both constrain and support the learners in their goals of transforming their knowledge and skills."

These developed aspects enable us to clarify some of the complexity associated with a learning process with mobile devices, aspects that turn to be the core element of the proposal developed in this chapter. The present framework attempts to approach more thoroughly the process of M-learning designing starting from the teaching practice. The main purpose is to clarify the theoretical relationship of learning models with mobile devices heading it to specific actions developed by teachers when designing learning environments and strategies.

## 5 Bases of the Proposed Framework

As can be seen in Fig. 1, the framework is divided into six stages: recognition, analysis, identification, bases, design, and implementation. Each of them has been designed as part of a process to be followed by the teacher and/or tutor to build effective mobile integration strategies. This process aims mainly to respond to his educational context needs, although integration purpose in the strategy is rooted by broader society's trends regarding ICT incorporation.

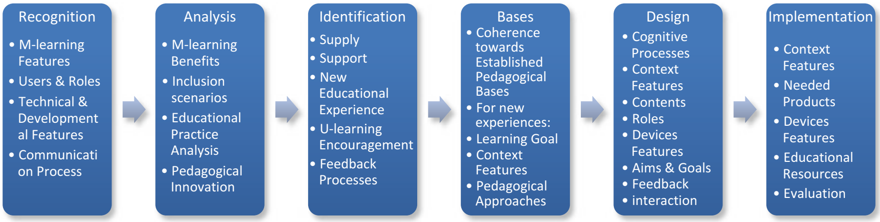


**Fig. 1** Framework for mobile learning strategies design

## 5.1 Recognition Stage

The first stage, *recognition*, suggests that for designing learning strategies supported or mediated by mobile devices (M-learning), as proposed by Parsons et al. (2007), Liu et al. (2008), and Mohammad et al. (2007), it should depart from what M-learning is in terms of its own features:

*Mobility*: it enables the teacher as well as his students to be in touch when they are out of the conventional face-to-face communication spaces as the classroom or inside the educational institution.

*Ubiquity*: it is the feature that enables learning process generation anywhere, anytime, thanks to the services available for these devices.

*Contextualized processes*: it is the feature that allows designing and implementing learning strategies in which the context or scenario becomes an active and significant actor in students learning process.

*Active learning support*: applications for mobile devices are designed for encouraging processes of communication, interaction, collaboration, and collective construction among devices' users. Additionally, they also allow users to have a personalized experience that contributes to make them the center of the learning process.

*Diversity*: it is the feature offered by mobile devices, in contrast with laptops or desktop computers, because they include a wide range of options in hardware and software resources for strategies designed by teachers.

*Augmented contents*: it is the characteristic that enriches didactic contents, activities, and strategies implemented on these devices, thanks to the great diversity and services offered for them.

Likewise, this first stage coincides with the ideas of Sharples et al. (2005), Parsons et al. (2007), Liu et al. (2008), Mohammad et al. (2007), and Nordin et al. (2010) regarding the recognition of the different users of these devices as well as their role in the learning process. It also coincides with Parsons et al. (2007) and Nordin et al.'s (2010) proposal on the recognition of technological needs and implications involved in the development like graphic interphase and adequate handling of audiovisual resources, even though they claim that there are many other aspects to bear in mind:

*Compatibility*: because there is a huge diversity of devices and operational systems in the market that separately demand different hardware and software.

*Diverse operational systems*: they, as well as their different versions, make some applications and services only available for some students.

*Connectivity*: neither the teacher nor the students have the same network content access level, and it could generate difference regarding what students can or cannot do.

*Processing capacity*: this feature, associated to memory capacity, implies that any teacher development will take longer execution or opening times of the demanded resources in some devices than in some others.

*Memory capacity*: most devices have limited RAM capacities, making their execution of operations difficult, and simultaneously play videos and images.

Finally, in accordance with Parsons et al. (2007), this stage proposes a careful thinking on the different aspects related to the communication process between teacher and students and among students.

## 5.2 Analysis Stage

This stage proposes the teacher to ponder about the students' learning benefits of incorporating mobile learning strategies in his teaching practice. However, it is important to point out that this incorporation must coincide with a thoughtful position of the teacher about how, when, why, and what for they are included in his teaching practice as well as the possible changes which might occur as a result of mobile learning strategy integration.

From this process, the teacher must reflect on his educational practice reality, i.e., on what learning is for him, his students' characteristics and expectations, his own expectations, and the educational strategies and resources he is able to incorporate, plus the way of assessing his students' learning (Colomina et al. 2001). It is worth mentioning that including M-learning is not an isolated process of teaching, and it is precisely in this thinking where the pivot lies in which the present teacher proposal and the M-learning strategy formulation spin around.

In the end, after that careful thinking, the teacher must come to a decision on whether it is better to design a mobile learning strategy oriented towards supporting or supplying his didactic strategies or, on the contrary, to design an M-learning strategy oriented towards generating a pedagogical innovation. In this way, different from Nordin et al. (2010) proposal, the teacher is expected to understand the M-learning before deciding on his strategy core theories, and, based on that, to recognize its function in the educational context and pedagogical goals. Nevertheless, this proposal coincides on the importance of including, in any mobile learning strategy development model, the careful thinking on what is the most suitable learning theory for supporting the didactic strategies to be used.

### 5.3 Identification Stage

This stage proposes that the teacher, at this point, must decide if including M-learning will be done for supporting or supplying a didactic strategy already designed or if he is about to propose a new educational experience. In order to make that decision, the teacher must follow an analysis process that includes the general characteristics of the educational context, learning goals, appropriateness of changing his current strategy, benefits and drawbacks of doing a new intervention, and actions to be taken when deciding on one of the proposed ways, among others.

However, aside from the decision made, the next issue to ponder about is whether the strategy about to be used is aimed at surpassing the traditional space frontiers of the educational process or if, on the contrary, it will be held inside the institutional area. The already mentioned decision is crucial because carrying on a ubiquitous education process or U-learning implies the teacher planning ahead diverse issues, for example, communication processes, geospatial location of resources, activities and contents, counseling process, query solving, and assessment, plus didactic sequencing plan to be followed over nontraditional spaces and its relationship with what is going on inside them, among others.

Moreover, it is important that at this stage the teacher decides how to develop the feedback process by determining times, tools, and strategies to be used. For example, in order to pursue a feedback strategy where students were asked to propose a problem solution, it can be decided that this process would take place across pseudo-real time over an instant messaging application like WhatsApp. It can also be decided that feedback for all the students would be individual through a group created for that aim so all the students would learn through the process.

### 5.4 Bases Stage

The fourth stage, bases, proposes the teacher can follow two different ways based on the decision made at the identification stage. *If the decision is supporting or supplying an already designed strategy*, firstly its pedagogical bases should be revised for assuring that the devices' activities or processes engaged are in agreement with these bases. The next stage consists in establishing a learning goal for these activities, activities that later should be formulated taking into account the targeted population features, as well as the context in which they will be held.

For example, the type of relationship between context in which the experience takes place and the contents, resources, and activities that students will develop there must be decided. Likewise, the characteristics of the population must be established, like study level, technology uses, type of communication, and other elements that could be significant for the proposed activities.

In contrast, *if the teacher decision is to generate a new experience*, the process must start by formulating one or more learning goals. In this point, the possible pedagogical approach or approaches that will be used for designing the mobile

**Table 1** Mobile learning strategy bases

| Mobile learning strategy bases | | | | |
|---|---|---|---|---|
| *Learning strategies* | *Pedagogical approaches* | *Population features* | *Environment features* | *Possible activities* |

learning strategy must be decided. Also, general features of the population and the environment where the strategy will be held must be considered. Lastly, a list of possible activities that may be used is proposed.

Moreover, in any of both scenarios, at the end of this stage, he must provide a table, as the one shown next, describing learning strategies, pedagogical approaches, possible activities, and the most relevant features of the population and environment where the strategy will be developed (Table 1).

## 5.5 Design Stage

This stage proposes the teacher to design, at this point, the mobile learning strategy. According to Parsons et al. (2007), Liu et al. (2008), and Nordin et al. (2010), it is necessary to decide and to organize the content to be used, the aims and goals to be reached, interaction processes and feedback processes, as well as the tools to be used, all aimed at achieving the purpose.

Even though different from the proposals of Sharples et al. (2005), Parsons et al. (2007), Liu et al. (2008), Mohammad et al. (2007), Nordin et al. (2010), and Ozdamli (2012), this stage proposes the teacher to decide the cognitive processes he wants to encourage or strengthen along with the strategy, as well as the role of devices, students, and teacher. Next, each of these elements will be discussed:

*Cognitive processes*: the significance on deciding and acknowledging the cognitive processes to be strengthened by means of a mobile learning strategy is grounded on two elements: first, where the teacher must establish a relationship between activities and student’s cognitive processes that he is interested on strengthening and, second, where the teacher must be able to contrast the cognitive development level of his students with the activity type he wants them to develop.

*Computer skills*: the teacher should identify the computer skills among the population where the mobile learning strategy will be held. This diagnosis will ease the teacher decision on whether to undertake a training process prior to implementing the strategy.

*Contents*: the teacher must decide on the content, resources, and their depth level in order to achieve the strategy objectives.

*Roles*: the teacher must decide his students, the mobile devices’ and additional tools’ roles, as well as his own role in the strategy.

*Aims and goals*: the teacher must decide each of the learning aims and goals for each of the activities to be developed with the strategy.

**Table 2** Mobile learning strategy design

| Mobile learning strategy design | | | |
|---|---|---|---|
| *Learning goals* | | | |
| *Pedagogical approaches* | | | |
| *Population features* | | | |
| *Educational context features* | | | |
| Needed cognitive processes | | | |
| Cognitive processes to reinforce | | | |
| Topics | | | |
| Computer skills | | | |
| Contents | | | |
| Resources | | | |
| Activity 1 | *Description* | | |
| | Aim and goal | | |
| | Feedback | | |
| | Interaction | | |
| | *Environmental features* | | |
| Activity 2 | *Description* | | |
| | Aim and goal | | |
| | Feedback | | |
| | Interaction | | |
| | *Environmental features* | | |
| Roles | *Students* | *Teacher* | *Devices* |

*Feedback*: as already mentioned, it is crucial that the teacher sets the mechanisms and tools he will use in order to do his student feedback process, as well as the time for it and the activities that will receive individual or group feedback.

*Interaction*: lastly, it is necessary to decide how the interaction process will be held among students and between teacher and students, as well as the tools to be used for that purpose.

At the end of this stage, as what happened in the previous stage, the teacher should have a chart with the following labels (Table 2):

## 5.6 Implementation Stage

This last stage proposes the teacher, before implementing the mobile learning strategy, must decide what are the educational resources demanded by the strategy. Accordingly, he must assess which of them are available on the net to be easily reused or adapted and which of them must be produced. In the same way, it is necessary to establish what educational products, tools, applications, or materials are available to be used or which of them need to be adapted or produced for diverse platforms (Table 3).

**Table 3** Mobile learning resource implementation

| | | | |
|---|---|---|---|
| Resource 1 | *Description* | | |
| | Activity | | |
| | Reusing | *Adapting* | *Producing* |
| Resource 2 | *Description* | | |
| | Activity | | |
| | Reusing | *Adapting* | *Producing* |
| Product1 | *Description* | | |
| | Activity | | |
| | Reusing | *Adapting* | *Producing* |
| Tool 1 | *Description* | | |
| | Activity | | |
| | Reusing | *Adapting* | *Producing* |

Lately, there has been an important movement that insists in a more collaborative work between teachers and promotes the use of resource repositories to share "reusable learning objects" or RLOs. However, recent research has raised questions regarding benefits in the reusability approach in teaching and learning (Sweet and Ellaway 2010). Accordingly, the assessment between creation and reuse of learning objects is a key factor for the following implementation. Unfortunately, the scope of this chapter is limited to the general implications of the stage and does not include the foundations for assessing or developing resources. But a careful examination of the potential impact of the decision taken in this stage is suggested, both from the pedagogical point of view and on the practical considerations for implementing the learning strategy.

The foregoing is important because the context can play a significant role in shaping the experience with mobile devices. For instance, in some rural areas of Latin America, there is very low or no Internet connectivity, which can affect the intended use of some resources that rely on network access. Given these difficulties, a good learning experience could be transformed in a stressful experience for teachers and students. In a recent implementation with a group of 300 teachers of Fusagasugá (a small city in Colombia), this framework was validated. This stage was essential to analyze and modify educational resources according to the proposed strategy, the schedule to implement, and the infrastructure and connectivity available on every educational institution. In some cases, when the context has a strong impact on the effective implementation of the strategy, it is recommended to produce particular resources or, at least, make use of customizable resources that can be adapted to required situations.

Finally, the last point of this stage is to encourage teachers to reflect on the evaluation process, responding to questions about what, when, and where to evaluate. The natural flexibility of mobile devices and a good learning design opens up new possibilities for learning and teaching. However, the final results depend on a consistent relation between the different stages of design and an adequate implementation.

## 6 Future Directions

This work has presented and discussed a theoretical frame for designing mobile learning strategies and has taken as its departure point those works done by diverse authors such as Sharples et al. (2005), Parsons et al. (2007), Liu et al. (2008), Mohammad et al. (2007), Nordin et al. (2010), and Ozdamli (2012). It has also taken into account the process followed by its authors as teachers when designing learning strategies mediated by ICTs.

Nevertheless, different from the theoretical proposals presented by the mentioned authors, this work is oriented towards offering teachers and researchers interested on mobile learning theoretical and practical tools that enable them to design and implement mobile learning strategies that might support or supply their teaching practice.

Likewise, it has been stated how important it is for designing significant mobile learning strategies that the teacher is aware of the educational process nature mediated by mobile devices, of its limitations and benefits. As a result, the teacher would be able to benefit from the current natural relationship between students and mobile devices.

Similarly, three different ways of integrating mobile devices to teaching-learning processes have been introduced. The first one consists in doing it as supporting the ongoing process developed by the teacher by including new communication channels. The second one consists in using it as supplying the ongoing process developed by the teacher through activities that might not to be done in the classroom by the students and that supply their educational process. The third and last one is to incorporate a new learning strategy in such a way that the teacher innovates his teaching practice.

It is worth mentioning that eight experts in ICT's integration to educational processes, coming from the Technologies for the Academy Center of the University of La Sabana, firstly assessed the proposed framework; they requested some adjustments regarding the location of some of the framework components but not about including or suppressing any of them.

However, the practical evaluation of it is being held by ten teachers in charge of different educational levels, who are also students of master's in computer education at the University of La Sabana and who are members of the research area on designing learning environments mediated by ICTs. The results of this implementation will be published in a subsequent work.

Likewise, the results of the present work are being used for designing an educational process oriented towards higher education teachers whose main goal is contributing to design mobile learning strategies as significant for the teacher as for his or her students. If the teacher departs from a deep understanding of M-learning, it will enable him or her to design mobile learning strategies that fit the needs of the population.

Based on the results achieved in the mentioned processes, the framework will be adjusted and research projects will be designed for deciding how much the teacher understanding of M-learning contributes to designing significant mobile learning strategies for students and deciding on those processes that contribute to developing good practices by teachers.

## 7 Cross-References

- ▶ Adoption of Mobile Technology in Higher Education: Introduction
- ▶ Characteristics of Mobile Teaching and Learning
- ▶ Design Considerations for Mobile Learning
- ▶ Design of Mobile Teaching and Learning in Higher Education: Introduction
- ▶ Designing a Mobile Applications Curriculum: Overview
- ▶ Development of Mobile Application for Higher Education: Introduction
- ▶ Evaluation of Mobile Teaching and Learning Projects: Introduction
- ▶ Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom
- ▶ Mobile Learning and Engagement: Designing Effective Mobile Lessons
- ▶ Transformation of Traditional Face-to-Face Teaching to Mobile Teaching and Learning: Pedagogical Perspectives

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# Gamification and Mobile Teaching and Learning

# 7

Keith Brophy

## Contents



**Abstract**

In conjunction with rapid technological advances in mobile web-enabled devices, the concept of applying gamified strategies and mechanisms to online learning contexts is gaining widespread interest and adoption. Aspects of gamification are now applied across many areas of life – business, health, politics, and community. The gamification of the consumer and social web already provides many examples where game concepts have been integrated in nongame contexts in order to engage and motivate users and enrich their online experiences. A well-designed gamification strategy within online education seeks to translate these positive experiences to further encourage and enhance the student learning experience. The core elements of games (rules, feedback systems, and voluntary participation) are integrated into the learning activities. As technology enhanced learning becomes a pivotal component of educational practice, learning experiences are increasingly designed to include online and digital elements. Mobile web-enabled devices are a natural complement to this

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transition, enabling new ways for students to interact with subject material. The nature and capabilities of these devices further enables the possibilities of gamifying learning activities by unobtrusively encouraging and motivating the student in a familiar context. The successful integration of a gamified learning experience requires it to be part of a well-defined plan that promotes collaboration, research, systems-thinking, and problem-solving skills. Overall, the gamification strategy must align with the desired learning outcomes and avoid detracting from the core learning activity. In the future, the proliferation of gamification will continue within education and beyond – with the potential to engage, motivate, and build new collaborative, cross-disciplinary communities.

## 1 Introduction

Collectively, the planet is now spending more than three billion hours a week gaming (McGonigal 2011). With the rise of mobile internet enabled devices, this number is set to increase as continuous access to games (from 10 s mini-games to elaborate, immersive virtual worlds) is now possible anytime, anywhere. With such interest and energy expended in the gaming world, there is a growing movement seeking to harness the power and potential of gamification – the application of games, game design, and game concepts in nongame contexts.

People are seeking and finding engagement, motivation, fulfillment, and social bonding in and through the structured world of games. Through the utilization of game design and mechanisms, it is envisioned that these positive experiences and results can be extrapolated to other situations.

The accelerating adoption of mobile internet enabled devices, along with rapid advances in their functionality and capabilities, further enables the possibilities of gamification – with the potential for applications and implementations in all quarters of life, including business, politics, health, and education.

### 1.1 Gamification

At their core, all games share four defining traits: a goal, rules, a feedback system, and voluntary participation (McGonigal 2011).

The goal defines a specific achievement that players work towards, focusing attention and providing the player with a sense of purpose. The rules impose boundaries and restrictions as to how the goal may be achieved. The rules force the player to explore the options available in order to progress towards the goal and, as a result, can help foster strategic, systems thinking. The feedback system informs the player as to the results of their actions as filtered through the rule system. It also indicates progress made (or lost) in moving towards the goal and can motivate the participant to continue or re-evaluate their approach. Voluntary participation encompasses a mutual acknowledgement and acceptance of the goal, the rules, and the feedback system, providing a common ground for the players involved.

Gamification is the application of these core game concepts and other mechanisms in nongame contexts and activities. Elements of gaming such as rules, competition/ranking, reward systems, progress indicators, and community collaboration are applied to nongame activities with the intent of engaging, influencing, and motivating participants to achieve goals.

In the age of big data, with a focus on gathering and processing quantitative information, gamification also has the potential to provide a new source of activity data. Through the setup of appropriately designed gamified components and systems, participants and observers can monitor, compare, and review progress and levels of engagement, motivation, understanding, and achievement. A suitably defined gamified system has the potential to provide real-time feedback, allowing the system designer to adjust system controls and participants to review their understanding and interaction with the system.

While the term gamification is relatively new, the practice of using game-like mechanics in nongame contexts is not. Gamified systems are already prevalent in many different areas and guises: school prizes for perfect attendance, awarding scout badges for mastering skills, store loyalty and airline frequent flyer programs. Harnessing a user-centered design, these gamified systems seek to engage and motivate participants towards specific goals.

The workplace and corporate management are also adopting gamification strategies to engage and motivate workers and increase morale, quality control, and productivity. Major corporations are already utilizing gamified strategies with gamified performance reviews, game-like training simulations of work tasks, and recruitment games used to gauge skills of potential employees.

Within the areas of science and medicine, gamification techniques are being used to transform our understanding of and how we interact with complex problems. Breakthroughs in virus research have been accomplished through crowdsourced online games, while surgeons can practice operation procedures virtually on their mobile devices.

Taking cues from the world of computer gaming, applications in the digital space are increasingly developed with gamified elements at their core. While questions have been raised as to the appropriate application of and overall impact of gamified strategies, the available empirical research on gamification largely supports the popular view that gamification does produce positive effects, but many caveats exist (Hamari et al. 2014). Further, it is envisioned that digital strategies around gamification within higher education are set to be incorporated into technology planning and decision making over the next 2–3 years (Johnson et al. 2014).

In the broader space, the social web and mobile applications provide some context to the impact of game strategies used to connect, foster engagement, and motivate users. The advent of web-enabled smart phones and tablet computers further enabled the use of game mechanisms in this space, allowing people to more easily collect, share, and compare data of all types – generally through a gamified filter of global scoreboards, progress bars, and achievement awards.

A gamification strategy requires careful design and implementation in alignment with the core activity. Proponents of gamification suggest that, when appropriately and intelligently applied, the strategy can produce positive results and reinforce the experience or outcome of the activity – engaging, motivating, and instilling collaborative system-thinking and problem solving skills in participants. Detractors submit that gamification may trivialize the activity itself, leaving participants disillusioned with a false sense of achievement with the potential to deter participants who do not embrace game systems or mechanics.

As technology enhanced learning becomes a pivotal component in the development of education, the combination of mobile devices and gamified learning activities offers new possibilities in enriching student engagement and learning experience. The game mechanics design needs to be carefully aligned with the intended learning outcomes. The gamified elements should not subsume the principal goal of the activity and thereby compromise the core activity goals and experience.

## 2 Gamification in General

With the rise of the social web and mobile applications, gamification has been employed in many different areas from health and fitness to social location sharing to online learning, with varying degrees of success and failure. The gamified experience across these applications seeks to encourage user participation through continued interaction with the application and motivation to achieve new goals.

### 2.1 Foursquare

One of the most successful implementations of gamification in the online context is evident in the social location-sharing application, Foursquare. At its core, Foursquare allows users to confirm and share their location. The advent of web-enabled mobile phones helped advance this idea further – allowing users to more readily check-in and share their location with other users.

The application employed three main gamification elements:

- *Badges* – virtual badges awarded to users in relation to the type of check-in location (e.g., airport, coffee house, etc.), number of check-ins, or event occurring at the location. The act of unlocking a new badge could be shared with other users, while the badges were stored against a user's profile as a virtual trophy cabinet.
- Mayorships – virtual mayorship titles awarded to the user with the most frequent check-ins at a location. Retail and service operators capitalized on the marketing and indirect endorsement related to mayorships by further rewarding this loyalty with physical discounts and special offers to the "mayor."
- *Points/Scoreboard* – the points leaderboard ranks users with a scoring system based on check-ins. Users were ranked against their Foursquare friends – further encouraging users to make more check-ins.

While these elements initially helped amass five million users with 3,400 % growth in 2010 (Foursquare), Foursquare gradually revised the user experience as users realized that, ultimately, little was gained from earning badges or mayorship titles as the Foursquare user base grew. With a major redesign in 2012, the application focus moved to social interactions and consumer offers. Later still in 2014, Foursquare acknowledged the breakdown of the game mechanics as the virtual recognition associated with check-ins, badges, and mayorships became arbitrary and less reflective of real-world achievements when rated against the global user base (Foursquare Blog).

Foursquare ultimately ported the majority of the game mechanics to a separate application (Swarm), with a greater focus on direct friend and neighborhood interactions. Having already amassed substantial location based data, the Foursquare application itself has been relaunched as an exploration and recommendation engine, focusing heavily on personalization and customized experiences.

Foursquare provides evidence that gamification mechanics can be extremely powerful in engaging and motivating users, but the progression of the application highlights how over reliance on the gamified experience can subsume the primary activity and detrimentally affect user participation.

## 2.2 Foldit

The study of protein structure prediction and design is a complex scientific task that is key to advancing understanding of how living cells work and the development of new medicines. Developed by the University of Washington's (UW) Center for Game Science and the UW Department of Biochemistry, Foldit is an online video game simulating protein folding. The objective of the game is to fold protein structures into the most compact and stable states that they can adopt.

The online game is presented with a set of rules based on the nature of proteins and how they can be folded. The feedback system is visualized through the online user interface, enabling participants to create and experiment with new designs, while ensuring adherence to the rules. The overall goals of the game include predicting protein structure and the design of new proteins. Following a crowdsourcing model, the game allows participants to share and collaborate on protein designs – allowing for evolution and discovery of superior structure predictions and designs. The competitive scoring of designs acts as an incentive for participants to develop the optimal design and encourage continued involvement with the project. The highest scoring solutions are then analyzed by researchers, who determine if the design might apply to "real-world" protein structures.

Seeking to harness the power of humans' innate puzzle-solving and pattern-recognition abilities, Foldit provides a gamified context to address a very real and complex task. Extracting complex scientific rules and processes into a new context, the problem space is opened to a wider audience as a result.

The results of the game provide very real social benefits. In 2011, following a number of failed attempts to solve the crystal structure of M-PMV retroviral protease (an AIDS-causing monkey virus) by molecular replacement, Foldit players were able to generate models of sufficient quality for successful molecular replacement and subsequent structure determination (Cooper et al. 2012). The results provided new insights for the design of antiretroviral drugs.

## 2.3 Wearable and Smart Devices

With mobile technology increasingly becoming an integral part of day-to-day life, wearable technology and smart, self-quantification devices are further bridging the digital/online crossover with the physical world. Harnessing the possibilities and advances in mobile technology, activity specific devices allow users to gather, analyze, and share data directly sourced from their daily routine and environment. From wristbands that measure step counts, distance traveled, and calories burned to devices that measure sleep quality and ambient noise levels, a new industry is rapidly growing around the development of such devices, drawing interest from major corporations also.

With the increasing sophistication of these devices and their connectivity with the online ecosystem, gamification plays a common role in how this activity-related data is gathered, reported, and shared with users. The device interfaces and companion mobile applications promote the continuous collection of data through alerts and reminders, virtual rewards, and peer encouragement. With the data gathered, gaming strategies are again employed to further encourage the user to maintain and improve their activity scores (e.g., step counts taken, hours slept, etc.). Graphs and visualizations are used to collate the scores, allowing for quick comparisons with previous scores, providing continuous encouragement to achieve new goals. Users can earn virtual badges or trophies based on achieving goals and targets associated with the activity. With the ability to share scores and achievements, users can compete against a global user base, as well as their own personal best.

The gamification strategies used in this space seek to motivate and empower the user with guidance and knowledge, encouraging them to surpass their past achievements, and, in turn, to better their own selves. Tasks generally considered tedious or difficult (i.e., exercising, dieting, etc.) are transformed, allowing users to change how they view and relate to these tasks.

## 2.4 Business and Workplace

The business and corporate landscape is changing with the adoption of gamified strategies also. The technology consultancy firm, Gartner, has predicted that 50 % of corporate innovation will be gamified by 2015 (Anderson and Lee 2012). Recruitment, training, service management, and employee engagement and motivation are all areas where gamified strategies are used to encourage behaviors and generate measurable feedback. Some examples where these strategies have been applied include:

- IBM Connections social enterprise suite can be extended with Kudos Badges – a system that seeks to transform and accelerate adoption of the Connections platform through rewards and leaderboards.
- Badgeville offers a system that builds a similar reward structure around corporate sales teams and processes, with the ability to directly integrate with other management tools. Badges, points, and missions are used to encourage particular behaviors and motivate employees.
- The international recruitment agency, Hays, provides new graduates with an insight into the world of recruitment through an online game that simulates what it would be like to work as a recruitment consultant within the company. Participants receive feedback and points based on the decisions made within the game. The game seeks to change perceptions around the industry and help encourage appropriate candidates to apply.

## 3 Gamification in Education

The primary goal of gamification within the educational space is to motivate and engage teachers and students – seeking to improve interaction, connection, and understanding of learning activities. The gamification strategies can promote new methods of exploring and interacting with the information, helping students build on previous learning outcomes as they tackle new problems and build critical system-design and thinking skills.

With educators seeking to better engage and motivate their students, many educational institutions at all levels have already adopted and employ gamification strategies, in both real-world and online forms. Gamification offers the possibility of repackaging learning activities in more inviting and appealing forms – especially in cases where students are not connecting through standard teaching strategies.

From the outset, kindergarten students interact with tablet devices and smart whiteboards in daily learning activities. With exercises spanning mathematics, language, geography, biology, and more, the educational applications on these devices present a learning experience packaged as engaging and entertaining games. The market around these educational games is set to grow from $1.5 billion in 2012 to $2.3 billion in 2017 (Venturebeat 2013). At higher levels, similar principles are applied as students create blended-media creations with video, podcasts, and digital stories in order to earn extra credits in gamified projects.

The domain of technology enhanced learning and digital education is growing apace – across the USA, the number of students taking at least one online education course rose to 6.7 million in 2010 (Allen and Seaman 2013). This space is expanding from the explosive growth of MOOCs (Massive Open Online Courses) to the integration of social media to the use of data-driven learning and assessment. In line with this expansion, there is increasing adoption of gamified strategies in teaching and learning also.

### 3.1 CodeAcademy

Within the online space, CodeAcademy is one of many examples (e.g., Khan Academy, Coursera, MITx, Udemy, etc.) where gamification is embraced in online learning contexts in an attempt to better engage and motivate students.

The CodeAcademy platform and mobile application are designed to provide a web native learning experience with the provision of online tools, both for students and course creators, with the goal of teaching students how to develop and code computer programs.

Various gamification mechanisms are employed through the platform as the creators sought to use motivation and reward systems in order to engage students. As seen in other contexts, the interactive platform user interface utilizes:

- Points – awarded on completion of exercises.
- Profiles – users can enter basic personal and social web information, which is supplemented with their learning progress and achievements.
- Progress visualization – the UI provides a visual indicator as to the percentage of the exercise/course completed/remaining. These indicators also help direct users in continuing their experience when returning to an incomplete exercise.
- Badges – awarded on completion of a set of exercises or when particular milestones or challenges are met and displayed via the user profile.
- Forums – users can ask and answer each other's questions.
- Social sharing – the platform connects to various social sharing sites (e.g., Facebook and Twitter) to allow sharing of learning achievements.

In part, due to the novel approach adopted by CodeAcademy and the rising interest in web development and technologies, 450,000 users pledged to learn to code through the site with the launch of their self-proclaimed *CodeYear* in 2012 (CodeAcademy Blog 2013).

While other online teaching/learning experiences have been developed in different forms prior to the launch of CodeAcademy, the simple presentation of complex concepts in line with the gamified experience helped reduce perceived barriers and make the material more accessible to a wider audience.

The platform forums enable the participants to form collaborative communities around the exercises, allowing them to discuss and learn from each other and broaden their understanding. The site reports achievements in various formats – the user profile presents total points earned as an overall record of progress made, while the "daily streak" count encourages continued interaction with the exercises.

The platform immerses the student in writing code from the very beginning and attempts to guide the student along a learning path through continuous feedback. While the platform provides high level learning outcomes, in some instances the fundamentals and deeper understanding of the subject are not explored. Students can still complete exercises without fully grasping the rudimentary ideas behind the activity or understand the background to how a result was reached.

### 3.2 Mozilla Open Badges

As web-based/connected learning platforms grow, the Mozilla organization has developed the Open Badges open technical standard to further extend the application and use of virtual badges. The standard seeks to address the issue of creating, issuing, and verifying digital badges that recognize and reflect student work and achievements. Mozilla provides a free service that implements the standard, but any organization is free to develop their own implementation of the standard.

Through Open Badges, students are able to gain recognition for their online and real-world achievements as they build a collection of digital badges. While the badges can come from many disparate organizations, the badges are stored in an online digital backpack linked to the student. Students can choose to showcase particular badges they have earned on any service utilizing the standard (e.g., personal website, blog, social media website).

The digital badge can be information rich with links back to the issuing organization for verification purposes, along with the inclusion of any relevant badge metadata (e.g., date issued, criteria for attaining badge, level attained, expiry date, etc.). The verified nature of the badge and metadata allows the badge holder to more easily evidence their achievements and mastery of skills associated with the badge.

As more and more learning activities take place online, the Open Badges standard helps provide context and recognition for this type of learning. With the ability for students to showcase their badges in other online forums, the students are further motivated and able to build reputation within communities (Oblinger 2012).

Along with a growing number of institutions and services, the latest versions of online learning management systems Moodle and Blackboard are Open Badge enabled, with the ability to issue badges on the completion of assignments/tasks. Embracing the gamified notion of feedback and achievement acknowledgment, the Open Badge allows the student to unlock their achievements from a closed system and share them publicly – further enriching the value of those achievements.

### 3.3 Classcraft

The Classcraft platform aims to gamify the entire classroom experience. Following the rules and mechanisms used in role playing games (online and otherwise), students assume a role from three distinct character classes while the teacher creates evenly balanced teams of students. Daily learning activities are completed through a system of rewards and risks, with the ability for students to earn experience points for completing certain tasks (e.g., correctly answering a question in class, assisting another student with homework) while they seek to maintain life/hit points (e.g., avoid being late for class, noncompletion of homework).

As students earn experience points, they rise through levels and earn power points that can be exchanged for class privileges (e.g., late submission of assignment, eating in class). When a student loses all of their life points, their character dies and a penalty is imposed by the outcome of rolling the “Death Dice” (e.g., detention, less time to complete exam). Similar to the role-playing game equivalents, the various character classes allow the students to modify their team's interaction with or the result of events within the game setting. Each class begins with a random event that may benefit some teams while impairing others.

The game elements are designed to raise the level of student motivation and participation within the class, while the points and team systems work to foster and reinforce collaborative activities.

## 3.4 Quest To Learn

Quest To Learn (QTL a pioneering public school in New York, fully embodies gamification strategies in an effort to better engage and motivate students. Bringing together students, educators, game designers, curriculum specialists, and parents, QTL presents the students with a series of increasingly complex, narrative challenges, games, or quests, where learning, knowledge, sharing, feedback, reflection, and next steps emerge as a natural function of play (Institute of Play).

The daily student schedule at QTL differs from the normal classroom-based curriculum with the student immersed and challenged with structured educational game play throughout the day. Direct from the world of computer video games, the QTL curriculum is delivered through *Quests*, *Discovery Missions*, and *Boss Levels*.

Quests compromise of goal-based challenges that help equip the student with data, knowledge, resources, and practices necessary to help solve part of the larger mission (Salen 2011). The very nature of the quest further embodies game strategy and situated learning – assignments associated with the quest may be delivered as part of secret tasks (e.g., a race to break a mathematical code as discovered in a book in the school library).

With the end goal of the mission known to the students, missions generally contain 4–10 inter-related quests.

Boss levels are intensive 1–2 week tasks where students and teachers work collaboratively on a capstone project. Knowledge and learning gathered throughout the preceding quests and missions are combined in order to overcome a final challenge. During this time, students engage in a rigorous process of research, theory building, hypothesis testing, evaluation, and critique – all followed by a public defense of results (Salen 2011). Each semester concludes with a student-led conference showcasing the achievements and results.

Standard grades are replaced with game-like ranking levels. Students are encouraged to "level up" by building points against a competency and the completion of quests. Quests can be replayed and the more quests tackled and competed, the quicker the student can rise through the levels.

Designed to encourage and facilitate collaboration, QTL promotes an online "expertise exchange" within the school. Students are encouraged to complete online profiles, in a similar fashion as to online video game profiles, allowing them to highlight and promote their own area of expertise. Students need not limit their profile to the standard, core subjects normally taught, but can include hobbies or other interests pursued outside of the classroom. Students and teachers can then build teams based on these profiles in order to tackle quests, allowing each student to utilize their specialist skills in completing the task. Having made real contributions with skills the students are genuinely interested in and proud of, the student experience is enriched with a greater sense of achievement.

QTL students can also interact with online teachable agents – virtual characters designed to allow the student "teach" the process of solving a problem or conveying a concept. These interactions are designed to replace quizzes, allowing the student to mentor another by virtue of their own learning. Removing the anxiety normally associated with quizzes, the teachable agent promotes the concept of sharing and collaboration.

At its core, QTL builds on the premise that learning is a social exercise mediated by social activities and technological tools – utilizing game mechanics to fully engage and motivate the student. Using the structure of games as a primary framework, QTL students will be able to design, understand, critique, and manipulate the internal architecture of systems (Salen 2011).

## 4 Mobile Learning and Teaching

The global adoption of web-enabled mobile and tablet devices has become a major catalyst for change in the world of technology enhanced learning. As these devices become firmly embedded in daily life and activity, the consumer and social web has greatly influenced and raised student expectations as to what constitutes as an effective and engaging digital learning experience. Students now expect to connect, access, process, interact with, and collaborate on online accessible subject material and systems, directly via their personal mobile devices, whether on or off campus. As a result, many institutions now recognize and provide access and support for the growing "Bring Your Own Device" (BYOD) student population. The digitization of subject material allows the student to approach their learning activities in new and unique ways. Providing always-on access to the resources, mobile devices allow the student to consume, review, and interact with the resources in their own time and space.

Gamified strategies are a natural complement for learning resources and activities made available online and accessed via mobile devices. As seen in other contexts, these strategies can help engage, motivate, and guide students in their online and mobile learning experience. While not strictly confined to the mobile experience, a learning gamification strategy is afforded greater opportunity for success and increased engagement through the accessibility and integral role that mobile devices now play.

Successful gamification in teaching and learning is most effective as a pedagogical tool where it forms part of a well-planned strategy to encourage research, inspire creativity, teach basic principles, or hone problem-solving skill (Educause 2011). The gamification strategy needs to suitably align with the desired learning outcomes. Allowing the teacher and student to remain focused on the core learning activity, the nature of mobile devices allows for the integration of many gamification strategies: points, visual progress indicators, achievement acknowledgement and sharing, team-based activity, and collaboration. Some examples of mobile-enabled, gamified solutions include the following.

### 4.1 Socratic

Socratic is an online audience response tool with inbuilt mobile support that allows for real-time questioning with instant result aggregation and visualizations. Teachers can create polls, quizzes, and other exercises with the ability for students to provide real-time answers via their mobile devices.

Within the classroom context, Socratic can be employed as a formative assessment tool in order to gauge the level of student engagement and understanding of the lesson material. The tool gathers and reports on student responses immediately, allowing the teacher to modify the lesson delivery and activities based on this feedback. Answers can be submitted anonymously, allowing students to be more forthcoming with candid responses. The tool offers a "Space Race" mode, where students complete questions in order to progress in a race, either in teams or individually. After the classroom experience, "Exit Ticket" mode can provide the teacher with feedback on the lesson as a whole – with a simple overview of what the student learnt and what they expect in subsequent lessons.

### 4.2 Kahoot

The Kahoot platform is another online audience response tool that employs many of the same principles found in Socratic. Students can engage with quizzes, discussions, and surveys through their mobile devices directly within the classroom. The system aggregates responses and presents a scoreboard ranking the students.

Kahoot also promotes further research and collaboration of learning by encouraging the students to create their own learning exercise, based on the knowledge learnt within the original lesson. The student becomes the teacher as other students can partake in the student-created lessons with the ability to further discuss the material presented.

### 4.3 ClassDojo

ClassDojo is a behavior management tool for teachers that gamifies the reinforcement of desired classroom behaviors. With the ability to access the tool via any web-enabled device, the teacher can define a class (with avatars assigned to each student) and specify the behaviors that are to be rewarded. During class, the teacher can award points to students performing well or exhibiting the desired behaviors. The points data is aggregated immediately and can be presented to the classroom (via projector, smart board, or individual mobile devices), providing immediate reinforcement of good behavior. The data can be collated into reports and shared with parents, providing the ability to monitor and review how the class is progressing. The tool itself includes some analysis capabilities and can highlight trends (e.g., days when more points are awarded, etc.). The tool also allows for basic messaging between teacher and parents – with the ability to send broadcast information or direct messages to individual parents.

With the behavior reinforcement backed by the points system, teachers can seek to motivate their students with a real-time feedback loop enabled through the use of mobile devices.

## 5 Benefits

In general, a learning gamification strategy in a mobile context can foster better student engagement and motivation, cultivate systems-thinking, and instill the ability to build upon past learning experiences. The socialization of the learning experience through gamification can also help promote collaboration, enabling and encouraging students to assist each other and thereby further their own understanding and learning.

As gamification is set for adoption in many other contexts also, students who have worked through a gamified learning context may well be better prepared for subsequent gamified experiences. The common elements of the gamified system may allow the student to evaluate a gamified task in a familiar context.

Within a gamified system, failure need not be presented as a finality, but rather an opportunity from which to learn and increase knowledge, enabling the participant to re-attempt the task in a different way.

## 6 Negatives

Conversely, a poorly conceived or implemented gamification strategy has the potential to detract from the main learning activity and ostracize and alienate students.

A poorly defined strategy may deter students who do not embrace the game-like mechanics and find them a barrier as to how they would normally engage and interact with the subject material. With games generally seen as leisurely pursuits, there also exists the possibility of trivializing the learning experience and devaluing the core activity.

The competitive nature inherent in most game systems may cause anxiety for some and help compound a sense of deficiency, especially for those struggling with the material and the gamified format.

As seen in some social web contexts, there is a potential danger that the gamification elements may subsume the primary learning activity. Even further, students may have difficulty in translating such learning experiences to real-world scenarios and applications without the gamified scaffolding in place.

Without suitable alignment with the desired learning outcomes, gamification may indirectly lead to a simplification of the subject material presented and provide only a high level understanding without any deeper learning of fundamental theories taking place.

The overall management and processing of gamified systems and the results generated also has the potential to increase the workload for subject coordinators.

## 7 Future Directions

With growing exposure and general interest in the strategy and the perceived benefits, gamification is set for increasing adoption in many contexts, including mobile teaching and learning. As the teaching and learning landscape moves to embrace a technology enhanced context, in line with further advances in mobile technology, gamification will become an inherent element in most learning activities. Future implementations of gamification will utilize mobile devices and capitalize on the integral role they occupy in daily activities. Learning from current success and failures, future gamified systems will be more refined with careful integration of gamified elements that support the core activity.

Gamification will extend beyond the learning activities in individual classes and integrate at a wider level – potentially at the departmental or institutional level. Seeking to engage students in all aspects of the student community experience, such a gamified system might reward social club membership or gym attendance, in addition to the standard classroom activity achievements. Opportunities in cross-disciplinary projects also become possible, allowing the student to collaborate with new networks and build a portfolio – a portfolio that has the potential to gather work and learning evidence throughout the students' learning and work career.

With increasing alignment between educational practice and workplace expectations, educational institutions might further incorporate a gamified experience through the use of workplace-scenario simulation games. These simulations would provide the student with an insight as to what they might expect on a specific career path, while providing prospective employers with tools for skill evaluation and assessment. Mobile devices would naturally complement these simulations, providing students with ease of access in a familiar context. With the expectation of further adoption of gamification within the workplace, students will more readily apply their skills and complete the transition to the workplace more easily.

As the core elements of gamified systems are perfected, the social and collaborative aspects of gamified systems will come to the fore, allowing students to increasingly interact and learn from each other in their learning experiences. Mobile devices will further enable a continuous connection between students and allow for creative and innovative project solutions.

## 8 Cross-References

▶ Characteristics of Mobile Teaching and Learning
▶ Tutors in Pockets for Economics

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# Mobile Learning: Critical Pedagogy to Education for All

# 8

Kshama Pandey and Neetu Singh

## Contents



**Abstract**

The mobile phone industry in India is experiencing an astonishing growth since the introduction of mobiles in the country. Mobile phone subscriber base has increased from a meager 0.03 million in 1995–1996 to 893.31 million in 2013–2014. This transformation shows a rapid increase not only in the form of urban mobile subscriber base but also for rural mobile subscriber base. The emergence of revolutionary technologies has had a significant impact on

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educational technology. It has increased the potential of e-learning as a mode of delivery in education. By definition, mobile learning is learning by means of wireless technological devices that can be pocketed and utilized wherever the learner's device is able to receive unbroken transmission signals (Attewell and Savill-Smith 2005). Mobile devices allow students to gather, access, and process information outside the classroom. They can encourage learning in a real-world context, and help bridge school, after school, and home environments. Because of their relatively low cost and accessibility in low-income communities, handheld devices can help advance digital equity, reaching and inspiring populations "at the edges" – children from economically disadvantaged communities and those from developing countries. Moreover, it is an aid to formal and informal learning and thus holds enormous potential to transform the delivery of education and training. This chapter is structured into the five sections. Section 1 deals with the conceptualization of mobile learning. Section 2 discusses the technological attributes and pedagogy of mobile learning. Section 3 comprises with the historical data of population, literacy rates, and demand of mobile phones in India, whereas Sect. 4 presents the contribution of mobile learning to education for all and the last section (Sect. 5) contains future directions.

## 1 Introduction

The evolution of handheld portable devices and wireless technology has resulted in radical changes in the social and economic lifestyles of modern people. Today, many technological devices are produced in convenient form and people have become accustomed to them. These devices are reshaping users daily lives in different ways. But the development of digital technologies has so far been limited to social communication and few people have regarded mobile learning as a core pedagogical activity in learning. Mobile phones, which were introduced a decade ago in 1995–1996 in India, are becoming the dominant means of accessing communication. Simultaneously, the prices of mobile devices and services are plummeting around the world. Just a decade ago a mobile phone was appropriately seen as a luxury item; today it is generally considered a staple of day-to-day life in each and every section of society. As mobile devices are becoming increasingly ubiquitous, many researchers and practitioners have incorporated the technology into their teaching and learning environments. It resulted in a form of new learning approach, which is called mobile learning.

## 2 A Conceptualization of Mobile Learning

The first step is to explore the wider concept of mobile learning. Mobile learning as an educational activity makes sense only when the technology in use is fully mobile and when the users of the technology are also mobile while they learn. These observations emphasize the mobility of learning and the significance of the term "mobile learning."

Before studying the commencement and development of m-Learning, it is required for one to know what the term means in order to comprehend what the field encompasses. Mobile learning is defined by many scholars and practitioners in different forms, many different definitions have been provided to recognize its meaning. For example, m-Learning:

- Is using the Palm (an early brand of mobile technology) as a learning device (Quinn 2000; Soloway et al. 2001).
- Is any sort of learning that happens when the learner is not at a fixed, pre-determined location, or learning that happens when the learner takes advantage of learning opportunities offered by mobile technologies (O'Malley et al. 2003).
- Is a form of e-Learning that specifically employs wireless communication devices to deliver content and learning support (Brown 2005).
- Is any educational provision where the sole or dominant technologies are handheld or palm-top devices (Traxler 2005).

From these literature reviews, it can be concluded that mobile learning can be an effective tool for learning or enhancing the teaching-learning process, because it increases access as well as equity. Moreover, it can be harnessed anywhere, anytime. Similar to e-Learning, mobile technologies can also be interfaced with many other media like audio, video, the Internet, and so forth.

## 2.1 Meaning of Mobile Learning

Mobile learning values and defends in its own unique way the introduction of what is radically new in the technological, social, and cultural spheres of human life and activity. It is argued that human beings are obsessed by the desire to change, to explore, to learn, design, and to introduce what is absolutely new into the framework of past conventions and protocols. Mobile learning opens our minds to the possibility of a radically new paradigm and encourages us to abandon the constraints of our habitual ways of thinking, learning, communicating, designing, and reacting. There are various researchers and practitioners clarify the meaning of mobile learning in different terms. It can be viewed from Fig. 1.

Mobile learning using handheld computers is in its infancy in terms of both technologies and pedagogies. As a result there is still some dispute amongst industry advocates in how mobile learning should be defined: in terms of devices and technologies, in terms of the mobility of learners and the mobility of learning, and in terms of the learners' experience of learning with mobile devices. Mobile learning basics in this regard, El-Hussein and Cronje (2010) has tried to clarify the meaning of mobile learning in his article. According to El-Hussein and Cronje (2010), using the mobile device as a signifier, the concepts of mobility can be divided into three significant areas:

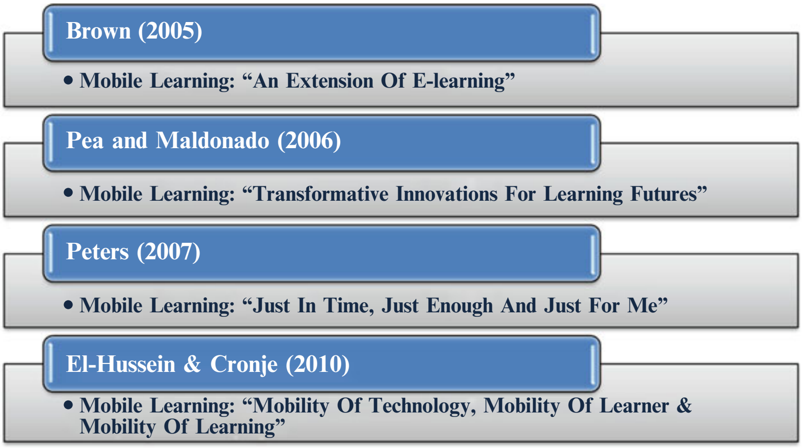



**Fig. 1** A compilation of meanings of mobile learning

- Mobility of technology
- Mobility of learner
- Mobility of learning

This tripartite division of mobility is evident in the current literature on the subject, and designers who have used mobile technology for educational purposes have confirmed this. Figure 1 is a graphic depiction of the three divisions of mobile devices that can deliver a higher level of educational instruction. These three elements are interdependent and are equally important in making mobile devices viable as instruments for the delivery of higher education instructional contents (Fig. 2).

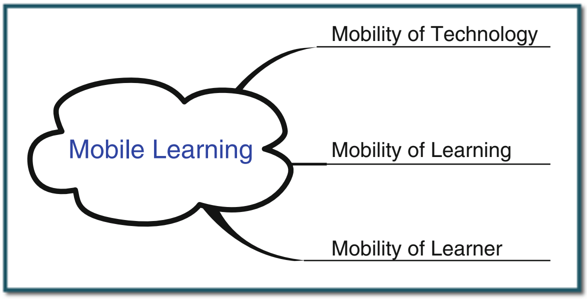
### Mobility of Technology

The mobile technology referred to in this chapter is mainly more advanced cellular telephones. But there are other forms of technology such as "smart" phones, digital cameras, flash-discs, iPods, and personal digital assistance devices Personal Digital Assistants (PDAs). The mobile cellular devices have the capacity to link to the Internet and deliver content and instruction that can enable learners to learn at anytime and anywhere in a format that is culturally prestigious among people in the same age group. Most of the more advanced models can support a portable, digital, and wireless lifestyle and mode of teaching and learning.

### Mobility of Learners

Educators and designers should address the needs of learners in this age of wireless communication and connectedness. Slogans such as "walk and use," "walk and talk," "just for me," and "just in time" usher in the new phrases in education like "You ring, we bring" ushered in previous developments in society. Instructional theory in this mobile age should be learner-centric rather than technology- or teacher-centric.

**Fig. 2** The three concepts of mobile learning (Source: El-Hussein and Cronje 2010, pp. 12–21)




This is because, as Uden (2007) observes: "Mobile technologies offer new opportunities for students' educational activities in that they can be used across different locations and times." Students using mobile technologies are not only remote from their instructors, they also fully control the access of information on their mobile devices. In this light, one of the main advantages of mobile learning is that it allows this generation of learners to enjoy a certain amount of freedom and independence.

#### Mobility of Learning

Mobile learning devices have also enriched the theory and practice of e-learning. Contemporary consumers of higher education in developing countries almost always use mobile learning devices as adjuncts to e-learning in higher education. Sophisticated mobile devices are currently capable of delivering a comprehensive range of e-learning materials by means of web connections, infrared, and bluetooth transmissions. For Ally (2005) "mobile learning [is at the] intersection of mobile computing and e-learning; it provides accessible resources wherever you are, strong search capabilities, rich interaction, powerful support for effective learning and performance-based assessment."

Thus it can be concluded that Mobile learning is the ability to obtain or provide educational content on personal pocket devices such as PDAs, smart phones, and mobile phones. Educational content refers to digital learning assets which includes any form of content or media made available on a personal device. New technologies such as cell phones provide unique technological attributes that could be harnessed to enhance teaching and learning. These new technologies can be used to support personalized, immediate, and situated learning.

### 2.2 Quality Appearances of M-Learning

UNESCO Working Paper Series (2012) on Mobile Learning makes clear, such a view limits educational opportunities by overlooking a host of programs that rely on mobile technologies to improve teaching and learning. From initiatives that afford learners greater control over their own education to those that facilitate teachers' professional development, mobile devices assist learners and teachers working in diverse settings across the globe.

The software that underlies m-learning includes not only mobile applications designed specifically for learning purposes, but also those designed for other uses – such as geolocation, data access, readers, and maps – but that can be adapted for educational purposes. M-learning hardware may include mobile phones, handheld Personal Computers (PCs), tablets, the iPad, and net books, as well as devices such as the iPod touch that are able to run mobile applications. Because m-learning utilizes a variety of devices, many of which are ubiquitous in the lives of students, it can foster student engagement and offer opportunities to make learning integral to daily life.

The quality appearances of mobile learning are organized in four criteria:

***One*: M-learning is convenient as:**
- It is accessible from almost anywhere; it has no geographic boundaries.
- Learners can learn at any time.
- Like other forms of e-learning, m-learning is also collaborative.
- Sharing is almost instantaneous among everyone using the same content, which leads to the reception of instant feedback and tips.
- M-learning also brings strong portability by replacing books and notes with small devices, filled with tailored learning contents.
- It is simple to utilize for a more effective and entertaining experience.

***Two*: It includes the use of mobile/handheld devices to perform any of the following:**
- Deliver education materials and promote learning
- Faster communications and collaboration
- Conduct assessments and evaluations
- Provide access to performance support and knowledge
- Capture evidence of learning activity

***Three*: Mobile devices and personal technologies that can support mobile learning, include:**
- Smart phone, an aggregator of most of the following technologies
- E-book
- Handheld audio and multimedia guides, in museums and galleries
- Handheld game console, modern gaming consoles such as Sony Play Station Portable (PSP) or Nintendo Dual Screen (DS)
- Personal audio player, e.g., for listening to audio recordings of lectures (podcasting)
- Personal digital assistant, in the classroom and outdoors
- Tablet computer
- Ultra-Mobile Personal Computer (UMPC), mobile phone, camera phone, and Smart phone

***Four*: Technical and delivery support for mobile learning include:**
- Third Generation Partnership Project (3GP) For compression and delivery method of audio-visual content associated with mobile learning

- General Packet Radio Service (GPRS) mobile data service, provides high speed connection and data transfer rate
- Wireless Fidelity (Wi-Fi) gives access to instructors and resources via internet
- Cloud computing for storing and sharing files
- Mobile web and mobile apps for the dominant content formats for smart phones

According to Huang et al. (2008), the environments in which the study of mobile learning has been conducted have some similar features with those in previous studies. These features include:

1. Enhancing availability and accessibility of information networks
2. Engaging students in learning-related activities in diverse physical locations
3. Supporting of project-based group work
4. Improving of communication and collaborative learning in the classroom
5. Enabling quick content delivery

## 2.3 Mobile Learning for Up-To-Date Learning

In this new millennium modern technology plays inevitable role in our lives. The technological revolution poses tremendous challenges to the educators to rethink their basic tenets, to apply technology in creative way to redesign education. In this context, e-learning and m-learning plays an important role. e-learning and m-learning are the new innovations which provide greater learning opportunities for the students. As learning management systems adapt to the mobile platform, m-learning may become a common tool for exploration by tech-savvy faculty. The use of mobile devices seems a natural fit for distributed learning and field activities in that handheld technology can not only accompany the learner almost anywhere but also provide a platform that is rapidly evolving and always connected to data sources. Learning management systems may drive campuses to recognize the potential of this always-on, anyplace technology that lowers the physical boundaries to learning and extends the classroom. Ease of use offered by mobile devices supports lifelong learning, and because the devices themselves are integrated into everyday life, they facilitate authentic learning. Ultimately, it might be the ubiquity of these student-owned devices that ensures their use as teaching and learning tools. While some m-learning applications may be provided by colleges and universities, mobile technology in the main provides an inexpensive layer of functionality to the institution, capitalizing on an infrastructure that is increasingly supported by cloud services and by the technology that students bring to campus.

The cell phone is currently the most common raised area for m-learning, lending itself to collaborative and project-based efforts that influence its potential to support the communication requirements of a team. Where wireless networks are available, or where smart phones with data plans have access to cell networks, mobile lessons and exercises can leverage the ability to gather information from a variety of interdisciplinary sources in a wide array of formats while exploiting the value of location-based learning. In developing countries where mobile devices are available at a fraction of the cost of other computing hardware, m-learning has extended the infrastructure of distance education to outlying areas that have previously been poorly served. Regardless of the hardware employed, as demand requires that more applications be re-authored for mobile formats, institutions may find it necessary to overhaul data-sharing and content-delivery techniques to support the mobile platform. Consequently, m-learning provides the potential to provide the right information to right people at any time and any place using portable learning devices. Thus, m-learning can be summarized in a single statement – "*deliverance of education or any learning* via *any portable devices*" Behera (2013).

## 3 Theoretical Perspectives: An Evident in Mobile Technology Studies

While there are many exemplars of prosaic uses of mobile devices for communication, few examples currently exist of how they might be used as cognitive tools (Jonassen and Reeves 1996) to solve complex problems and to engage students in authentic and meaningful tasks. In an extensive literature review of mobile learning, Naismith et al. (2004) proposed six broad theory-based categories of activity in the field (Fig. 3).

All these theories are applied by different researchers and practitioners; examples of these theories are as follows:

1. Wood (2004), applied Behaviorist theory, e.g., classroom response systems for providing feedback on multiple choice questions.
2. Chesterman (nd), issues related to educational media explored through videos, documentaries, animations of educational concepts, and news bulletins with mobile phones. However, Constructivist theory can be applied in this process.
3. Proctor and Burton (2004) focused on multimedia tools at the Tate Modern art gallery as situated learning.
4. According to Palm Inc. (2005) teacher trainers' use of personal digital assistants (PDAs) to beam questions for a virtual treasure hunt to groups of teachers. Therefore it also supports in collaborative learning.
5. Wood et al. (2003), revealed that breast cancer care may be possible through the delivery of text images and audio-visual materials to patients' PDAs during their course of treatment. Hence, it provides informal and lifelong learning.
6. Perry (2003), managing teachers' workloads using PDAs to record attendance, marks, and organize lesson plans. Therefore, learning and teaching support can also be given through mobile learning.

It is perhaps this last category that has seen the most interest and activity in terms of the use of mobile technologies in universities to date, that is, practical and

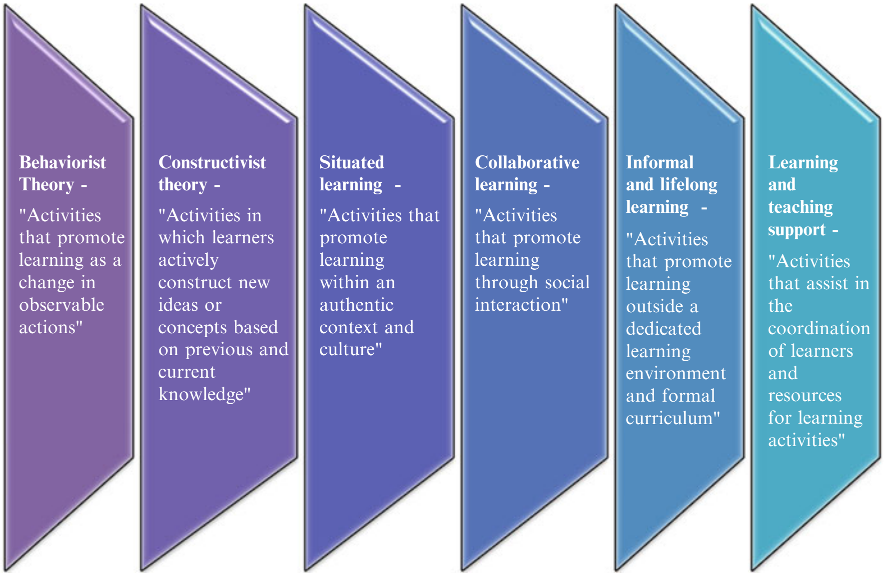



**Fig. 3** Six broad theory-based categories of activity in mobile learning (Source: Naismith et al. (2004))

administrative functions rather than pedagogical purposes. Similarly, in terms of student use of mobile technologies, the focus of the debate has been upon the problematic use of mobile phones in schools (e.g., Campbell 2005) and the social and cultural shift in communication dynamics through the use of mobile devices.

## 4 Technological Attributes and Pedagogical Affordances

Mobile learning has unique technological attributes which provide positive pedagogical affordances. Pea and Maldonado (2006) summarized seven features of handheld device use within schools and beyond: "portability, small screen size, computing power (immediate starting-up), diverse communication networks, a broad range of applications, data synchronization across computers, and stylus input device." As Klopfer and Squire (2008) summarized, "portability, social interactivity, context, and individuality" (p. 95) are frequently cited affordances of mobile learning. Specifically, *portability* is the most distinctive feature which distinguishes handheld devices from other emerging technologies, and this factor makes other technological attributes such as individuality and interactivity possible.

Above all, this mobility enables ubiquitous learning in formal and informal settings by decreasing "the dependence on fixed locations for work and study, and consequently change the way we work and learn" (Peters 2007). Gay et al. (2002) developed the "mobility hierarchy," including four levels of objectives that encourage the use of mobile computers in education settings. This hierarchy

**Table 1** Technological attributes and pedagogical affordances

| Levels | Mobility hierarchy | Sample applications | Technological affordances |
|---|---|---|---|
| **Level 4** | Communication and collaboration | Real-time chat<br>Annotation<br>SMS (simple message system)<br>Wireless e-mail | Communication intensive<br>Group work<br>Synchronous |
| **Level 3** | Capturing and integrating data | Network data base<br>Data collection/synthesis<br>Mobile library | |
| **Level 2** | Flexible physical access | Local data base<br>Interactive prompting<br>Just-in-time instruction | **Mobility** |
| **Level 1** | Productivity | Calendars<br>Schedule<br>Contact information<br>Grading | Asynchronous<br>Individual Work<br>Content Incentive |

Source: Mobility hierarchy, sample application, and technological affordances (Adopted from Gay et al. 2002)

presents the contrasting attributes of mobile devices. The focus of "productivity" (level 1) is content-intensive, whereas the focus of collaboration and communication (level 4) is communication-intensive. Level 1 aims at individual learning, and level 4 aims at collaborative learning by multiple users. Levels 2 and 3 fall into the "middle-range applications, such as personal tour guides, computer-aided instruction, database activity, mobile libraries, and electronic mail."

As this hierarchy indicates, mobile technology has two comparable attributes. Scheduling and calendar applications are useful to increase an individual's organizational skills and self-regulative (or self-directed) learning ability; whereas, real-time chat and data sharing applications support communication, collaboration, and knowledge construction. This shows that students can consume and create information both "collectively and individually" (Koole 2009) (Table 1).

## 5 Pedagogy of Mobile Learning

In trying to understand how mobile technology can be appropriated for teaching and learning at a distance, we should start by looking at how different is mobile learning from other technologies that are used in teaching and learning (Laurillard 2007). The strength of using mobile technologies is that they offer learning that is intimate, spontaneous, pervasive, and versatile. Mobile learning "provides an enhanced cognitive environment in which distance learners can interact with their instructors, their course materials, their physical and the virtual environment" (Koole 2009, p. 38).

The difference between mobile learning and other technologies is that it has the ability to support situated learning (Kukulska-Hulme and Traxler 2005). Mobile learning provides students with opportunities to engage in authentic activities. In this context, students are able to explore, share, and interact with each other as they try to learn together in their real-life learning environments.

The nature of mobile learning is that it tends to ascribe to the student-centered approach. This pedagogical approach assumes that students come into the learning environment with their own perceptual framework and therefore they need to be encouraged to construct their own meaning by talking and listening to each other, writing and reading as well as reflecting on content. When students are in control of their learning, they are able to link up with other students in collaborative learning networks. Through peer collaboration, according to Laurillard (2007) students are more likely to be motivated to share their work with each other as well as to augment their conceptual understanding with others. In the distance education context, social interaction relates to the socio-emotional aspect of group forming and group dynamics (Kreijns et al. 2003). UNISA students were able to set-up study-groups through MXit – a cell phone social network system, to help each other through difficult areas of their courses (Makoe 2010). Mobile learning was able to facilitate this process through building communities of learners who are committed to working together to achieve a goal. "Collaborative learning leads to deeper level learning, critical thinking, shared understanding and long term retention of the learned material" (Kreijins et al. 2003) as well as developing communication and social skills (Table 2).

A number of studies have been carried out looking at the key benefits that mobile technology offer educators (Rau et al. 2008; Markett et al. 2006; Peters 2007; Kukulska-Hulme and Traxler 2005). In Kim et al. (2006), these benefits have been summarized into four main groups:

- Providing students (and educators) with freedom of location and time
- Increasing speed in teaching and learning
- Enabling one-to-one learning based on individual educational histories or test results
- Allowing teachers to keep up the new educational subjects for future education

Cell phones can be used as a tool to facilitate interaction through synchronous and asynchronous learning; it is suggested that different cell phone applications are harnessed for teaching and learning. Students can also be encouraged to use cell phone social networks such as MXit, WhatsUp, and BBM to form study groups and work collaboratively on projects. Through these communities students will be able to get together, engage in joint activities and discussions, help each other, and share information about the course. Communities develop their practice through problem solving, requests for information, coordination and discussing developments, mapping knowledge, and identifying gaps.

**Table 2** Theories and the pedagogies that support the use of cell phones in distance education context

| Theoretical framework | Pedagogical focus | Uses of cell phones |
|---|---|---|
| **Guided Didactic Conversation Holmberg** (1983) | Study material should be written in a personal style; easily accessible; offer explicit advice, suggestions, and invite exchange of views. Mediated conversation should facilitate the development of learning relationship between the lecturer and the student. | Cell phones can be used in conjunction with printed materials to give and get feedback from lecturers and students, access learning games, simulations, self-assessment quizzes, podcasts, and video casts.<br>Content can be broken into small chunks to make access easier and avoid scrolling. |
| **Transactional distance** (**Moore** 1989; **Moore and Kearsley** 1996) | Learner–lecturer: The lecturer provides an organized curriculum to ensure that the student masters the content.<br>Learner–learner: Students form peer support groups.<br>Learner–content: Student reads a book, views, or listens to DVDs and CDs and interacts with inanimate learning resources. | A lecturer can send an SMS that is meant to trigger discussion on a particular topic and then encourage students to engage on a discussion.<br>Students can form peer support study groups through cell phone social networks such as MXit, WhatsUp, BBM, etc. They can support each other synchronously or asynchronously.<br>Student can interact or get clarity on a difficult concept by checking it on the internet using cell phones. |
| **Hillman et al**. (1994) | Learner-interface: interaction between the student and the technologies used to deliver the instruction. | Podcasts and video casts can be created to record, store, and deliver content (Anderson 2010).<br>Lecturers and students can acquire different technological skills and competencies they need to understand and know how to use different mobile features and applications for teaching and learning. |
| **Theory of integration of the teaching and learning acts Keegan** (1990) | The course is designed and developed using networks of diverse applications such as Open Educational Resources (OERs), wikis, blogs, discussion boards, conference sessions, social networks such as Twitter, Skype, and podcasts. | Students can be asked to access certain OER material on the internet; and be asked to offer their own ideas and post them in their cell phone social networks where they share them with their peers and lecturers.<br>Students can take pictures, share with others, and hold discussions on how to solve a particular problem using different cell phone applications. |

Source: Makoe (2012)

## 6 Contribution of Mobile Learning for Authentic Learning

Authentic learning situates students in learning contexts where they encounter activities that involve problems and investigations reflective of those they are likely to face in their real-world professional contexts (Brown et al. 1989; Lave and Wenger 1991). Herrington and Oliver (2000) have identified nine characteristics of authentic learning:

- *Authentic contexts* that reflect the way the knowledge will be used in real life
- *Authentic activities* that are complex, ill-defined problems and investigations
- *Access to expert performances* enabling modeling of processe*s*
- *Multiple roles and perspectives* providing alternative solution pathways
- *Collaboration* allowing for the social construction of knowledge
- *Opportunities for reflection* involving meta-cognition
- *Opportunities for articulation* to enable tacit knowledge to be made explicit
- *Coaching and scaffolding* by the teacher at critical times
- *Authentic assessment* that reflects the way knowledge is assessed in real life

These characteristics formed the basis for teachers to plan and design learning environments where mobile technologies could be used in their different subject areas and specializations (Herrington et al. 2008, 2009).

## 7 Mobile Device: Development and Learning Possibilities in India

As computers and the Internet become essential educational tools, and technologies become more portable, affordable, effective, and easy to use, so too is increasing the focus on how they can be incorporated to support learning. These technologies provide many opportunities for widening participation and access to ICT. Mobile devices such as phones and PDAs are more reasonably priced than desktop computers, and therefore present a less expensive method of accessing a myriad of tools all in one small device. Features such as the facility to make phone calls, take pictures, record audio and video, store data, music, and movies, and interact with the Internet all provide opportunities that could be harnessed in the educational context (MacCallum and Jeffrey 2009). Mobile learning offers a fundamental change in the way learning can be regarded and opens the door to countless uses for educational purposes. The expansion of these devices is growing day by day and today the reach of this technology is in every home and every section of society in India.

### 7.1 Visions and Goals of Indian Government

It is being increasingly realized all over the world that economic well being and productive efficiencies can be realized with higher intellectual and professional capabilities of human beings. A good quality human resource base is extremely important in today's highly competitive environment. The very concept of development in the past two decades has evolved in this direction which has moved from income and income distribution to human resource development. This is the very reason for the marked shift from the welfare approach of education to the right based approach – providing the foundation for the right to dignified living through its transformative potential to development.

The ongoing Sarva Shiksha Abhiyan (SSA) has been aligned with the provisions of the RTE Act with a shift in focus from quantity to quality. All States have taken major initiatives to implement RTE Act. Various interventions were made for teacher development, infrastructure creation particularly science laboratories, ICT-enabled education, curriculum reforms, and teaching learning reforms to enhance secondary education quality.

Vigorous attempts are being made to leverage and exploit the (ICT) information communication technology to reach out to the vulnerable sections and regions, to explore global sources and resources of learning, and to make the Indian higher education system competitive to the global standards.

## 7.2 Steps Taken by Indian Government

1. National Mission on Education through Information and Communication Technology (NMEICT)
   (i) Sakshat: One Stop education portal
   (ii) Building Connectivity and Knowledge Network
2. National Programme on Technology Enhanced Learning (NPTEL)
   (i) E-Content Generation for UG and PG Courses
   (ii) Availability of Low Cost Access Device (LCAD) for use of ICT in Education
3. Virtual Labs
4. Educational Resource Planning (ERP)
5. National Library and Information Services Infrastructure for Scholarly Content (NLIST)
6. Education Satellite (EDUSAT) and Direct to Home (DTH) Platforms

In order to better understand the current status of mobile learning and come up with learning possibilities in India, it is necessary to systematize mobile learning and mobile technologies in a developmental framework. This developmental framework will include three categories:

- Population
- Literacy rates
- Mobile subscription

As this study is focusing on urban and rural development in India, consequently all the three categories are studied in urban and rural divisions.

**Table 3** Population of India from 1991 to 2011 (in millions)

| Year | Rural | Urban | Total |
|---|---|---|---|
| **1991** | 628 | 217 | 846 |
| **2001** | 741 | 285 | 1027 |
| **2011** | 833.08 | 377.11 | 1210.19 |

Source: (i) GOI, Final Population Totals, Paper-2 of 1992, Vol. I Census of India (1991); (ii) GOI, Census of India (2001), Provisional Population Totals, Paper-1 of 2001, Registrar General, India; (iii) GOI, Census of India (2011), Provisional Population Totals, Paper-1 of 2011, Registrar General, India

## 7.3 Rural and Urban Population of India

Out of the total of 1210.19 million population in India in 2011, the size of rural population is 833.08 million (or 68.84 % of the total population) and the size of urban population is 377.11 million (or 31.16 %). During 2001–2011, the population of the country increased by 181.4 million. Increase in rural areas was 90.4 million and increase in urban areas was 91.0 million. Rural–urban distribution in 2011 was 68.84 % and 31.16 %, respectively. The level of urbanization increased from 27.81 % in 2001 census to 31.16 % in 2011 census. It also seems clearly that the proportion of rural population declined from 72.19 % to 68.84 %. It can be seen in Table 3.

The graphical representation of the total population of rural and urban India can be seen in Fig. 4.

## 7.4 Growth of Literacy Rates in India

Literacy is one of the important indicators of social development and closely associated with the indispensable characteristics of modern civilization. This also helps in improvement of economic condition and developing human resource without which progress of any society or nation will be paralyzed. In census terminology, a person aged 7 years and above who can both read and write with understanding in any language is treated as literate and the percentage of literates in the age group 7 years and above is called literacy rate. The number of literates in India is 778.5 million in 2011. The rural literates were 493.0 million and the urban literates were 285.4 million. There has been an increase of 217.8 million literates since last census in 2001. Out of this, 131.1 million were in rural areas and 86.6 million in urban areas. The graphical representation of the growth in rural and urban literacy rates since 1991–2011 in India is shown in Fig. 5.

Figure 5 reveals that in national level during 1991–2011, the increase of 24.22 % point of rural literacy rate is slightly more than double that of urban literacy with 11.90 % point. The improvement in literacy rate in rural area is two times that in urban areas. The rural–urban literacy gap which was 28.3 percentage points in 1991 and 21.2 percentage points in 2001 has come down to 16.1 percentage points in 2011. Thus it can be concluded that the literacy gap between rural and urban population is decreasing day by day.

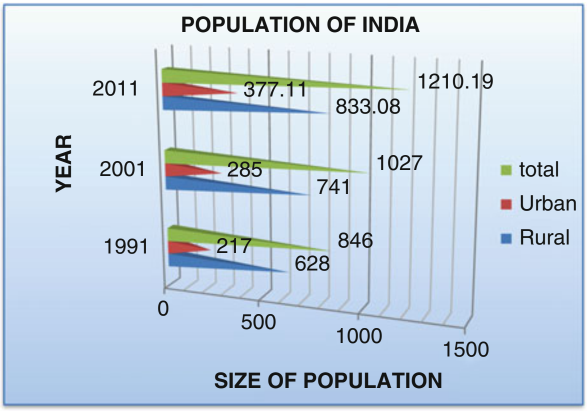



**Fig. 4** Graphical representation of the population of India (Source: (i) GOI, Final Population Totals, Paper-2 of 1992, Vol. I Census of India, 1991; (ii) GOI, Census of India 2001, Provisional Population Totals, Paper-1 of 2001, Registrar General, India; (iii) GOI, Census of India 2011, Provisional Population Totals, Paper-1 of 2011, Registrar General, India)

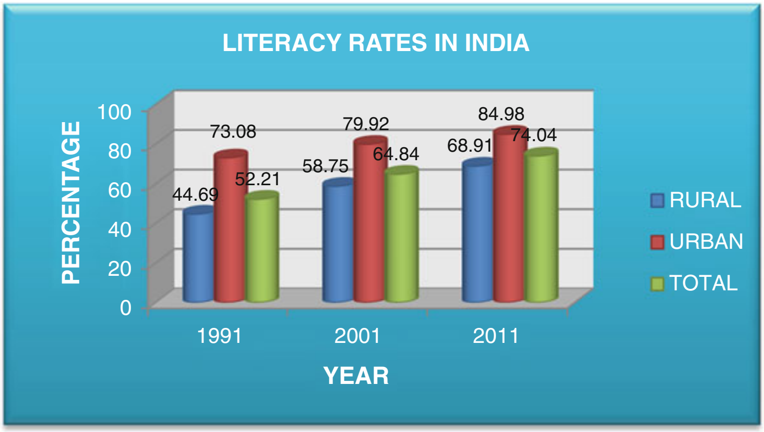



**Fig. 5** Literacy rates in rural and urban India (Source: Census 1991, Census 2001, and Census 2011)

## 7.5 Mobile Evolution in India: Market Realities

Figure 6 presents historical data of mobile phone demand in India. The mobile phone industry in India is experiencing an astonishing growth since the introduction of mobiles in the country. Mobile phone subscriber base has increased from a meager 0.03 million in 1995–1996 to 90 million in 2005–2006. Mobile phones, which were introduced a decade ago in 1995–1996 in India, are becoming the dominant means of accessing communication. At the end of 2005–2006, there were 90 million mobile phones in India in comparison to just 50 million landlines. There has been 25-fold increase in mobile subscriber base in a span of just 5 years from 2000–2001 to 2005–2006.

Wireless telephone segment has been the key contributor to remarkable growth in the telephone network in India. The number of wireless connections rose from

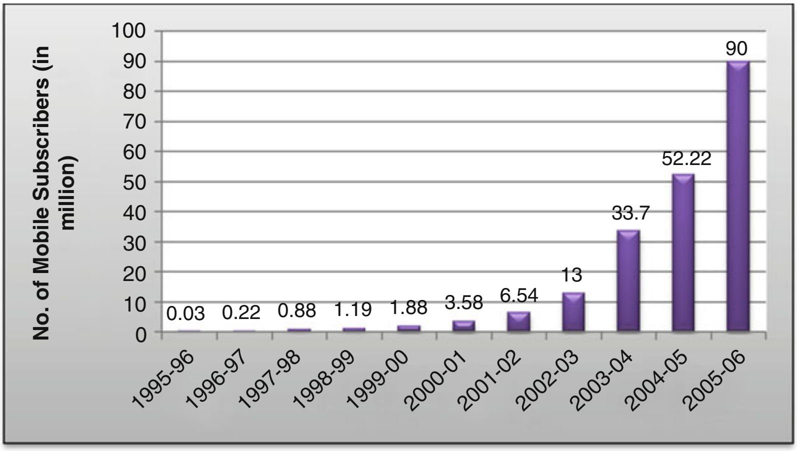



**Fig. 6** Growth in mobile subscriber base in India (Source: Singh 2006)

3.58 million in March 2001 to 165.09 million in March 2007 and reached to 876.73 million as on 31 August 2013. With 876.73 million wireless connections, Indian telecom has become the second largest wireless network in the world after China.

### 7.6 Mobile Density in India

Although India's mobile network with 90 million connections ranked among the largest in the world, its mobile-density (number of mobile phones per 100 inhabitants) is still among the lowest. However, growth in mobile-density has been phenomenal during the last 5 years or so. Mobile-density in the country has increased more than 23-fold from 0.35 in 2000–2001 to 8.12 in 2005–2006 (Fig. 7).

India has a significant base of mobile telecom subscriptions, about 950 million in the third quarter of 2012, according to the Telecom Regulatory Authority of India (TRAI 2013). Besides this very large number of subscribers, the speed of range of mobile telephony in India is a vital factor to reminder, with tele-density (number of telephone lines per 100 population) moving from under 4.38 in 2001 (Minges and Simkhada 2002) to 67.67 in 2011 (ITU 2011). The urban tele-density is thought be over 100. The spread in rural areas is lower than in urban areas and the TRAI estimates that the number of rural subscriptions as of June 2012 is between 150 million and 160 million. The rural population accounts for 68 % of the total population, according to the Census of India, 2011. A typical handset with a rural user is likely to be a basic instrument with voice and texting capabilities. Most such handsets cannot display characters in Indian languages, thus making voice the principal medium of use Ally and Tsinakos (2014).

The mobile subscriber base in India has shown upward trend after several months. It increased from 861.66 million in February 2013 to 867.80 million at the end of March 2013, registering a monthly growth of 0.71 %, according to data

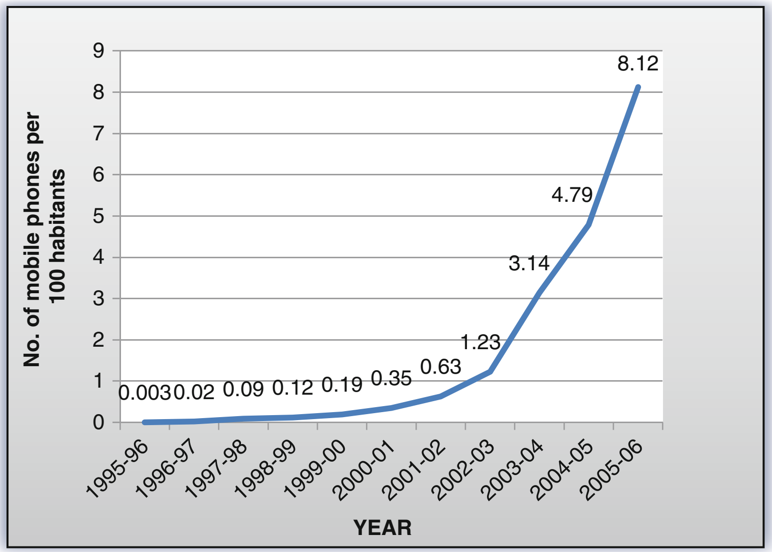



**Fig. 7** Mobile-density in India between 1995–1996 and 2005–2006 (Source: Singh 2006)

released by TRAI. The share of urban mobile subscribers has increased from 60.50 % to 60.53 % whereas share of rural wireless subscribers has decreased from 39.50 % to 39.47 %. The overall wireless tele-density in India has reached 70.85. Mobile subscription in urban areas increased from 521.29 million in February 2013 to 525.30 million at the end of March 2013. The wireless subscription in rural areas increased from 340.38 million to 342.50 million during the same period. The urban wireless tele-density has increased from 139.83 to 140.67 and rural tele-density has increased from 40.01 to 40.23.

The number of telephone subscribers in India increased to 898.02 million at the end of March 2013 from 892.02 million at the end of February 2013, thereby showing a monthly growth rate of 0.67 %. The share of urban subscribers has increased to 61.11 % from 61.08 %, whereas share of rural subscribers has decreased from 38.92 % to 38.89 % in the month of March 2013. With this, the overall tele-density in India increased to 73.32 at the end of March 2013 from 72.90 of the previous month.

Subscription in the urban areas increased from 544.86 million in February 2013 to 548.80 million at the end of March 2013. Subscription in rural areas increased from 347.16 million to 349.22 million during the same period. The monthly growth rate of urban and rural subscription is 3.94 % and 2.06 %, respectively. The overall urban tele-density has increased from 146.15 to 146.96 and rural tele-density increased from 40.81 to 41.02.

TRAI said the overall tele-density in the country increased to 73.32 at the end of March 2013 from 72.90 in the previous month. Reliance Communications added the maximum of 30.26 lakh subscribers in the month to take its user base to 12.29 crore at the end of March 2013. It is followed by Vodafone, which added 24.66 lakh users to

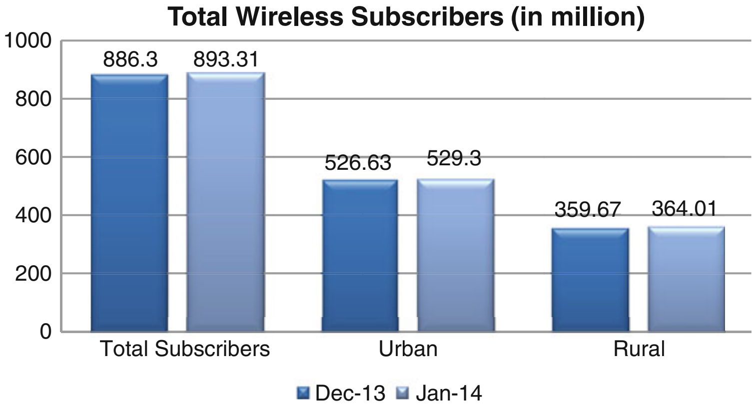



**Fig. 8** Total wireless subscribers in India (December 2013 and January 2014) (Source: www.trai.gov.in)

take its base to 15.23 crore. Idea Cellular added 23.17 lakh new subscribers, while market leader Bharti Airtel added 15.73 lakh users in March. State-run BSNL added 5.36 lakh new subscribers while MTNL lost 86,833 users during the same period.

The number of telephone subscribers in India increased from 915.19 million at the end of December 2013 to 922.04 million at the end of January 2014, thereby showing a monthly growth of 0.75 %. The share of urban subscribers has declined from 60.03 % to 59.86 %, whereas share of rural subscribers has increased from 39.97 % to 40.14 % in the month of January, 2014. With this, the overall tele-density in India increased from 74.02 at the end of December, 2013, to 74.50 at the end of January, 2014.

The data in Fig. 8 reveals that total wireless subscriber base increased from 886.30 million in December 2013 to 893.31 million at the end of January 2014, registering a monthly growth of 0.79 %. The share of urban wireless subscribers has declined from 59.42 % to 59.25 % whereas share of rural wireless subscribers has increased from 40.58 % to 40.75 %. The overall wireless tele-density in India has reached 72.18 from 71.69 of previous month.

Figure 9 shows that wireless subscription in urban areas increased from 526.63 million in December 2013, to 529.30 million at the end of January 2014. The wireless subscription in rural areas increased from 359.67 million to 364.01 million during the same period. The urban wireless tele-density has increased from 138.94 to 139.42 and rural tele-density has increased from 41.95 to 42.43.

## 8 Mobile Learning in India with Special Reference to Rural Areas

India has 791 million mobile subscribers according to regulatory body TRAI with a significant share in villages. That is the target group several start-ups and educational institutions are looking at. Krishna Durbha, head of value added services,

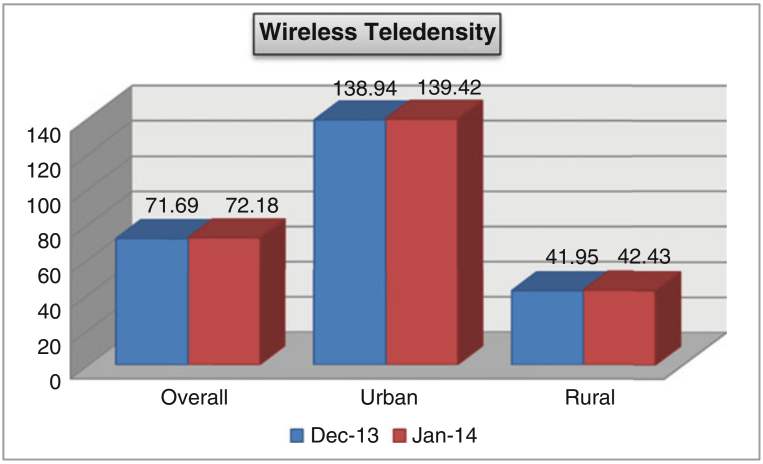



**Fig. 9** Wireless tele-density in India (December 2013 and January 2014)

mobile data, and content at Reliance Communications, said, "Mobile is a viable medium for basic education. The mobile learning space is completely new and is waiting to grow. There is a lot of opportunity but there is a need to find the right content. Touch screen and large screen formats will do wonders and they need to be available at cheaper rates. With good network and connectivity we can do lots. We are promoting mobile learning with some large foreign organizations in social sector with roots in India."

"Mobiles can penetrate better as they have things in favor like better battery life and people do not need any training to operate it. This gives it an upper hand over computers," Sunil Abraham, ED, Center for Internet and Society, said. According to Vikram Nagaich, director and founder, Innovate Edu, on one side, with mobile phones the reach of the content could be very wide. However, the efficacy would have to be delivered through extremely innovative and sophisticated content. For those institutions looking for an alternative focus, Park's (2011) pedagogical framework for mobile learning is a way of understanding how "transactional distance" and the "social" nature of an activity can be mapped against one another. Launched in 2009, Nokia Life has brought information and educational opportunities to over 90 million people in India, China, Indonesia, and Nigeria (UNESCO policy guidelines for mobile learning 2013). Towards the promotion of education remotely, SNDT Women's University, Tata Tele Services Ltd., Atom Tech, Mumbai, and Indian PCO Tele-services Ltd have entered into a strategic alliance to develop and disseminate mobile education, an additional vehicle in distance learning, to reach the masses for remote teaching and learning in rural communities and physically challenged (India's First M-Education Service 2013). Indian telco Bharti Airtel has launched a range of affordable mobile education services, dubbed m-Education, allowing customers access to services such as English lessons, exam preparation, and career advice over their handsets (Yap 2013). Mobile learning space is rapidly evolving in India and thus is playing a significant role in imparting education. The significance of this medium is slowly and steadily being realized by players in various industries, who are constantly developing the necessary applications to work towards mobile education. The key drivers behind growth of this sector include high portability, small size, low price, adaptable technology of mobile devices and most importantly, its increasing penetration in the country. Anticipating the future potential, several telecoms have started offering m-education services, such as English lessons, dial-in tutorials, school syllabi, question sets, vocabulary general knowledge tutorials, exam tips, exam result alerts, and education for the physically challenged. Operators usually partner with software companies to develop these applications. As per our estimation, penetration of m-learning in MVAS is around 7–12 % in India, which is expected to grow significantly in the coming years.

Enable M-Technologies currently provides multiple m-learning solutions to five operators, including BSNL. Amit Zaveri, chief operating officer, Enable M, says, "We manage the entire learning portfolio for Nokia and also power some of the content. We are also planning to go to Bangladesh. We see a lot of opportunity in the emerging markets as there is low bandwidth and dissemination of content is not standardized. We have already seen a lot of traction. We have a two-pronged strategy – we work with telcos and Nokia, as well as with closed user groups such as corporates, publishers and government."

## 9 Contribution of Mobile Learning to Education for All

Mobile learning is emerging as one of the solutions to the challenges faced by education. UNESCO's program of activities is therefore based on growing partnerships geared towards exploring how mobile technologies can enable the achievement of Education for All. Its partners include Nokia and the US Department of State. As increasingly powerful mobile devices continue to saturate rich and poor communities alike, advances in mobile learning – learning using mobile technologies – are likely to accelerate. A growing number of initiatives are demonstrating ways in which mobile phones can help confront existing educational challenges and pioneer new strategies for learning (McKinsey and Company and GSMA 2012). The applications of mobile learning range widely, from K-12 to higher education and corporate learning settings, from formal and informal learning to classroom learning, distance learning, and field study.

Inclusive education promotes the right of all women and men, girls and boys to a quality education that meets basic learning needs and enriches lives. Focusing particularly on vulnerable and marginalized groups, including women and girls and people with disabilities, inclusive education aims to develop the full potential of every individual (UNESCO 2009). Mobile devices can help overcome many of the challenges associated with larger technologies, as they fit more naturally within various learning environments. Mobile learning has already proven valuable to many learners, including marginalized women and girls and learners with

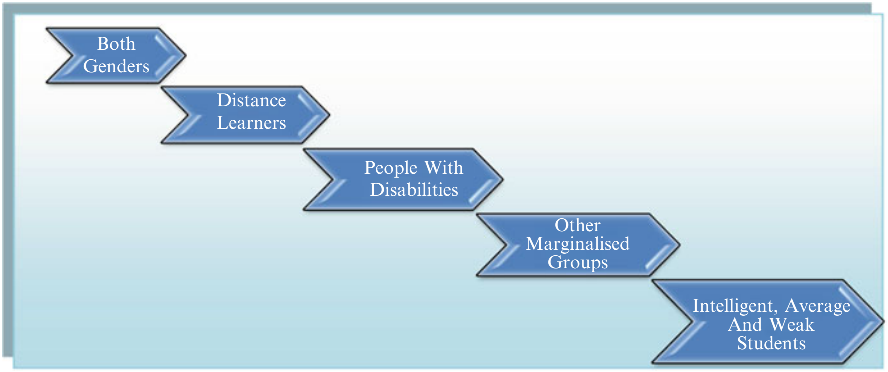



**Fig. 10** Mobile learning for every section of society

disabilities. By promoting gender equality and adherence to accessibility standards for hardware, software, website design, and content development, mobile learning policies can vastly extend the benefits of mobile learning to all (Fig. 10).

Mobile learning carries significant potential to extend educational opportunities to learners with disabilities. Mobile technology can deliver flexible and personalized learning experiences that meet the unique and varied needs of disabled learners in ways that traditional education resources and other ICTs cannot. For example, SMS communication, as opposed to audio voice messaging, is easily accessible to hearing impaired users, and assistive programs that read text aloud or enlarge text size on screens are useful to learners with visual impairments. A study of smart phone use at the Royal National Institute of Blind People (RNIB) College in the UK showed that visually impaired learners used mobile phones in their daily lives as much as non-disabled learners (Uffendell et al. 2009).

M-learning is turning geographically dispersed learners into a valuable teaching resource by enabling them to contribute their local knowledge and research data more easily. Consequently, this learning approach is supporting learner retention, progression, and transition.

## 10 Prospects and Retrospect of M-Learning

It is clear that the huge interest of mobile phones in developing countries has played a vital role in the triumph of many development interventions over the past decade. As well as aiding communication, mobiles have given people access to a range of services and information and revolutionized information collection and recording in humanitarian disasters.

However, one fundamental question was raised, is mobile technology a part of the blend of higher education learning or a replacement? Mobile technology is clearly rapidly establishing itself as part of the learning blend. Because of that, there will be a significant and important redistribution of technology ownership patterns, which in turn will affect usage patterns. As mobile devices become more powerful and more capable because mobile devices are less expensive, at least up front, it is clear every one of us will be new combinations of ownership. These changes will reshape the way the faculty and student do their computing.

Still students are not necessarily ready to fully move into the mobile space for their coursework. “Don’t assume student expertise other than listening to music” was one way this challenge was worded. Mobile technology might be in student hands, but the expertise needed to use it effectively for course work and assignments might not be – indeed, it noticed clearly that most students do not have strong expertise. This is a factor that any program using mobile technology needs to take into account.

## 11 Future Directions

The conceptualization, technological attributes, and existing pedagogy of mobile learning introduced above can help readers gain an understanding of mobile learning and how it is relevant to the future of teaching and learning with mobile technologies. As the author explained above the growth of mobile learning in relation to literacy rates, it can easily be understood that mobile technologies are changing the way of learning and making it affordable for everyone and allow learners to access learning content and learning interactions anywhere, such as factories, museums, hospitals, shopping malls, cafes, and outdoor areas. Learning materials can become accessible to a larger audience, through podcasts, mobile applications, blogs, and e-books, which are seen by potential students. Catering for disadvantaged social groups, mobile learning presents an opportunity to improve their life chances.

The developmental framework of mobile learning in India clearly explains that mobile devices are not only limited to urban parts but also its subscription growth is in a rapid phase in rural areas. Mobile educational systems have started to emerge as potential educational environments supporting lifelong learning; though other forms of learning like distance learning, etc., are very popular in India, learning is yet to find a pathway into Indian educational system. Also mobile services market in India is growing at a very rapid pace and the technological base required to support mobile devices is also quite strong in India. So India has the potential to be considered as a strong market for M-learning.

Attempting to predict the future of mobile learning, it can be said that m-learning in education process will hold much promise such as students will enjoy the advanced knowledge of their field, use of mobile devices will play an important role to enhance literacy in India, mobile devices will make learning possible for physically handicapped students also, and this learning approach will connect the students with technological developments.

The ubiquity of mobile devices makes them well suited for field-based learning experiences that require students to gather data as part of the process of developing scientific inquiry practices. The usefulness of these devices, however, is strongly influenced by the nature of the applications students use to collect data in the field. To increase student success and satisfaction with these experiences, mobile learning applications must be intuitive and functional for students, and support a systematic approach to the complex process of collecting data during a scientific inquiry. Mobile technologies have the power to promote and foster collaboration and communication, which are deemed essential for twenty-first century success.

## 12 Cross-References

▶ Characteristics of Mobile Teaching and Learning
▶ Transformation of Traditional Face-to-Face Teaching to Mobile Teaching and Learning: Pedagogical Perspectives

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# Mobile Learning and Education: Synthesis of Open Access Research

**9**

Teresa Cardoso and Renato Abreu

## Contents



**Abstract**

In a global and mobile society characterized by the possibility of portability, mobile devices are no longer accessories, but they are rather resources that we cannot do without. In fact, nowadays no one seems willing to give up these tools recognizing its potential in various fields. For instance, they allow not only to shorten various distances but also to respond to different situations of our daily life, and also, of course, they provide moments of leisure and entertainment. Thus, combining all these attributes and to benefit from them in education seems obvious.

However, to what extent and how are mobile devices integrated in education? Is mobile learning or m-learning a reality? Or a fiction, instead? Therefore, the present study aims at clarifying these issues through a literature synthesis of research available in online databases.

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In this state of the art, m-learning is briefly characterized, namely, by describing some of its particular types and environments and also by a SWOT analysis. Students and teachers' perceptions and practices on m-learning were also identified. We further identified determining factors that both students and teachers consider important in the use of mobile devices and in the acceptance of mobile learning.

In short, the systematization of the analyzed literature summarizes experiences that promoted changes in both the alphabetization and digital literacy of the whole participating school communities. One can conclude that m-learning is a research area with a recent past, a dynamic present, and a promising future.

## 1 Introduction

The Horizon Report foresaw six emerging technologies that could revolutionize the current framework of the teaching of scientific research and the economy of countries until 2015 (New Media and Corsortium EDUCAUSE (Association) 2010). Among these emerging technologies and according to this report, mobile computing and open content were soon to reach the maximum point of use. As a result of the evolution of mobile technologies, education is entering in the so-called third wave technology called mobile learning (Sarrab and Elgamel 2013). Thus, a new area of research arose to determine how these technologies can be used as learning tools (Kukulska-Hulme 2009), with the first projects emerging in the second half of the 1990s (Traxler 2005).

There is evidence to suggest that mobile learning is growing in visibility and importance. Firstly, in the last decade several studies have been developed on m-learning experiences, in formal and informal contexts, reporting positive results in the process of teaching and learning with relevant levels of adherence with regard to the acceptance of these technologies by the students (Attwell 2007). Secondly, we are witnessing an increase of workshops and conferences on the subject at all latitudes of the planet. As an example, there is the growing interest that mLearn conferences – Conferences on Mobile and Contextual Learning – are having within the scientific community, with successive meetings since 2002, being the last congress held in Istanbul. Thirdly, the community now has a peer-reviewed academic journal, the *International Journal of Mobile and Blended Learning*, as well as a professional research organization, *the International Association for Mobile Learning*.

Hence, the mobile learning has gained clarity on the main issues, a well-defined research agenda, and a greater awareness of the need for the existence of guidelines and ethical frameworks. Nevertheless, it is still a field in which practice has not yet been standardized in terms of research, mainly in terms of methods and tools (Traxler 2005). Therefore, it is appropriate to summarize the current state of knowledge and research on the subject, so as to identify potentialities and constraints of this type of learning.

**Table 1** Online databases searched for defining the corpus of this literature review, © Teresa Cardoso and Renato Abreu

| Online journals and databases | Impact factor | Uniform resource locator (URL) |
|---|---|---|
| *Educational Media International* | – | http://www.tandfonline.com |
| *Revista de Educación a Distancia* | – | http://www.um.es/ead/red/red.html |
| *Journal of Educational Technology & Society* | 0.824 | http://www.ifets.info |
| *eLearning Papers* | – | http://www.openeducationeuropa.eu/pt/elearning_papers |
| *Distance Education* | 0.725 | http://www.tandfonline.com |
| *Computers & Education* | 2.630 | http://www.journals.elsevier.com/computers-and-education |
| *Learning, Media and Technology* | – | http://www.tandfonline.com |
| *RIED. Revista Iberoamericana de Educación a Distancia* | – | http://ried.utpl.edu.ec |
| *The International Review of Research in Open and Distance Learning* | – | http://www.irrodl.org/index.php/irrodl/index |
| *Open Praxis* | – | http://openpraxis.org/index.php/OpenPraxis/index |
| *Comunicar* | – | http://www.revistacomunicar.com |
| *Informática na educação: teoria & prática* | – | http://www.seer.ufrgs.br/index.php/InfEducTeoriaPratica/index |
| *The Internet and Higher Education* | 2.048 | http://www.journals.elsevier.com/the-internet-and-higher-education |
| *American Journal of Distance Education* | – | http://www.tandfonline.com |
| *Repositório Científico de Acesso Aberto de Portugal* (RCAAP) | – | http://www.rcaap.pt/ |

Source: Data collected for this study

In this text, the result of a literature review on m-learning is presented, considering documents available on the Internet at specialized electronic databases in education. A methodology focused on the criteria proposed by Rosenberg and Donald (1995) for the research of scientific evidence was adopted, thus claiming the comparability with the medical sciences, which have the largest collection of electronic databases on the Internet (McVeigh 2004). In addition, the selection of the analyzed publications was made in view of the recognition by experts in the field, their scientific committees, and, when possible, their impact factor as indicated in Table 1.

The last criterion considered to constitute the corpus of analysis for this study was the temporal filter defined between 2010 and 2014. This option was due primarily because of the speed of technological innovation when it comes to computers and therefore in the evolution of mobile devices, and also so as to take into account the technical update and progress of m-learning.

## 2 Mobile Learning and Education: An Emergent Field of Research

M-learning is still an emerging research field. So, different actors and several factors are involved in conceptualizing it (Traxler 2007). This will determine the perceptions and expectations in its evolutionary process towards the future (Traxler 2009). Therefore, it is not surprising that various definitions arise, although one can already highlight the attributes shown in Fig. 1.

Thus, based on the attributes of Fig. 1, we can define m-learning as the connected, interactive and personalized use of portable devices in classrooms, in collaborative learning, field work, advice and guidance for students (Traxler 2011). This definition means that mobile learning can include the following technological options: personal digital assistants (PDAs), mobile phones with SMS, smartphones, tablets, game consoles, iPods, and wireless infrastructures (Traxler 2005). However, this is still one characterization among others. It is, perhaps, technocentric, maybe unstable and focused on the set of hardware devices previously mentioned (Traxler 2005). It is therefore important to explore other approaches to this contemporary phenomenon.

M-learning is also a reality in online education, and knowing the latter results from the evolution of e-learning, it is also important to note that online education is expanding at great speed in primary and secondary education as well as in higher

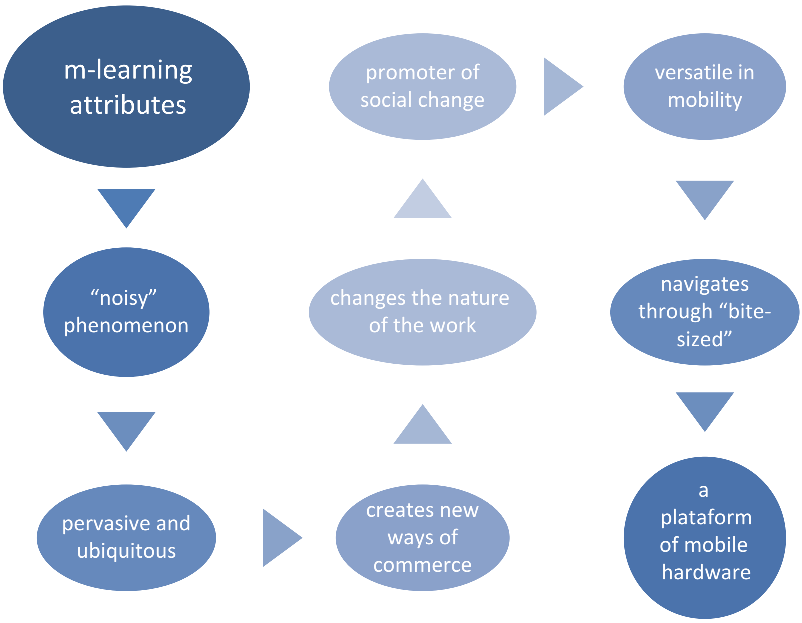


Fig. 1 M-learning attributes (Source: Based on Traxler 2009), © Teresa Cardoso and Renato Abreu

education. Most of the educational institutions are aware that change is a constant feature in the lives of students. That is why they continuously analyze ways to incorporate change in their practices. However, some traditional higher education institutions are hesitant to introduce e-learning in their teaching methodologies, like m-learning as well. Despite being innovative and technically achievable, incorporating pedagogical benefits, and currently knowing visibility and growing importance in higher education (Traxler 2007), m-learning may eventually have no possibility of institutional large-scale implementation in the near future (Traxler 2010). For m-learning in higher education to become a successful story, it is important to address the social, cultural, and organizational factors involved. These can be formal and explicit and tacit or informal and may vary greatly in all institutions and within each of them (Traxler 2009). Adding to this problem, most of the work done on m-learning in universities is still in a pilot phase testing, which points to considerable difficulties in the support and development of new teaching methodologies (Traxler 2009).

Another political action line for higher education institutions to equate is the desirable availability of open content to the world, that is, the higher education institutions' repositories of open educational resources must adapt their characteristics, so that their contents (at the level of creation, publication, exploration, acquisition, access, use and reuse of learning objects) can be accessed from mobile devices. This action line of open content democratization is reflected in the 2004 and 2010 Horizon Reports, which referred to, respectively, learning objects and open contents, predicting its short-term impact due to the current trend of availability of open contents, free of charge on the Internet, which can be viewed on mobile devices (Tabuenca et al. 2012).

In fact, mobile devices produce almost a universal effect of connectivity between people, data, content, and media. So, we are watching changes and disruptions in learning that are launching the countries to emerge as a knowledge society oriented towards technology. The success of these societies depends on the ability to promote the acquisition of key skills and expand opportunities headed for more flexible and innovative ways of learning for all citizens, including nonformal education. Bearing in mind that in Asia almost everyone has a mobile phone or will soon have one, an Indian researcher argued that Asian countries can establish and use mobile networks for learning. The researcher proposed an "each-one-teach-one" mobile network project as a strategy to access to new knowledge, especially for the Asian countries and in general for all countries of the world. Mobile network proposals will work on the principle that those who want to teach and those who want to learn should have a free and open service to connect and share knowledge (Misra 2012).

In addition, the development of m-learning has often been driven by educational need, technological innovation, and funding opportunities. M-learning should be characterized as a specific project within the education systems, and its strengths, weaknesses, opportunities, and threats are, generally, those shown in Fig. 2.

As shown in Table 2, some information can be added, by further explaining the factors identified in Fig. 2.

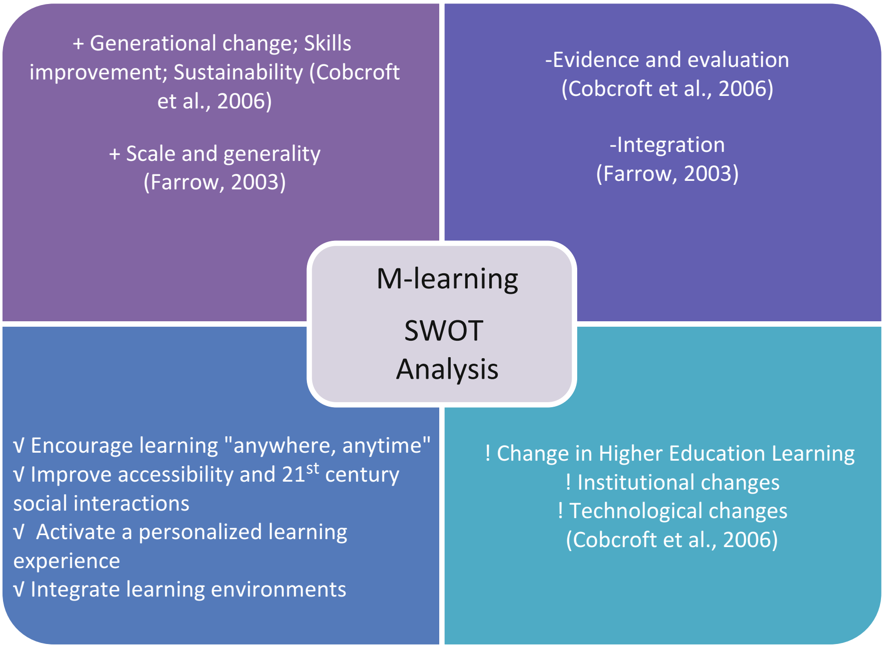


**Fig. 2** M-learning SWOT analysis (Source: Data collected for this study), © Teresa Cardoso and Renato Abreu

## 3 Mobile Learning and Education: A Knowledge Systematization

As a result of scientific research, there is nowadays a vast repository of case studies, essays, and pilot studies publicly available, which enable to identify three main types of m-learning: personalized, situated, and authentic (Traxler 2007). The personalized m-learning is defined as the learning that resorts to different pedagogical approaches and that acknowledges social, cognitive, and physical differences and diversity in designing contents, interfaces, and mobile devices. The situated m-learning occurs during the learning activity, in rather specific contexts. Finally, the authentic m-learning is the learning that uses real-world problems and projects that are relevant and of interest to the student. This typology may be further differentiated, when instilled by the correct applicability of the available mobile technologies. This, in turn, enables constant changes of educational contexts or environments (Nash 2007), thus facilitating the integration by the student of the real world into the world of tools or devices and successfully showing achievement of the learning goals. Hence, it is possible to create different m-learning environments characterized by different aspects (Traxler 2009):

**Table 2** Detailed m-learning SWOT analysis, © Teresa Cardoso and Renato Abreu

| Strengths(S) | Weaknesses(W) |
|---|---|
| ± ***Generational change***: the identification in today's young people of the desire to be creative, to collaborate, and thus gain celebrity status is seen as belonging to the "Generation C." This trend indicates a movement towards the DIY (do it yourself), which is presented as the creation of content and the dissemination of knowledge led by the users themselves (Cobcroft et al. 2006)<br>± ***Skills improvement***: the mobile devices can help improve literacy and numeracy skills; encourage independent and collaborative learning experiences; identify areas where students need assistance and support; mitigate resistance to change using ICT; engage reluctant learners, allowing that they stay more focused for longer periods; and promote the self-confidence and self-esteem (Cobcroft et al. 2006)<br>± ***Sustainability***: the sustainability of m-learning pilot studies and experiences in educational settings tends to achieve a balance between costs, on the one hand, and the creation of financial profitability and social capital, on the other hand (Cobcroft et al. 2006)<br>± ***Scale and generality***: the m-learning community is excited to understand how some pilot studies, projects, and experiences in educational settings successfully can be applied on a larger scale in order to find the balance between the possible generality and the specificity (Farrow 2003) | **-** ***Integration***: the integration of mobile learning in other learning systems based on technology and institutional and organizational processes has not been a top priority (Farrow 2003)<br>**-** ***Evidence and evaluation***: the scientific community should give signs of greater relevance, meaning, and impact on the evaluation of m-learning, as it has presented more intrinsic problems than the evaluation of e-learning (Cobcroft et al. 2006) |
| **Opportunities (O)** | **Threats (T)** |
| The **opportunities** commonly associated to m-learning are essentially the following:<br>*Encourage learning "anywhere, anytime"*<br>*Improve accessibility and the twenty-first-century social interactions*<br>*Activate a personalized learning experience*<br>*Integrate learning environments*<br>However, the enthusiasm for the incredible potential of the mobile devices must be tempered by the functional, cognitive, and social considerable challenges, which are identified within m-learning (Farrow 2003) | ***! Change in higher education learning***: the predisposition for an increasing availability of mobile and wireless devices has direct implications on the blended learning environments, which combine physical and virtual strategies. These environments have in turn implications for students (learning experience) and teachers (practices) and for the planning of technology and sustainability. Thus, these are critical aspects in the implementation of m-learning in higher education institutions (Cobcroft et al. 2006)<br>***! Institutional changes***: the reference model to determine the most suitable technological choices in implementing m-learning should include criteria such as adequacy and access, easiness of use and reliability, costs, new trends in pedagogy, interactivity, organizational issues, innovation, speed, and alignment with the institutional goals. Consequently, the institutions should understand that the adoption of m-learning is in need of a strategic approach to risk management, with an assessment of the adequacy, quality, compatibility, and cost of the devices. Otherwise, it will be very difficult to keep the resources and minimize the change fatigue (Cobcroft et al. 2006)<br>***! Technological changes***: the wide availability of technology is essential but by itself it is not enough for learning environments to be considered effective (Cobcroft et al. 2006) |

Source: Data collected for this study

- *Oriented technology* – some innovations in mobile devices are implemented in the academic environment to determine the technical feasibility and the pedagogic features of such devices.
- *Portable miniaturization of e-learning* – learning using mobile technologies is much more flexible and replaces with great efficacy the static technologies of desktop computers, taking into account the privileged environment of e-learning.
- *Connected classroom* – the same technologies are used in the classroom to support collaborative learning, together with other technologies, such as interactive whiteboards.
- *Additive technology* – the mobile technologies are enhanced with additional functionalities, for instance, video capture, to improve the educational experience, which would otherwise be difficult or impossible to achieve.
- *Just-in-time training* – mobile devices are used to improve the productivity and efficiency of the workers in geographic mobility, providing just-in-time information and support.
- *Environment and development* – technologies are used to cope with challenges regarding environment and infrastructure, supporting conventional education, in places in which it would be difficult to implement e-learning technologies.

In these educational scenarios, it is useful to analyze students and/or teachers' perceptions and practices regarding m-learning and the ownership of mobile devices by either or both of them. This will be done in the following sections, on the basis of a synthesis of some of the examples included in the open access research corpus of this study.

## 3.1 Students' Perceptions and Practices

Lowenthal (2010) carried out a study in which he analyzed the factors or determinants of the behavioral impact that explain the adhesion of students (51 men; 62 women) to m-learning at a university in the USA. These determinants included the expectation of performance and the expectation of the effort and self-management of learning, all mediated by age, gender, or both. The regression coefficients showed strong significant relationship between the expected performance and the expected effort and behavioral willingness to use a mobile learning strategy. Researchers have shown also that the age and sex had no impact on mediation.

Two years later, Firmin et al. (2012) reported on the results of a qualitative research study carried out with 3,000 students of the American University, located in the Midwest, on their phenomenological perspectives (perceptions and motivations) with regard to using the BlackBerry. Three key aspects inductively emerged during the interview process: the students described the motivations that influenced their decisions of buying and using the BlackBerry, including the rather quick and convenient access to the e-mail and the Internet that these smartphones offer; all students compared their BlackBerry with the iPhone, valuing their mobile phones as only moderately "cool" and technologically less advanced; students reported specific perceptions related to the use of the BlackBerry, which included a financial stigma and a stereotype of entrepreneur.

More recently, Gikas and Grant (2013) studied not only the students' perceptions regarding learning using mobile devices but also the role that these play in virtual communities. This qualitative research study focused on eight students of three universities of the USA. These students used the mobile devices on their courses for at least two semesters. The main data collection method used to assess the students' perceptions was the focus group. Two specific themes emerged from the data of the interviews: benefits and frustrations regarding students' learning related to the use of mobile devices. Participants in this study acknowledged the changes that occurred in learning, regardless of the limitations they identified, including the phobia of incorrect functioning of technologies, small keyboards that difficult typing, and the possible potential of distraction that these technologies offer. It is, however, important to mention that the participants that volunteered to share their experiences did so because they believed that mobile devices had an impact on their learning.

Another study, both quantitative and of transversal observation nature, was carried out by researchers from a Dutch university with the participation of 3,132 students. They answered an online survey on ownership and use of laptops, tablets, and smartphones, as part of a strategy by the university, called bring your own device (BYOD), to promote learning improvements resorting to mobile computational devices. The survey included the sociodemographic characterization of the students, information about parents' earnings (indicator of the socioeconomic status of the student), and questions regarding the usability of the mobile devices. The results showed that 96 % of the students owned at least one mobile device (laptop, tablet, or smartphone). By using an econometric model, it was perceived that the students' earnings, their family earnings, and typology, gender, and immigration have a statistically significant effect with regard to having a mobile device. The high percentages of mobile device ownership are, however, not associated by any means to the support given to the classes attended by the students. In this study, the students did not seem much enthusiastic to bring their mobile devices to the classes, choosing rather to leave their laptops at home. In general, the students only brought the laptop to the university once every 4 days, as they felt it was too heavy to carry. As a consequence, the students were not keen on the BYOD strategy despite the didactic benefits that this could provide to their education. Therefore, it seems that the strategy defined by that university was hampered (Kobus et al. 2013).

In Spain, research was carried out to analyze the use and the concept of mobility of the information and communication technologies (ICT) of a group of 67 postgraduate students participating in an experiment of m-learning at the IL3 Institute for Life Long Learning of the University of Barcelona. During the online postgraduation course, designed from a traditional e-learning perspective, the students had access to a tablet (iPad) to work and for professional and private life use, as well. Before and after the course, an original survey was applied; it was designed to analyze the students' attitudes, opinions, and habits. Trends in the use of mobile devices and the participants' perceptions, from exams, goals, grading, as well as the integration with other technologies and genuine applications in the students' personal, social, and professional life, were analyzed. The research aimed at answering five questions; the first question was "for what purposes do students usually use the Internet before and after the e-learning experience?" The authors concluded that the use of the Internet is mainly focused on the participation in social networks in order to produce information (and not necessarily only from a perspective of collecting information). The answers to the second question – "for what purpose do students use mobile devices in the framework of their formal/professional education before and after the m-learning experience?" – enabled them to state that the use of mobile devices changed significantly. Thus, the authors emphasize the students' tendency to focus the attention on multifunction mobile devices and on using the tablet as an extension of the computer. Regarding the third and fourth questions ("what use is made of the mobile device in their daily life before and after the m-learning experience?" and "does your evaluation of the Internet and of the mobile devices change after the e-learning experience?"), the results show that the introduction of the iPad led to a change in the habits of connection and use of technology. This caused direct implications in the students' daily, personal, and professional life, and a key change on the processes of accessing information was witnessed. Finally, with the sample of their study, the researchers were unable to prove that the Bernoff profiles were reproduced (Oró et al. 2013).

For Aish and Love (2013), the successful implementation of m-learning in higher education is essentially based upon the acceptance of the users. Hence, taking into account the unified theory of acceptance and use of technology (UTAUT), coined by Venkatesh, they proposed a model to identify the enhancing factors of m-learning acceptance. They also studied whether the previous experience with mobile devices affected the m-learning acceptance. A model of structural equations was used to analyze data gathered from 174 students of the Brunel University. The results indicated that the performance and effort expectation, the influence of the teachers, the quality of the service, and the capacity of personal innovation are significant factors that affect the behavioral intention of adhering to m-learning. With regard to previous experience with mobile devices, this was also considered an important factor in the behavioral intention.

To summarize, it can be inferred that the determinant factors of the behavioral impact that explain why students adhere to m-learning are the following:

- Expectation about performance, effort, and learning self-management
- Influence of the teachers
- Quality of the mobile service
- Personal ability to innovate
- Key changes on the processes of accessing information
- Previous experience with mobile devices

Summarizing now the factors regarding the use of mobile devices, the following were perceived:

- Rather quick and convenient access to the e-mail and the Internet
- Students' earnings, their family earnings, and typology, gender, and immigration

### 3.2 Teachers' Perceptions and Practices

In this section some factors that determine the adhesion of teachers to m-learning and their attitude towards it are contextualized, as it is deemed important also to understand whether teachers define their mediated activities by mobile devices. Firstly, it is considered a study developed by four Spanish researchers who analyzed the feasibility of the incorporation of mobile technological support in educational practice, assessing the level of acceptance of this innovative measure. The sample of the surveyed population included 50 participants, grouped into three distinct sets: teachers of the University of Alcalá, specializing in technology; students who had their master's in teacher education at the same university, in the school year 2011/2012; and former students. The results revealed a broad acceptance of the incorporation of mobile devices, as well as a high degree of awareness of some of its effects. Different levels of teachers' former training needs were also perceived (Álvarez et al. 2013).

In the same year, Mifsud et al. (2013) presented different perspectives on the role of the teacher equipped with PDAs (Palm IIIc and iPAQ PPPs) in the classroom, describing four studies in two countries (Norway and the USA). The general aim of those studies was to understand how teachers use the new tools in different educational contexts. The teachers of the Hedland Primary School (Norway) had no experience in the use of PDA in the classroom, but they revealed an assimilation of its functionalities aligned with the historical and chronological development of technology (books, a typewriter, and so on). In other words, teachers took advantage of this connectivity when resorting to the oldest and most familiar ways of planning the classroom activities, using the PDAs as a new form of book. This contrasts with the teachers' attitude of the Midlands Intermediate School (USA), in which these types of mediated actions seem to be in regular use in the classroom. However, these teachers were more experienced in the use of PDA, as it was the fifth year of adoption of the PDA in the classroom, and revealed stronger opinions about the mediation of the PDAs. Finally, Mifsud et al. (2013) stated that it is not enough to introduce a new tool like the PDA in the classroom and wait for the teaching practice to change automatically. That is, teachers need to be aware of the new tool; they need to become proficient in their use, to realize their usefulness, and to be able to reflect on the advantages and restrictions of the tool in the context of learning, so as to take out all the benefits of its use in the classroom.

Another issue to bear in mind as far as the "digital teachers" or "technological teachers" are concerned is the fact that they can be recognized as online tutors.

Indeed, Mathew and Sapsed (2012) suggest that in distance learning programs, both technology and pedagogy are crucial and mutually dependent elements and that the online tutors take on roles that go beyond the traditional scope of teaching. Besides, they are frequently forced to assume roles of adviser that fit more the skills of a counselor or of another professional from a different area.

Of the analyzed studies, it may be suggested that the proactive attitude of teachers towards m-learning involves:

- Assuming the role of online tutors
- Showing a wide acceptance in the use of mobile devices
- Seeking prior training actions for different purposes
- Becoming proficient in the use of mobile devices
- Realizing the usefulness and reflecting on the advantages and constraints of mobile devices in the context of formal learning

### 3.3 Students and Teachers' Perceptions and Practices

Among the analyzed studies portraying different contexts, there are still those which refer to the m-learning perceptions and/or practices of both students and teachers.

For example, studies on m-learning have also been developed in the field of health research, namely, in the area of self-efficacy, as the case of a research which took place in a nursing college in Canada. The aim of this research was to evaluate the teachers and students' self-efficacy in the use of the full potential of mobile technology, in the process of teaching and learning in educational settings and in clinical practice. Within this transversal study, implemented in two education programs, 100 and 21 teachers and students were interviewed. The results showed a high level of ownership and use of mobile devices among them. The result of the median of the mobile self-efficacy was 75 on a scale of 100, indicating that both the teachers and the students were highly confident in the use of mobile technologies and prepared to engage themselves in mobile learning (Kenny et al. 2012).

Another of the research focus on m-learning, as pointed out before, are the guidelines and practices regarding the use of the mobile phone by teachers and students. This goal was sought after by Obringer and Coffrey in their study, which took place in 2007. For this purpose, a questionnaire was sent at random to 200 directors of the USA High Schools, involving the 50 States. The response rate was 56 per cent from all regions of the country. The main results are summarized to the following:

- The majority of the schools presents guidelines on the use of mobile phones.
- Parents generally support the use of mobile phones at school.
- In the classroom the teachers use mostly their mobile phones to solve issues not related to the school subjects.
- There is disciplinary action for inappropriate use of the mobile phone by the students, varying from a mild admonishment to the confiscation of the mobile phone in school.

Seven years later, a different research had as its starting point the following question: "How can mobile phones be used to improve teaching and learning in science in secondary schools?" In this study, a group of teachers (5 men and 13 women) from Sri Lanka developed four lessons on household chemical products, functions and reactions of a voltaic cell, interactions between organisms and the environment, and the diversity of leaves. These lessons explored the features of mobile phone cameras, instead of its communication functions. A qualitative methodological approach was used to analyze the data collected, from the teachers' planning to observations of lessons, and subsequently interviews were put forward with a number of students. The results showed that the use of images and videos captured by the students with their mobile phones allowed teachers to bring the outside world into the classroom and to provide unbiased data. These enhance the assessment of learning and also allow the teachers to clarify possible misconceptions of the students (Ekanayake and Wishart 2014).

Still in the scope of the use of a mobile phone in an educational setting, more specifically in Portuguese primary and secondary schools, Carrega (2011) developed a case study on the representation of students and teachers of the 9th and the 12th grade. The results of the survey to 179 students and 88 teachers of these grades indicate that students and teachers have different representations, but the majority of them are not very receptive to using mobile phone in educational contexts. The students of the two grades stated that they were unable to indicate a situation in which teachers could teach better a subject by using a mobile phone. They could neither imagine a situation in which they could learn better a subject by using a mobile phone. As for teachers, a significant percentage of them did not recognize pedagogical advantages in using a mobile phone.

A process that created great controversy in the past few years was a study on the impact of the efforts of m-learning implementation in the Estonian school system. The results showed different reactions by students, school leaders, and teachers. Although all of them have almost all the needed tools and skills, teachers showed an almost total lack of motivation on promoting mobile learning. Researchers presented some positive and negative scenarios and predicted huge problems if the teachers' training remains unchanged and if the policies of Internet security (e-safety) are not adequately developed (Lorenz and Kikkas 2013).

## 4 Future Directions

The m-learning community has been focused on pedagogy and technology proving to be able to strengthen, broaden, enrich, and validate concepts of the learning activity itself, as well as to challenge and defy it, now and in the near future. However, the advances achieved in m-learning are not exempt from the risks of learning massification and industrialization (Traxler 2010).

M-learning has the potential to convey the learning process to people, communities, and isolated countries, offering students the opportunity to take control of their learning experiences in a different way. Thus, students will have the ability to engage themselves in information and discussion activities, as part of real life, by becoming instruments of social policy. However, one cannot forget that mobile technologies used to teach may eventually turn out to be dysfunctional. This can be the case when they are vehicles of a certain culture or a spare and undesirable social luggage or just when they are empty containers loaded with unnecessary and inadequate expectations (Traxler and Agnes Kukulska-Hulme 2006).

Research on m-learning should question and deepen wider learning theories that include new fields of knowledge such as cognitive psychology, bioinformatics, nanotechnology, and artificial intelligence. Research on motivation levels generated by m-learning should be further studied by the scientific community in order to become a universal truth, since to this date the evidence is scarce (Traxler 2011).

In general it is possible to call m-learning to any form of learning through mobile devices, energetically autonomous and small enough to go along with people anywhere and anytime (Roschelle 2003). Currently students inhabit a social, cultural, and technological environment, where knowledge is built and shared, as part of a social process. Mobile technologies, managed effectively, can withstand constructivist approaches in learning and can be observed as tools to expand the discussion beyond the classroom and provide new ways for students to collaborate and communicate within their class or "around the world," creating their own learning contents (Cobcroft et al. 2006). This reflects the need to validate a conceptual framework of m-learning to improve quality, increase flexibility, and customize and centralize the learning process on the student. This conceptual framework should be based on four fundamental principles (Cobcroft et al. 2006): engage students, recognize the context of learning, challenge students, and provide practical activity.

The crucial factor to consider all integrating aspects of the m-learning development, including its conceptual framework, is the identification of the "turning point" in which the adoption of mobile and wireless technologies will gain a critical mass that will force the institutions to adopt effective and efficient plans and approaches in m-learning.

## 5 Cross-References


- ▶ Augmented Reality and 3D Technologies: Mapping Case Studies in Education
- ▶ Adoption of Mobile Technology in Higher Education: Introduction
- ▶ Characteristics of Mobile Teaching and Learning
- ▶ Design of Mobile Teaching and Learning in Higher Education: Introduction
- ▶ Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom

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# Mobile Learning and Engagement: Designing Effective Mobile Lessons

# 10

Kimberly Vincent-Layton

## Contents



**Abstract**

As the world continues to move deeper into mobile, higher education classrooms (virtual and face to face) are positioned well for utilizing mobile learning to further enhance student engagement and learning. This is significant to today's millennial learners who are tech savvy and have never known a world without the Internet. Connecting to this internet generation via mobile technologies creates relevance in the learning environment. Educause discusses the implications for teaching and learning in the May 2010 "7 Things You Should Know About Mobile Apps and Learning" and stresses that ". . . mobile devices support lifelong learning, and because the devices themselves are integrated into everyday life, they facilitate authentic learning" (Educause 2010). Yet one of the greatest challenges lies in the reality that there are few resources published that

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offer comprehensive mobile lessons and concrete methods to effectively implement mobile learning into the classroom. Educators need specific guidelines and model examples of mobile lessons to fully understand how to create the lesson, what to consider when developing, and how to successfully integrate it into the classroom. Having these essential components will change the ways in which learning takes place, breaking free of traditional pedagogical structures and finding new and relevant ways to engage the millennial learner. Christy Price, a psychology professor at Dalton State College, indicates that in order to reach this level of engagement, relevance is one of the greatest challenges in connecting learning outcomes and activities for the millennial learner (Price C, Why don't my students think I'm groovy?: The new "R"s for engaging millennial learners, 2009). Educators can create relevance to learning using effective mobile design and implementation.

The Mobile Lesson Template is a design guide that includes several elements for teachers to thoroughly examine when considering the ways in which mobile can support students' learning (see Appendix A). As discovered in a semester-long faculty learning community on mLearning, faculty were successful in utilizing the Mobile Lesson Template to create and implement mobile lessons into the classroom, allowing for reflection and evaluation of students' learning. Educators worldwide can create significant connections between engagement and learning by incorporating mLearning strategies into teaching and learning design.

## 1 Introduction

As students today continue to expand the use of mobile devices for everything from entertainment to social communication to news, educators can view this as competition for time-spent learning or take advantage of the ubiquitous nature of mLearning by integrating mobile lessons into course work that can further extend students' learning beyond the walls of classroom space. In looking at both mobile learning and millennial characteristics, it is important to consider how the two intersect with respect to the learning environment. Mobile learning characteristics include "anytime and anywhere" and "flexible access," which are key in understanding the scope of where the learning can reach. The boundaries are endless. Millennials, otherwise known as "Generation Y" or "Digital Natives" or "Net Generation," are people who were born between 1981 and 1999, a quarter of the United States population and a significant part of the college base today. These learners have unique characteristics that include technological, goal-oriented, team-oriented, high achieving, pressured to succeed, sheltered by parents, and socially conscious (Howe and Strauss 2007). Millennials are creative and want learning to be a fun experience. The ways in which millennials impact teaching and learning are significant to the integration of mobile in today's classrooms. In Price's studies of millennial learners, the most important elements in a learning environment were found to be "interactive" and "participatory" (Price 2009). Millennial learners crave the technology and the interactive team aspects that flexible mobile learning environments support and allow the extension of the learning into the world beyond a physical space. This provides a very strong relationship between millennial learners and mobile, which is further enhanced by utilizing tangible methods and tools to support mobile learning and teaching practices.

The Mobile Lesson Template is one such method/tool. The template allows the educator to tap into the millennial learner's crave for technology and interactivity while considering a well-rounded look at all the necessary elements to consider when designing the lesson (see Appendix A). Creating a lesson is by nature a challenging and sometimes daunting task for an educator. Design takes precision, deep thought, and reflection. Add the persistent nature of mobile to the mix, and this can appear to add another layer of complexity. However, the Mobile Lesson Template creates a solid foundation for the design and development of a mobile assignment. The template begins with identifying the goal of the mobile lesson with respect to meeting the learning outcome(s). Additional template elements contribute to the creation of a well-rounded, thoughtful lesson.

Looking at mobile as something that can be integrated, rather than as an extra step in the creation of in-class and/or online assignments, is a sound approach. In ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning," it is noted that a blended learning environment is considered the preferred format with respect to mobile learning at this time. For this reason, mobile lesson design can be easily incorporated into existing lessons rather than starting from a blank slate. The Mobile Lesson Template guides the educator in recognizing a number of essential elements that should be considered in supporting successful outcomes of the mobile lesson. Elements such as allowing app and device freedom of choice and alternative assignments are some of the key mobile best practices because all students are included, regardless of ability and/or access. The elements take a close look at the crucial considerations when going mobile.

In this chapter, *mobile lesson* will be defined, and key elements of the Mobile Lesson Template will be presented and discussed to support educators in successfully creating mobile lessons. A case study on the design and implementation of once such mobile lesson using the Mobile Lesson Template will also be shared. Lastly, a look at a semester-long Faculty Learning Community on mLearning will provide further evidence of the effectiveness of the Mobile Lesson Template as a model for designing mobile activities. As mobile technology expands and penetrates education at faster and deeper rates, educators can easily grasp and apply mobile methodologies and pedagogies to extend students' learning outside the confines of the classroom.

## 2 What is the Mobile Lesson?

The mobile lesson is an activity that may take place in a face-to-face classroom, in a virtual classroom, or out in the world. It allows the students to reach outside the walls of physical space and connect course concepts to a personalized learning experience. The personalized learning experience is meaningful and therefore encourages the individual to take charge of his/her own learning as it continues beyond the life of the course.

One example of a mobile lesson is students adding and sharing voice data to various locations around the world by using a geolocation app, such as GeoGraffiti. Classmates (and others!) can "go" to these locations and find the data and add further information. Another example is students using a live-blogging tool, such as CoverItLive, to generate content during class or other learning sessions. In an online anthropology course, students might use mobile devices to capture observations using field notes and images to share in a course blog, wiki, or forum. Higher levels of learning skills that are used from these types of experiences include critical thinking, problem solving, and analysis (Atherton 2013). In order to achieve these higher levels of learning using mobile pedagogies, the Mobile Lesson Template becomes a useful guide in creating learning experiences that are designed to consider the knowledge and skills that create desired outcomes.

## 3 The Mobile Lesson Template

There are several key elements of the mobile lesson that need to be considered in order for it to be effective in the classroom. The first step in designing the mobile lesson is to look at the goal and the outcomes. An effective mobile lesson can be created to meet the outcomes of an assignment by utilizing the Mobile Lesson Template, which includes core principles (goal, outcomes, instruction, assessment) of Wiggins and McTighe's *Understanding by Design* (see Appendix A) (Wiggins and McTighe 2005). The first six elements of the Mobile Lesson Template create the foundation that is needed to build the lesson. Once these are defined, the template includes other elements that should be considered and also allows for flexibility in including only what is needed for the particular activity.

*Element 1: Assignment Name*. It is important to include a name for the assignment and lesson concept that uses the word "mobile." As with any lesson, providing a concise name draws the student into the lesson. For example, *Scavenger Hunt Mobile Lesson on Motivational Appeals for Persuasive Speaking* offers students a specific focus for the assignment while also including the mobile aspect (see Appendix B).

*Element 2: Goal*. What experience will the lesson provide for the student? This is where the lesson overview is described to give the student an understanding of what is expected in the assignment. For example, *"In order to be an effective speaker, it is important to consider the emotional impact on our audience, as well as relate our ideas to their emotions, needs, and values. We need to find out what is meaningful to our audience so we can relate to them in persuasive speaking. Work together as a team to discover and capture a variety of objects and/or visuals that include motivation appeals."* The student experience becomes the goal of the lesson, which is tied to larger assignment in this assignment (i.e., persuasive speech).

*Element 3: Learning Outcomes*. The learning outcomes must be clearly stated in order to understand the expectations of the lesson and also to be able to evaluate the student's performance. For example, *"upon completion of this assignment, you will be able to evaluate at least five different objects and/or visuals that demonstrate motivational appeal*." This structure defines a specific measure (*five* different objects and/or visuals...) for the student who is completing the work and for the teacher who will be evaluating the student's work.

*Element 4: Materials/Resources*. In this step of the template, the educator should consider what materials and/or resources are required in order for the student to complete the assignment. For example, students may be offered choices in the apps and devices used or even an alternative format, as long as the expected outcomes are met. This not only allows the student's experience to be personalized, but it also creates a more inclusive learning environment.

*Element 5: Instructions*. The instructions (including technical aspects) should be clear and broken down into detailed, concise steps in order for the student to successfully complete the lesson. Note in the *Scavenger Hunt Mobile Lesson*, the numerical instruction list serves as a simple, step-by-step guide for the student to follow. If there is any pre-lesson work that students need to complete, this should be stated as well. For example, if students are required to work in groups and use a specific type of mobile app, defining these ahead of time helps to prepare the students and reduce confusion during the activity. It is critical to map out a process that reduces student and teacher frustration while also increasing engagement.

*Element 6: Assessment*. How will the students be evaluated? It is important to define the assessment process for both educator and student so that each knows exactly what is being asked in order to meet the outcome(s). For example, in the *Scavenger Hunt Mobile Lesson*, a rubric is used to define three criteria and point value for the associated expectations. Students can clearly identify for what an exemplary assignment includes and how it will be evaluated.

Once these first six critical elements are defined, the mobile lesson is ready to further build using Elements 7–13 as appropriate. Not every mobile lesson will need to include all elements of the Mobile Lesson Template; however, each should be considered and modified as the design and development take shape.

*Element 7: Weighting of the Assignment*. What percent of the student's grade is reflected in this activity? It is important for the student to know how the grade for the lesson affects the overall class grade to give relevancy to the course.

*Element 8: Submitting Assignment for Evaluation*. Assignment submission details that include how and where to submit should be included if the student is required to submit something. For example, in the *Scavenger Hunt Mobile Lesson*, the submission information is included in Element 4: Instructions, Step Four. In this example, the Mobile Lesson Template was modified to combine submission information with the detailed, step-by-step instructions.

*Element 9: Time Commitment*. Students need to know the expected time commitment to complete the assignment in order to guide the process. In the *Scavenger Hunt Mobile Lesson*, students have 20 min to complete the mobile lesson during a class session, with face-to-face and online discussion following the lesson.

*Element 10: Deadline*. A specific deadline should be given in order for students to successfully engage in the mobile lesson. In the *Scavenger Hunt Mobile Lesson*, students are required to submit the final lesson URL during the class period. Online discussion of other teams' submissions is the final piece of the lesson due at the end of the week.

*Element 11: Feedback Expectations*. When and how will students receive feedback on the assignment/activity? Feedback is an important part of the learning process because this is where the student reflects with information that can guide changes and improvements, i.e., learning! In the *Scavenger Hunt Mobile Lesson*, students receive three forms of feedback: classmates' oral feedback, classmates' written feedback in an online discussion forum, and instructor feedback in Moodle Gradebook.

*Element 12: Examples*. If appropriate, examples of previous students' work or an instructor example can provide a model for students to emulate, as well as get an understanding of what the lesson is asking. In the *Scavenger Hunt Mobile Lesson*, the instructor provides two sample video collages created with different mobile apps. These examples help to highlight the exact expectations and provide an exemplary example of the end product.

*Element 13: Technology Considerations (Challenges/Solutions)*. One of the final elements to address is potential technology challenges and solutions. What considerations are needed to identify challenges for both instructor and student? What potential solutions could solve these challenges? For example, is Wi-Fi access available? If not, will students have to use personal data service? Are there suggested, cross-platform mobile apps for varying devices? Some challenges in the *Scavenger Hunt Mobile Lesson* include student access to mobile devices and time used to select the mobile app and create accounts. Potential solutions include asking for student volunteers who are willing to provide a mobile device and selecting team leaders to choose and set up the mobile app prior to the activity.

Thinking about potential technology issues in advance will help reduce barriers; however, it is not intended to create an experience that is constrained by structure. Instead, the educator should allow some "chaos" in the mobile learning experience, just as with any other learning activity (Yu 2008). It is these "chaotic" environments that allow the learner to reach beyond traditional knowledge models and create a personalized learning environment that can continue to grow throughout college and beyond. The Mobile Lesson Template becomes a guide for creating effective mobile assignments that include elements that allow for flexible design and implementation.

## 4 Implementation of the Mobile Lesson: A Case Study

One such lesson that utilized the Mobile Lesson Template was the *Scavenger Hunt Mobile Lesson on Motivational Appeals* (Appendix B). The instructor created this lesson with the goal of improving students' application of a concept that had not been met in previous lessons and assessments. To begin creating the lesson, each of the elements in the Mobile Lesson Template were addressed with the applicable information, with a particular focus on Element 11: technology considerations. In order to successfully integrate the lesson into the classroom, the instructor walked through the entire lesson and created examples to not only test the instructions, but also the various technologies. This step was critical in ensuring the student's success in meeting the lesson outcomes. The activity included five parts: student prework to prepare for the activity, the activity itself, an in-class activity share, a discussion-based reflection activity focused on the outcomes of the activity and the process, and, finally, an online discussion post-activity. A final measure of students' application of the learned concepts was evaluated in a culminating persuasive speech. The mobile lesson is now in the third year of successful implementation into the classroom.

The mobile lesson was implemented into a section of Fundamentals of Communication (Public Speaking) at Humboldt State University, a required course to graduate from the California State University system. In previous semesters, students struggled with the concepts of motivational needs and values in persuasive speaking. The *Scavenger Hunt on Motivational Appeals Mobile Lesson* became a method to not only give students direct application with the concept, but also appeal to the millennial sense of teamwork and technology by using mobile to create personal connection with each other and the world around them.

Student preparation before class included a chapter reading and an associated reading quiz based on values and Maslow's hierarchy of needs. In class, the instructor facilitated a mini-lecture that incorporated student discussion related to the concepts of the reading and quiz. The mini-lecture also included a brief overview of mobile lesson examples for students to clearly understand what the final product may look like. Students were then divided into teams based on volunteers willing to use a smartphone for the mobile activity. This pre-class work was critical to the success of the lesson because students needed to come prepared with foundational understanding to build upon in order to successfully participate in the lesson during the class period. After student teams were formed, the mobile scavenger hunt began. (Note: a virtual scavenger hunt was also considered possible with this activity.) Student teams were seen all over the campus, searching for examples of images/signs/other visuals that represent motivational needs and values. Examples included a restroom sign, appealing to a person's survival needs; a sports team flyer, appealing to someone's peripheral values; and a support group poster, appealing to a person's belongingness needs. Excitement and energy filled the northwest side of campus as teams scurried to make the best use of 20 min capturing the visuals to support the idea of needs and values.

Students returned to the classroom to finalize uploads using the team choice mobile app. These uploads took about 10 min and included a period of classroom chaos. The chaos was measured as a sign of deeper learning as students grappled and struggled with the technology, reached consensus over specific images and meanings, and worked together to accomplish the outcomes. The instructor facilitated some of the technological challenges, while also letting students wrestle to find solutions in a team-based environment. The learning and collaboration that unfolded during this "process" period created a sense of student ownership and accountability. Final video links were also uploaded to the course online discussion forum on the learning management system for reflection.

The reflective component included:

- Entire class watching each of the 30-s to 1-min videos.
- Brief discussion period after each viewing.
  Student teams explained the specific needs and values addressed in the visuals while answering questions and receiving comments from classmates.
- Class discussion about the mobile activity itself:
  - What worked well?
    Most students commented on the team element being the most valuable part of the scavenger hunt.
  - What was challenging?
    Some students confided that there was a period of confusion at the beginning of the lesson when it was not clear what was required.
  - How did the team work together to accomplish the objectives?
    Most to all teams stayed together during the scavenger hunt; one student would film and team members shared the search for visuals.
  - What could have been done differently?
    Some students reflected that a different mobile app might have worked better after viewing another classmates' app selection.
  - How is individual understanding of appealing to needs and values improved by the activity?
    All students reported an increase in understanding after the activity, including students who performed well on the reading quiz.
    Some students reported that the collaborative component (team) improved learning.

A final post-activity to culminate the lesson included students' individual comments to other teams' videos on the online discussion board. Comments required focus on the effectiveness or ineffectiveness of the images to persuade a target audience. Students were asked to post at least one online comment to another teams' video before the next class period. A rubric that included individual and team participation was used to evaluate students' work on the entire lesson.

The formal assessment of the student application of these concepts was evaluated in the students' persuasive speeches, which focused on the following outcomes:

- Ability to apply strategies to motivate audience to adopt perspective or influence in specific direction
- Ability to apply sound reasoning and evidence
- Ability to apply motivational appeals and credibility

Additional gains were made during this activity that were not included as formal outcomes of the mobile lesson. Students reported the feeling of a deep sense of camaraderie and satisfaction among the teams during the process of creating the video. Students had fun learning! Building community with classmates motivated student to reach beyond what the minimum requirements of the lesson asked. One semester, before students returned to the classroom at the end of the scavenger hunt, all teams did one extra video that was not required. All students stood in a long line "high-fiving" each other and jumping in the air, while a classmate captured it on video. The video was posted in the online discussion forum and viewed at the end of the video series in class. This final video gave evidence that students were able to use mobile to collaborate, create, and have fun while learning. Students truly engaged in a community of learning while improving individual understanding during the experience.

This mobile lesson case study speaks to the value of both mobile learning itself and the use of the Mobile Lesson Template as a guide in creating a fully designed mobile activity. Students were able to meet the outcomes successfully and improve performance on the formal assessment following the lesson.

## 5 Faculty Learning Community on Mobile Learning

The Faculty Learning Community (FLC) on mLearning was a personalized learning environment in which faculty used both collaborations to explore the "chaos" in mobile. The FLC included a small group of multidisciplinary faculty members engaging in the scholarship of teaching and learning with a semester-long, collaborative environment, structured to provide encouragement, support, and reflection. The FLC discussed pedagogical methods that could be enhanced through the use of mLearning. It was not designed to be just a "how to" class for technology but more as a space for sharing ideas and experiences and for the opportunity to develop an activity or unit that uses mobile to enhance student learning. The group members shared mobile lessons and experiences with the wider university community at a semiannual professional development event following the FLC.

The goal of the FLC was to create a fun and safe environment to collaboratively explore, apply, and share mobile technologies and pedagogies to enhance student learning. The outcomes included:

- Understand how mLearning can support learning.
- Identify potential technology challenges and possible solutions.
- Create and apply a mobile learning lesson.
- Reflect on lesson implementation.
- Share findings with campus community.

During the semester, faculty participated in "mobile explorations" that utilized mobile apps as well as resources such as a Moodle course, a shared mobile apps wiki, a Twitter hashtag, a Tagboard feed for live collaboration, a Diigo group for web resources, Google Drive for peer collaboration, and asynchronous discussion forums for reflection.

The faculty participated in further "mobile explorations" where collaboration, evaluation, and reflection were utilized to create and implement a mobile lesson in the classroom using the Mobile Lesson Template.

Some “mobile explorations” that faculty engaged in included:

- Looking for ways to explore the “flip the classroom”
- Exploring the range of uses and develop a way to use a mobile device to increase student engagement
- Looking for ways to stimulate students in large classes
- Exploring ways that mLearning can support student-generated content (students apply the learning)
- Looking for ways to teach beyond the classroom, i.e., virtual office hours, podcasts, and social media

The majority of this faculty group added a mobile learning layer to an existing activity. This process allowed each to use a familiar lesson and explore the addition of a mobile component.

The final portion of the FLC was to share mobile lessons at a campus-wide event. Faculty facilitated a discussion workshop, *Exploring Mobile Learning to Support Students,* where participants were asked to identify mobile strategies and/or techniques to integrate into future work as a result of workshop participation. Participants were also given a collection of mobile lessons created by FLC faculty that utilized the Mobile Lesson Template as a model for effective mobile design for higher education learning. This template served as a catalyst for educators, who needed a guide to begin harvesting personal connections that are created when the student’s mobile world becomes integrated into the learning of course concepts.

## 6 Future Directions

The future of mobile learning is wide open. Educators can play a vital role in developing mobile lessons to support authentic learning with collaboration and critical thinking, as well as increasing student engagementthat allows the student to reach far beyond the limits of a classroom. Mobile opens the doors even wider for distance education students accessing all course resources from a learning environment that is free of physical space and time. Suddenly, the student’s personal world collides with the academic world in one of the most amazing learning disruptions ever. Possibilities such as advanced image retrieval technology and student opportunities to pursue relevant and personal learning experiences are just some of the many directions.

Rick Oller, from the Marlboro College Graduate School, makes a clear connection to mobile learning potential by discussing its future in higher education in terms of traditional pedagogical structures being left behind and the need for teachers to “innovate, experiment, and be prepared to fail” (Oller 2012). It is this potential that gives educators opportunities to experiment with mobile in the classroom. Teachers can adapt existing lessons or create new lessons by using the Mobile Lesson Template as an effective roadmap for mobile lesson creation that provides relevance and personalized learning experiences for millennial students in a world that becomes the infinite classroom. Expanding mLearning to include collaboration across courses and curriculum with trends, such as augmented reality and learning implants, becomes a movement beyond the traditional pedagogies and technologies and into a whole new arena of reexamining and adapting in higher education.

## 7 Cross-References


▶ Advanced Image Retrieval Technology in Future Mobile Teaching and Learning
▶ Characteristics of Mobile Teaching and Learning
▶ How Irish Postgraduate Students Use Mobile Devices to Access Learning Resources


## Appendix A: Mobile Lesson Template

1. **Assignment Name**
   [Provide a name that includes the lesson concept and the word "mobile."]
2. **Goal**
   [What *experience* is this providing for the student?]
3. **Learning Outcome(s)**
   [By the end of this lesson, what will the student be able to do?]
4. **Materials/Resources**
   [Materials, handouts, software, special equipment needed.]
5. **Instructions**
   [Specific, concise, step-by-step details of the process that is expected to complete the assignment.]
6. **Assessment/Rubric**
   [How the assignment will be graded.]
7. **Weighting of this Assignment**
   [Percent of overall grade.]
8. **Submitting Assignment for Evaluation**
   [How/where to submit the assignment.]
9. **Time Commitment**
   [Expected time to complete the assignment.]
10. **Deadline**
    [When is the assignment due?]
11. **Feedback Expectations**
    [When/how will students receive feedback?]
12. **Examples**
    [Provide an exemplar example so students understand what you're looking for.]
13. **Technology Considerations: Challenges/Solutions**
    [What considerations are needed to identify challenges for both instructor and student? What potential solutions could solve these challenges?]

## Appendix B: Scavenger Hunt Mobile Lesson on Motivational Appeals for Persuasive Speaking

*Kimberly Vincent-Layton, Department of Communication*

### Goal

In order to be an effective speaker, it is important to consider the emotional impact on our audience, as well as relate our ideas to their emotions, needs, and values. We need to find out what is meaningful to our audience so we can relate to them in persuasive speaking.

**Work together as a team** to discover and capture a variety of objects and/or visuals that include motivation appeals.

### Learning Outcome

Evaluate at least five different objects and/or visuals that demonstrate motivational appeal.

### Materials/Resources

- Smartphone with video or collage app of choice
- Account with app if needed (Animator, Vine, Flipagram, Instagram, etc.)
- Wi-Fi
- Classroom computer with projector to share final video/collage

### Instructions

You have 20 min to go on a team scavenger hunt, **looking and capturing** objects/visuals around campus that appeal to needs and values (think: signage, posters, layout of structures, etc.).

**Include:**

- **Needs** – think Maslow's hierarchy of needs (Maslow 1943)
- **Values** – think general values (culture, family, social), core values, authority values, peripheral values

**Step One:** Scour the campus looking for objects/visuals of any type that demonstrate appeals to needs and values (*must include at least one example for need and one for value*).

**Step Two:** Use a mobile app, such as Vine, YouTube Capture, Animoto, Pic Stitch, and Photo Grid, to create a video or photo collage of no more than 1 minute; upload it to YouTube, Twitter, Facebook, Animoto, or any site where you can share with the class.

**Step Three:** Think about the purpose and the target audience of your visuals. Answer these two questions in your video:

1. What **values** are appealed to in the object/visual? Identify the values.
2. What **needs** are appealed to in the object/visual? Identify the needs.

**Step Four:** Upload your video/collage URL to the *Share Your Scavenger Hunt Video Here* forum on Moodle immediately following the scavenger hunt.

**Step Five:** Reflection/share out – is the object/visual effective/persuasive to the target audience? What motivational appeal is it an example of?

## Assessment

mLesson rubric valued at total of 10 points will serve as participation points for this class session.

Scavenger Hunt Rubric

| Criteria | Exceeds expectations | Meets expectations | Below expectations | Points |
|---|---|---|---|---|
| **Contribution to group (3 points)** | Team accepted responsibilities for constructing the hunt and collaborating on the video | Team accepted some responsibility for constructing the hunt and some collaboration on the video | Team made little contribution to constructing the hunt and/or collaborating on the video | |
| **Needs and values (4 points)** | Team included **at least two** examples of each: needs and values | Team included **at least one** example of each: needs and values | Team **did not include at least one** example of each: needs and values | |
| **Final hunt results (video) (3 points)** | Video demonstrates an appeal to needs and values by answering **all** four questions | Video demonstrates an appeal to needs and values by answering **most** questions | Video demonstrates an appeal to needs and values by answering **few** questions | |

## Deadline

URL submission due by April 21, 5:00 pm. Replies to classmates' posts due by Sunday 11:00 pm of Week 12.

## Feedback

Students will receive classmates' oral feedback during class share out, classmates' written feedback in online discussion forum, and instructor feedback posted in Moodle Gradebook by Sunday of Week 13.

## Examples

Sample Video/Collage

- See sample Vine on Moodle.
- See sample Animoto on Moodle.

## Technology Considerations

Instructor will create sample video/collage to demonstrate the final product [Vine, Animoto].

**Challenges**
Variety of devices and apps.
Students may spend a lot of time just picking the app.
Access to Wi-Fi could be intermittent in some areas.
Need accounts created that could potentially take time.
Time logging into accounts on classroom computer (to share video/collage).

**Solutions**
Ask students if they have a smartphone in class prior to activity.
Assign team leaders to choose an app before next class session.
If students are not using campus Wi-Fi, be sure to let them know that apps may require data usage on their plan.
Have student leader create an account (if needed) before the mLesson.

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# Mobilizing PD: Professional Development for Sessional Teachers Through Mobile Technologies

# 11

Bonnie Dean, Michael Zanko, and Jan Turbill

## Contents



**Abstract**

The emergence of mobile technologies has changed the higher education landscape. The expansion of mobile technologies in our classrooms presents new learning opportunities not just for students but also for teachers. While professional development is core business for higher education providers, over the years, increasing attention has been afforded to the growing cohort of casual teachers typically overlooked. Sessional teachers are at the interface of learning, yet have historically experienced limited professional development. A unique opportunity is presented to utilize the flexibly of mobile technologies with the needs of time-poor, provisional sessional teachers. This chapter explores this notion and what this might look like by offering two exemplary cases.

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These cases demonstrate ways in which to use the affordances of mobile technologies to deliver and customize professional development, thereby embedding professional learning in practice. This is an important strategic, pedagogical, and capacity building movement that currently seems to be lacking in uptake and explication of best practice.

## 1 Introduction

Australian universities take professional development seriously. Workshops, seminars, guest speakers, career goal setting, and consultations are delivered to build the capacities of the staff. Teachers in particular are offered various opportunities for professional development as teaching is closely linked with quality of education and student learning outcomes.

Over the last several years, greater emphasis has been placed on enhancing the opportunities for teachers who are not permanent, those employed on a sessional basis, to engage in professional development (PD) activities. Sessional teachers have been described as the backbone of higher education (Percy et al. 2008), yet have historically been overlooked in terms of ongoing support, knowledge building, or practice sharing. They have been excluded as an important community of practitioners through little, or no, induction, training, or ongoing professional development.

The aim of this chapter is to present two professional development programs at the University of Wollongong in Australia that, in different ways, facilitate professional growth through targeting and enhancing teaching practices of sessional teachers. These programs not only address the need for capacity building of sessional staff, but they do so in a way that is compatible with the provisional nature of much casual teaching. Specifically, these programs utilize the affordances of mobile technologies for opening up new ways in which higher education providers can deliver and customize professional development.

This chapter is structured as follows: First is an overview of where professional development is heading: from traditional modes of delivery toward a practice-based focus. Second, literature is presented on research taken to recognize and recommend ways of supporting sessional teachers at Australian universities. Third, new opportunities for engaging teachers through mobile technologies are highlighted through explicating important design principles for mobile learning. Next presented and discussed are two complementary online PD initiatives at the University of Wollongong. Our aim in disseminating these programs is not to evaluate their utility but rather to point to the opportunities created by using mobile technologies for sessional teacher PD through two exemplary cases, one at the institutional level and one addressing a particular faculty and its individual sessional staff needs.

## 2 Professional Development in Higher Education

Professional development of teachers in higher education is important at both strategic and operational levels. In many cases, without some form of institutional support, teachers may fall into the trap of teaching how they were taught or learn "on the job" with little knowledge of alternative approaches or the pedagogical processes that underpin what they do (Johannes et al. 2013).

Professional development initiatives typically include formal, structured learning courses, events, or individual one-on-one consultations convened by either central university teaching and learning units or faculty professionals. These activities are characterized as "push" or "pull" PD delivery models. In a "push" model, learning outcomes are set, and selected information is thrust upon participants to consume within the given timeframe (Shackleton-Jones 2012). In a "pull" model, participants are more self-directed, choosing to engage in the opportunities that suits them, "pulling" meaningful information forward when needed (Shackleton-Jones 2012).

Concerns have been raised with the nature of some structured courses or "push" models, as well as ad hoc development work, for two main reasons. First, one-off events can preclude ongoing engagement or community building that arises from practice sharing and networking among like-minded peers. Second, formal courses can run the risk of being too far removed from the individual's context (Boud and Brew 2013). While some professional development support, particularly one-on-one consultations, centers on issues in situ, other courses or workshops take the teacher out of context to discuss different aspects of work. Without this direct link to application, what is learned can potentially fail to make any real change to the teacher's practices.

According to a growing body of practitioners, if PD is to make any lasting impact, it must have direct influence on what a teacher does in everyday learning contexts (Boud and Brew 2013; Debowski 2014; McArdle and Coutts 2010). Boud and Brew (2013) suggest the key to effective PD is learning-conducive work that is deliberately located in teaching practices. This model of teacher development moves away from arguments about whether to employ a "push" or "pull" model and instead posits all PD activities take as their core activity practice transformation.

## 3 Sessional Teachers: The Precarious Professional

Sessional teachers are any non-permanent teachers employed on a course-by-course (subject-by-subject) or sessional basis, including postgraduate students, research fellows, industry professionals, clinical tutors, or casually employed lecturers. A substantial portion of university teachers are sessional, with research claiming between 20 and up to 80 % of faculty teachers as sessional or non-permanent (Percy et al. 2008). Sessional teachers are the invisible teachers at the coalface of learning, time-poor postgraduates or individuals that are interested in enhancing the knowledge and skills of learners.

Over the years, research has shown sessional staff experience vastly different opportunities, support, and recognition compared to full-time academic teaching staff. This has extended to poor or lack of induction, training and support, and professional development opportunities (Gottschalk and McEachern 2010; Percy et al. 2008). The degree to which sessional teachers feel supported by the faculty and socially included in the wider teaching community has been found to impact on levels of commitment to teaching (Joiner and Bakalis 2006) and quality of teaching (Myconos 2005). It has also been reported "the quality of education suffers when students are taught by teachers who cannot be available, who are exhausted, demoralized, and frustrated, who lack the time to be as well prepared as they would like to be. . ."(Dannin 2003, p.10).

A number of Australian Learning and Teaching Council (ALTC)- and Office for Learning and Teaching (OLT)-funded projects have focused on investigating these issues. The first of three large-scale studies on sessional teaching explores the recognition, enhancement, and development of casual teachers (also known as RED), by looking at their "significant but largely invisible contribution to the quality of teaching and learning in higher education" (Percy et al. 2008, p. 1). The findings of the RED report substantiate some of the claims in the literature, namely, all universities depend heavily on sessional teachers; sessional teachers are responsible for much of the teaching load; sessional teachers perform a range of teaching-related duties, from casual marker, invigilator, subject designer, and coordinator; and that, universities are unable to report comprehensive and accurate data on the number of sessional staff and their conditions of employment.

Arising from these concerns, a second project was undertaken to focus on exploring ways academic subject coordinators might lead and manage sessional teaching teams (Lefoe et al. 2011). Entitled the CLASS report (coordinators leading advancement of sessional staff), this project draws together quality processes, practices, and resources as recommendations that might be used across institutions. Their findings and resources are promoted through a website and demonstrated with good practice exemplars (see www.classleadership.com).

The third most recent OLT national study employed a procedure and policy approach by establishing a set of institutional benchmarks from which to evaluate the quality of management and performance issues related to sessional teaching (Harvey et al. 2014). Known as the BLASST report (benchmarking leadership and advancement of standards for sessional teaching), this project established a framework and an accompanying interactive tool (see www.blasst.edu.au) from which institutions can use to reflect upon and evaluate their own procedures, policies, and practices. This report makes an important distinction between how different departments within an institution can support sessional staff. It distinguishes four levels of sessional support: institutional, faculty/school, department, and individual. At each of these levels, different needs, resources, and responsibilities are required for capacity building and supporting sessional staff (Harvey et al. 2014).

Taken altogether, this literature suggests a number of considerations for the professional development of sessional teachers in higher education. First, while there have been some improvements in the sector, few universities still struggle to adequately integrate and support sessional teachers in both administrative functions and professional development. Second, different approaches are required to address the needs of sessional staff at the different levels within an institution. Third, professional development must be relevant to practice transformation.

Whether the professional development of sessional staff is mandated or made optional and paid or unpaid is a debate for another time. In line with the discussion above, sessional teachers should at least have the opportunity to participate in programs or have access to resources and support that is commensurate with teachers' evolving needs. This means having strategies for professional development in place that are tailored for sessional teachers – but what might these look like and how can they be delivered to a cohort that is so contingent?

## 4 In the Palm of Your Hand: New Opportunities to Support Teachers

As Turbill highlights in ► Chap. 14, "Transformation of Traditional Face-to-Face Teaching to Mobile Teaching and Learning: Pedagogical Perspectives" moving from a predominantly face-to-face medium to embracing technological affordances has its own set of challenges. Over the years, a growing body of online courses, resources, or workshops has been developed to build teachers' capacity for this transition to online teaching and learning. These skills include those needed to teach, design, and implement courses through technology, blended with technology or in new-generation learning spaces (de la Harpe et al. 2014). When it comes to using mobile technology, a growing body of literature is focusing on ways handheld devices can be used in the classroom, in student-centered teaching and learning activities.

The rapid expansion of mobile technologies in our classrooms presents emerging opportunities to enhance the quality of learning not just for students but also for their teachers. Teachers could benefit from using mobile technologies for professional learning, because as a tool they enable accessible, just-in-time, and flexible delivery of information. This is an important pedagogical movement in higher education academic development that currently seems to be lacking in uptake and explication of best practice.

While professional development through online technologies is useful, it is limited in two ways. First, it targets online teaching skills at the exclusion of other issues, challenges, and insights of being a university teacher. It does not take into account the teacher as a whole person and the contextual sensitivities in which that person teaches. Second, if we are truly interested in skilling our teachers about the enablers of mobile technologies in our classrooms, then why not use this tool for their own learning? When it comes to professional learning and technology, "no amount of practice and coaching will enable someone to use a tennis racket to play golf" (Kim and Reeves 2007, p. 249).

Therefore, using mobile technologies offers an alternative, innovative tool for engaging teachers. Mobile technologies are appropriate for the professional development of teachers because they allow teachers to:

- Remain within the context
- Access and use the device when needed (just-in-time)
- Source what is needed based on own experiences, knowledge, and skill level
- Directly, and readily, transform practice

As Zhang highlights in ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning", there are a number of factors that educators must consider when using mobile technologies, such as the availability of Internet access on campus. Mobile learning is different from online learning, and the users must be placed front of mind in any design. According to Herrington, Herrington, and Mantei (2009), when incorporating mobile devices into higher education learning contexts, there are several design principles that frame its implementation. These include:

1. Real-world relevance: use mobile learning in authentic contexts
2. Mobile contexts: use mobile learning in contexts where learners are mobile
3. Explore: provide time for exploration of mobile technologies
4. Blended: blend mobile and nonmobile technologies
5. Whenever: use mobile technologies spontaneously
6. Wherever: use mobile technologies in nontraditional learning spaces
7. Whomsoever: use mobile learning both individually and collaboratively
8. Affordances: exploit the affordances of mobile technologies
9. Personalize: employ the learners' own mobile devices
10. Mediation: use mobile learning to mediate knowledge construction
11. Produce: use mobile learning to produce and consume knowledge

These principles create an innovative space from which to consider mobilizing PD for sessional staff. The flexibility of using mobile technologies, whenever and wherever, to mediate knowledge construction based on individualized needs fits well for offering professional development opportunities of sessional teaching given the precarious nature of the profession.

## 5 Mobilizing PD for Sessional Staff

Our activities to mobilize PD are drawn from strong pedagogical foundations underpinned and driven by active learning. Active learning is described as "anything that involves students doing things and thinking about the things they are doing" (Bonwell and Eison 1991, p. 2). Rather than watching or listening and passively receiving information, active learning involves two components: experiences and reflection (Fink 2003). By using active learning in PD, our aim is for participants to learn by doing and engage in ways that are relevant for their contexts and purposes.

The initiatives mobilizing PD in the following sections refer to two complementary online programs and resources aimed at supporting and enhancing sessional staff teaching practice. The first is an institutional-level course for sessional teachers, intended for professional teacher development through structured, optional activities and nurtured through online communities based on sharing, active learning, and reflection. It takes a learning-centered approach to demonstrate and encourage inclusive, active, and collaborative learning environments for quality teaching in higher education (Hunt and Chalmers 2012).

The second is a faculty-based initiative, which produced an online resource designed to be practical and malleable for individual needs. It fits with and extends the first program through offering active learning teaching strategies and contextual, discipline-relevant exemplars. Both initiatives focus on practice transformation front and center. They are also both "pull" models of PD in the sense that they are voluntary and enable accessible, flexible, and "just-in-time" delivery of information and support relevant to sessional teaching.

### 5.1 Institutional PD for Sessional Teachers

The Learning, Teaching, and Curriculum (LTC) unit at the University of Wollongong (UOW) is responsible for a range of programs, services, and supports including coordinating a formal program targeting the continuing professional development of academic staff called the University Learning and Teaching (ULT). ULT is a professional learning program for university teachers designed to enhance teaching effectiveness, develop expertise, and provide an educational context for ongoing career development. It engages participants through a series of face-to-face workshops, online modules, and assessments.

LTC introduced Flexi-ULT as an online course for sessional teachers in 2010. It emerged from what had been previously run for several years as a teleconference version delivered to academic staff at its remote campuses situated across the southeast region of New South Wales. Flexi-ULT has transformed the modular design of the workshop series and translated this into an online space to specifically meet the needs of sessional teachers at the University of Wollongong.

Flexi-ULT is a 1-year course conducted online through UOW's learning platform Moodle (see Fig. 1). There are ten modules, each addressing a topic relating to teaching in higher education, for example, "learners and learning," "dealing with challenges in teaching," "active learning," and "teaching online." If a sessional teacher is not able to take a module because, say, they are not teaching for a session or because they have

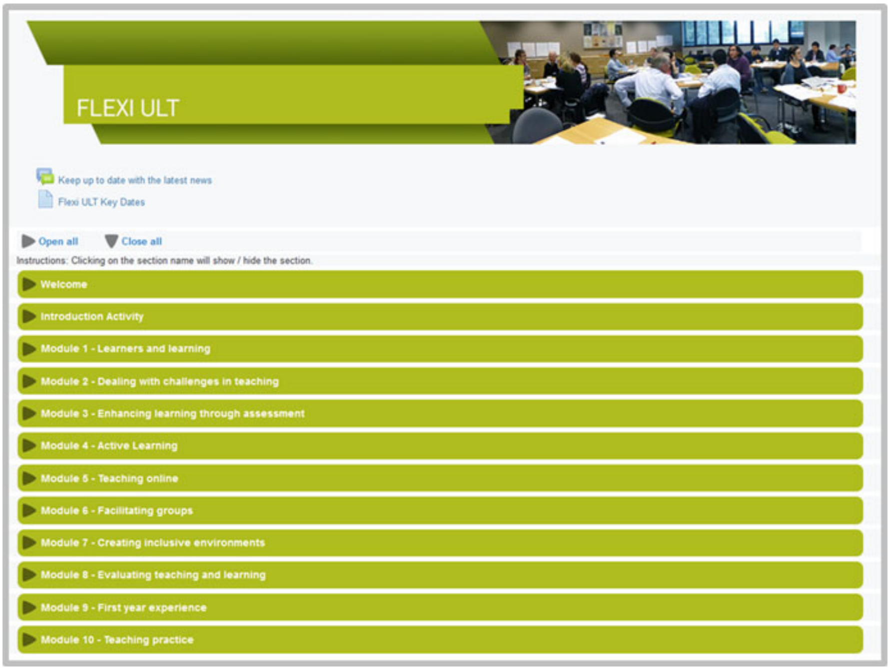


**Fig. 1** Screenshot of Flexi-ULT Moodle space

study demands, they can take that module the following year. Once modules 1–9 are complete, participants are eligible for module 10. In module 10, participants deliver either a face-to-face or online teaching session drawing on the strategies and knowledge learned from the course. “Teaching practice” is therefore offered twice a year, in June and November. The ten modules and learning outcomes are shown in Table 1.

Each module is run asynchronously and is open for 2 weeks. The timing of the modules takes into account the university semester and the teaching and marking peaks for sessional teachers. The modules are activity based to engage learners through active learning – a practice and process that is hoped that sessional staff will adopt in their own teaching. Each module is organized in three activities and is expected to take approximately 3 h. The module design is represented in Fig. 2. There is also one face-to-face workshop offered per module to cater for diverse learning styles and preferences. Participants can choose to attend these instead of completing the online activity. Video conferencing for the face-to-face workshop is available to satellite campuses.

Activity 1 introduces the theme or topic and provides an opportunity to share thoughts or experiences and activate prior learning. Activity 2 engages participants in the topic through an activity. Examples include compiling a database of teaching strategies, watching a video and responding to a discussion forum, completing a

**Table 1** Flexi-ULT modules and learning outcomes

| Module | Through active participation in this module, you will be able to |
|---|---|
| 1. Learners and learning | Describe the elements of effective learning in your context<br>Use your developing theories of learning to plan teaching activities |
| 2. Dealing with challenges in teaching | Explain alternative solutions for dealing with challenging classroom situations<br>Identify methods to manage the teaching space to create a positive learning environment |
| 3. Enhancing learning and feedback | Practice giving and receiving constructive feedback<br>Make judgments on marking and provide feedback through an assessment rubric |
| 4. Active learning | Share strategies for engaging students in active learning<br>Provide feedback on colleagues' teaching activities<br>Design active learning activities for your teaching context |
| 5. Teaching online | Discuss the benefits and challenges of teaching online<br>Identify strategies for maintaining an effective teaching presence in online learning environments<br>Identify strategies for student engagement in online learning environments |
| 6. Facilitating groups | Discuss the advantages and pitfalls of group work<br>Review and apply UOW policy relating to group work<br>Develop strategies for managing conflict in groups<br>Develop a teaching resource to use for group work in your practice |
| 7. Creating inclusive environments | Develop an awareness of students' varied circumstances and experiences and how this may impact upon their involvement in higher education<br>Reflect upon your teaching practices<br>Plan for ways to ensure inclusive practices in your teaching |
| 8. Evaluating teaching and learning | Explain the role of formative feedback in evaluating student learning<br>Identify the context of teaching evaluations<br>Identify a number of formal and informal ways to evaluate your teaching |
| 9. Teaching students in their first year | Identify complex factors contributing to a students' first-year experience<br>Plan teaching activities and strategies to support students in their first year |
| 10. Teaching practice | Plan for and demonstrate knowledge and techniques learned through the course in a teaching session to peers<br>Reflect on your teaching practice<br>Evaluate peers' teaching sessions and provide effective feedback |

cloze passage (see example set out later in this chapter), selecting subtopics from a list based on own preferences, interviewing fellow teachers and writing a blog, or doing a quiz. Activity 3 summarizes the module through an activity that participants relate directly to their teaching, such as developing an action plan or revising a

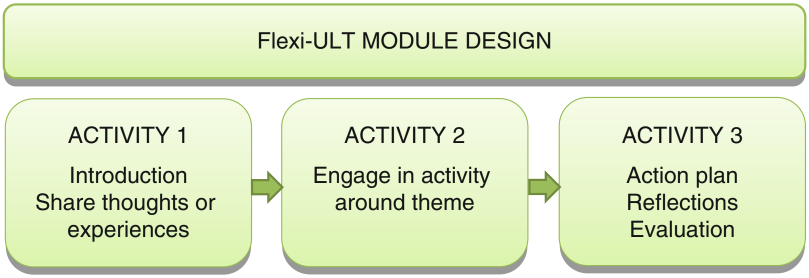


**Fig. 2** Flexi-ULT online module design

teaching session. It has a reflective component where participants contemplate what they have read, seen, or done, how this might be implemented, and any remaining questions or concerns. There is also an optional module evaluation.

Each activity begins with a description of an expected commitment time and a summary of participation to complete the module, e.g., "To complete this activity you are required to post one blog entry and respond to the blog entry of one colleague." Wherever possible, open resources are used, such as YouTube or the College of Fine Arts (COFA) videos and summaries on teaching and learning online (online.cofa.unsw.edu.au/learning-to-teach-online). The activities are not restricted to Moodle capabilities; other free tools are used in the creative design of activities and to expose participants to a range of ideas they may think about using themselves. One tool frequently used are Padlet walls (padlet.com). This tool provides virtual walls that anyone can write on by double-clicking on the wall itself. The result is either a streamline of text boxes or a messy culmination of people's thoughts and experiences strewn across the wall like graffiti.

The flexible, ongoing design of the course establishes and grows a supportive online community of sessional teachers. Sessional teaching can be an isolating experience for many teachers given that there are little opportunities for engagement outside the classroom (Percy et al. 2008). Communities of practice are critical to supporting teachers and are best integrated with reflective learning and opportunities for those reflections to be shared and grounded in practice (McArdle and Coutts 2010). This course is an opportunity for teachers to talk about personal teaching experiences and learn from one another, breaking down isolation by recognizing that others have similar experiences. The Flexi-ULT facilitators focus on developing activities that encourage interaction and reciprocal feedback in a space that is welcoming and safe and creates a sense of belonging (Thomas et al. 2014). For example, the overall course begins with introductory icebreaker activities, and open discussion forums are used for informal conversations within modules and are encouraged outside the space.

Because Flexi-ULT is run at an institutional level, it engages sessional teachers across all faculties. This diversity brings rich, varied perspectives to teaching and practice sharing. The facilitators also make a point of embedding teaching and learning activities within the strategic and contextual frameworks of the institution, for example, by offering web links to UOW contacts for security, learning development or student support advisors, or other policies and guidelines relevant for sessional teaching. However, as Harvey and colleagues (2014) pointed out in their review of sessional teachers, support can be offered at different levels to cater for different needs. The following section therefore outlines a "just-in-time" approach to support sessional teachers that was developed through a faculty-based project.

## 5.2 From Faculty to Individualized PD for Sessional Teachers

In 2011, a team of academics from the Faculty of Business at UOW received funding from a Higher Education Participation and Partnership Programme grant. This Australian federal government-funded scheme aimed to support domestic students from low socioeconomic backgrounds to enroll and participate in higher education. The project formed part of the approach to support enrolled students, through working with the teachers and the way they designed, scaffolded, and nurtured learning-conducive environments.

The project was initially planned to run for a year, focusing on developing the first-year curriculum with subject coordinators of first-year core subjects. A series of workshops and individual consultations were run over the year to assist in the design, delivery, and evaluation of curriculum to engage and support students from low socioeconomic status backgrounds. The success of the first year led to further funding and a snowballing of activities, ideas, and collaborations. As a result, the project ran and was funded for over 3 years. While the first year was directed at working with subject coordinators, the second year took a different focus, investigating how to better support sessional teachers.

First, peer observations of teaching practice were conducted with volunteer sessional tutors. A research assistant, also a sessional teacher, observed six first-year tutorials in core subjects covering management, marketing, finance, accounting, economics, and principles of responsible commerce. Preliminary feedback from these observations highlighted that students were more engaged in tutorials that used activities and group tasks compared to those that required students to simply listen to either the tutor or student presentations. However, it appeared that more technical disciplines (e.g., finance, economics) seemed to move quickly through a set number of problems or practice questions designated for the tutorial, privileging "the covering" of content matter over the learning activity.

Next, to explore the above issues, a focus group was conducted with head sessional tutors with first-year subjects in the Faculty of Business. These core subjects typically have student enrollments in the range of 400–700 students. The focus group involved all ten head tutors of the first-year business core subjects, with one via satellite link. All were paid an auxiliary rate for their time. Tutors were informed that the purpose of the focus group discussion was to identify general issues and concerns that may inhibit teaching and to further use the focus group as a platform to scope interest in professional teaching development.

The focus group confirmed suspicions that had unfolded from the observations regarding the nature of technical disciplines and the constrictions felt particularly from these tutors. In the focus group, they elaborated on their concerns, wanting to know if there was anything they could do in their capacity as tutors given their lack of control over assessments and tutorial outlines. They agreed that they were interested in seeking teaching support and that this was driven by a motivation to better engage students. They also wanted to see examples of how a tutorial activity might work in their discipline.

It became clear there was a need to develop an accessible, "just-in-time" resource specifically for sessional teachers that focused on practical teaching activities and were contextualized within business subjects. With the continued involvement and feedback from the head tutors, an online resource of practical strategies was developed that any teacher could either use spontaneously in the moment to engage students or plan for ahead of time.

The resource was underpinned by Sally Kift's work in the field of transition and first year in higher education. Kift's (2009) model offers a framework to support and enhance the first-year student experience (FYE), arguing that a curriculum focus on student diversity was currently the missing link between FYE experience and practice. Her work identifies six interconnected guiding principles of first-year curriculum:

1. Transition: consistent and explicit to transition students from prior learning to higher education, through first year and beyond
2. Diversity: attuned to student diversity, accessible and inclusive of all students, and responsive to special needs
3. Design: learner focused, explicit and relevant, and assists student development and engagement in learning environments
4. Engagement: enables active and collaborative learning opportunities
5. Assessment: supportive of a successful transition and increase in complexity from first to later years
6. Evaluation and monitoring: evidence based and regular feedback designed to improve student learning and to intervene in a timely way with students at risk of not succeeding

This accessible online resource focuses on classroom activities, monitored and implemented by teachers facilitating the lesson. It needed to include a suite of sustainable resources that are based on teachers' changing needs – where and when they need it.

To develop the online resources, four experienced and qualified sessional teaching staff were engaged to browse online teaching websites, literature, and materials, to trawl through YouTube, and to talk to other sessional teachers in order to come up with a bank of practical teaching activities. With each activity, exemplars were offered through open learning resources or created using examples from current first-year subjects in the faculty. These examples included digital stories, templates, quizzes, cases, photographs, quotes, and animations. Kift's six principles were used as the organizing framework, as shown in the Fig. 3.

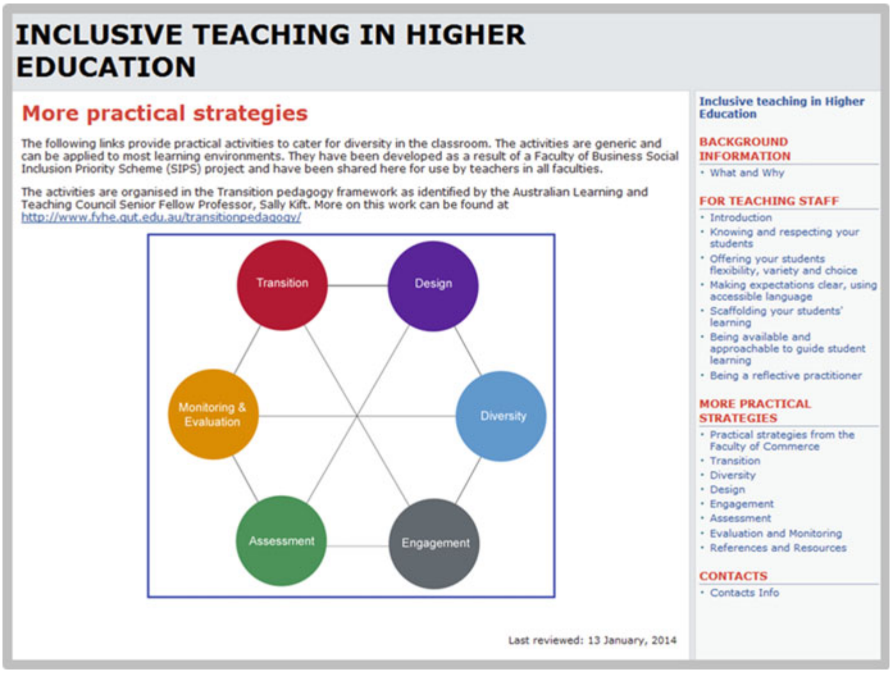


**Fig. 3** Screenshot of online resource

It is important to recognize that the activities were not isolated to one principle. To demonstrate the interconnectedness of the principles and how the activities may be used for different purposes, Table 2 was compiled (see below).

### 5.3 Examples of Practical Teaching Activities for Sessional Staff

In what follows are three examples from the online resource. Each is organized under descriptive headings, using easy-to-understand language. Tutors can choose one or several activities to be used in a tutorial, depending of the needs of the students and focus of the tutorial. The activities can be accessed on any mobile device Fig. 4.

## 6 Traffic Lights

### 6.1 What Is It?

This is a simple strategy for preparing for a test. Tutors provide students with a list of the skills, knowledge, and understandings the test will focus on. Students can evaluate their own readiness by assigning a red, amber, and green light. The resulting record gives students and teachers focus for their revision.

**Table 2** Action learning strategies aligned with Kift's principles

| | | Transition | Diversity | Design | Engagement | Assessment | Eval & monitoring |
|---|---|---|---|---|---|---|---|
| Transition Section A | First tutorial structure | ■ | | ■ | | | |
| | Unpacking the tutor's role | ■ | | | | | |
| | Student skills self-audit | ■ | | | | ■ | |
| | Helping students set goals | ■ | | | | ■ | |
| | Paraphrase and speculate | ■ | | | ■ | | |
| | Sharing learning criteria | ■ | | ■ | | | |
| | K-W-L charts | ■ | | | ■ | | ■ |
| | Name card tents | ■ | ■ | | | | |
| | Icebreakers | ■ | ■ | | | | |
| | Powerful powerpoint | ■ | | ■ | | | |
| Diversity Section B | Guided instruction | | ■ | | | | |
| | Questioning | | ■ | | | | |
| | Incorrect answering | | ■ | | | | |
| | Communication across language barriers | | ■ | | | | |
| Design Section C | Teaching episodes | ■ | | ■ | | | |
| | Post-it note concept mapping | | | ■ | ■ | | |
| | Reciprocal teaching | | | ■ | ■ | | |
| | Buzz groups | | | ■ | ■ | | |
| | Reading the textbook | | | ■ | | | |
| | Text comprehension | | | ■ | | | |
| | Mapping a text | | | ■ | ■ | | |
| | Helping students understand content | | | ■ | | | |
| | Number heads together | | | ■ | ■ | | |
| | Flipped classroom | | | ■ | | | |
| Engagement Section D | Learning styles | ■ | | | ■ | | |
| | Spatial arrangements | | | ■ | ■ | | |
| | Jigsaw | | | | ■ | | |
| | Pyramid discussion | | | | ■ | | |
| | Question and answer pairs | | | | ■ | | ■ |
| | Think-Pair-Share | | | | ■ | | |
| | Wordle | | | | ■ | | |
| Assessment Section E | Effective assessment | | | | ■ | ■ | |
| | Student self-assessment | ■ | | | | ■ | |
| | Cloze | | | | | ■ | |
| | Traffic lights | | | | | ■ | |
| | Exit tickets | | | | | ■ | |
| | One-minute papers | | | | | ■ | ■ |
| Evaluation & monitoring Section F | Reflective teaching | | ■ | | | | ■ |
| | Feedback | | | | | | ■ |
| | Student feedback | | | | | | ■ |
| | Mind-mapping | | | | ■ | | ■ |
| | Effective assessment marking | | | | | ■ | ■ |

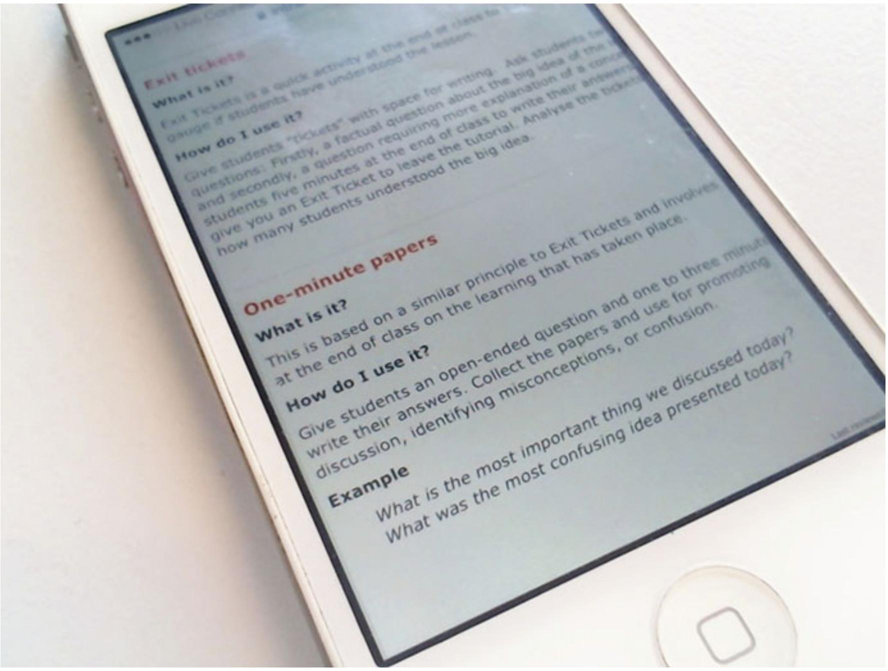


**Fig. 4** Accessing the handbook on a mobile device

### 6.2 How Do I Use It?

Green light: "I can explain this aspect to someone else."
Amber light: "I think I understand this aspect but I'd have difficulty explaining it to someone else."
Red light: "I don't understand this aspect."

### 6.3 Resource

This video explains how to use traffic lights.
https://www.youtube.com/watch?list=PL4C5A4FEB698EEC1A&feature=player_embedded&v=maDJ-YOHH1s

## 7 Exit Tickets

### 7.1 What Is It?

Exit ticket is a quick activity at the end of class to summarize and gauge if students have understood the lesson.

## 7.2 How Do I Use It?

Give students “tickets” with space for writing. Ask students two questions: firstly, a factual question about the big idea of the lesson and, secondly, a question requiring more explanation of a concept. Give students 5 min at the end of class to write their answers. Exit tickets are collected before students leave the tutorial and analyzed to learn how many students understood the big idea.

# 8 Cloze

## 8.1 What Is It?

This is a scaffolded activity for student learning. It is useful for evaluation of comprehension or language or assessing how well students have understood a text of writing.

## 8.2 How Do I Use It?

Construct the cloze by taking a key piece of text and removing about every tenth word. Leaving the first few sentences in place will help establish context. The reader is required to insert a meaningful word in the space (which does not have to exactly match the word in the text if the inserted word maintains meaning – if testing for comprehension).

Take the competed cloze and discuss in groups which words each student inserted and why. A cloze passage may be used to test English comprehension as well as to test subject knowledge.

## 8.3 Example: Accounting Discipline

A business may invest cash in stocks of other corporations. Or a company may buy other types of corporate or government securities. Accounting rules for such ________ can depend on the “intent” of the investment. If these investments were ________ for long-term purposes, or perhaps to establish some form of control over another ______, the investments are classified as noncurrent ______.

The accounting rules for those types of investments are covered in subsequent chapters. But when the investments are acquired with the simple intent of generating ______ by reselling the investment in the very near future, such investments are classified as _______ assets (following cash on the balance sheet). These investments are appropriately known as ____________ (Adapted from source accessed November 2013 www.principlesofaccounting.com/chapter6/chapter6.html#Accounting).

## 9 Future Directions

This chapter has argued the emergence of mobile devices in our classrooms has opened up new opportunities to engage time-poor sessional staff in professional development. By mobilizing PD, sessional teachers will have greater, flexible opportunities to draw on knowledge, teaching strategies, and ideas and connect with other teachers.

This chapter has suggested PD can and should be mobilized differently at institutional, faculty, and individual levels. It has demonstrated this through two exemplary cases at the University of Wollongong. This approach works toward a figure-ground reversal of the sessional teachers, whereby the contribution of these "invisible teachers" is foregrounded and valued. This is achieved through a direct focus on transforming practice using a tool that allows teachers to remain close to or within teaching spaces and making available practical and proven teaching strategies at the points of planning, preparation, and delivery of a class.

The design, creation, implementation, and sustainability of mobile technologies for professional development in teaching require a significant initial and ongoing institutional commitment. This commitment should ensure that, first, the technologies are current, available, and supported in teaching spaces and, second, that online teaching resources offered are continuously monitored, evaluated, and enhanced. Mobilizing PD is an important strategic, pedagogical, and capacity building movement that requires further research and evaluation yet holds rich potential to enhance the quality of higher education teaching and learning.

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# 12 Applying Open-Book-Open-Web Assessment In Postgraduate Accounting Subject: Flipping Test

Corinne Cortese, Sanja Pupovac, and Lina Xu

## Contents



**Abstract**

The purpose of this research is to extend the notion of the "flipped" classroom to subject assessment. A postgraduate accounting subject was taught using a "flipped" approach to encourage collaborative learning, foster student engagement, and develop students' critical thinking skills. The teaching style used throughout the semester was extended to the final exam, whereby an Open-Book-Open-Web format was adopted that enabled students to work collaboratively and draw on any resources available to them to complete the assessment. This research illustrates a novel approach to the teaching and assessment of theory-based accounting subjects and provides further support for the flipped approach as a means of enhancing the student learning experience.

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## 1 Introduction

This research presents a pilot study that applied a flipped learning approach in a postgraduate accounting subject. A flipped approach to learning has been defined by Berrett (2012, p. 36) as:

> [t]he inversion of expectations in the traditional lecture. It takes many forms, including interactive engagement, just-in-time teaching (in which students respond to Web-based questions before class, and the professor uses this feedback to inform his or her teaching), and peer instruction.

In this study, the principles of a flipped approach to learning were extended to incorporate subject assessment. The final exam adopted an Open-Book-Open-Web (OBOW) approach, which allowed students to draw on any intellectual resources available to them in order to complete the assessment. Many features of the flipped classroom approach are not new, with strategies around peer-learning, collaboration, team-work, and problem-based learning well-established in the education literature (Berrett 2012; Tucker 2012). Central to these strategies, and therefore the flipped classroom, is that students do not passively receive material in class in the way of the traditional lecture format (Berrett 2012). Instead of sitting and listening to a teacher deliver subject content, students are responsible for gathering knowledge about the subject matter before class, and are encouraged to interact, engage in problem solving, and discuss key themes arising from the subject content. Key to this is the incorporation of peer-learning, or a "two way, reciprocal learning activity" (Boud 2001, p. 3) that encourages peers and equals to share knowledge, ideas, and experience in a mutual beneficial way, with the aim of solving a problem or issue among participants that can be continuing for a long period both creating a learning awareness and completing an oriented task (see also Collier and McManus 2005). This approach has attracted attention from educators and is increasingly adopted as a learning approach in educational systems (see, e.g., Collier and McManus 2005; Gavota et al. 2010; Havnes 2008; Hwang and Francesco 2010; Parker et al. 2008; Sund 2009), along with similar learning approaches, such as collaborative learning (see, e.g., Magin 1982; Tielman et al. 2012), and group or team learning (see, e.g., Arbaugh and Benbunan-Fich 2006; Opdecam and Everaert 2012; Saito and Atencio 2014). Previous research has also demonstrated that students' results are higher as a consequence of collaborative learning methods (see, e.g., Arbaugh and Benbunan-Fich 2006; Gavota et al. 2010; Havnes 2008; Sund 2009).

In accounting education, peer-learning approaches are emphasized as an important means of developing the collaborative competencies that are required of accounting professionals (Opdecam and Everaert 2012). Previous research illustrates that the existing peer-learning research in accounting education is focused around six streams: first, studies which consider student involvement via peer-learning; second, research into ways of reducing or avoiding dysfunctional conduct in group and team processes; third, the impacts of peer-learning on student performance; fourth, student satisfaction with the peer-learning process; fifth, examples of successful peer-learning case studies; and sixth, literature reviews of collaborative learning approaches (Strand et al. 2004). The majority of this research has focused on minimizing student misconduct through peer-learning approaches and the achievements of this teaching and learning method, that is, categories two and three of Strands et al.'s (2004) review (Opdecam and Everaert 2012).

For example, Opdecam and Everaert's (2012) review indicated that much less attention has been paid to the use of case studies in accounting education (category five in Strand et al.'s (2004) research) and research on student satisfaction with respect to peer learning approaches has also been neglected. The absence of literature in these areas, and the importance of case study approaches (Adelman et al. 1976) and the construction of learning environments which enhance student learning (Opdecam and Everaert 2012; Strand et al. 2004), provides an opportunity for this study to contribute to the existing accounting education research. The first objective of this study, therefore, is to present an example of how a case study was used in an accounting theory subject to construct a peer-learning environment. The second objective is to provide comprehensive evidence of student satisfaction with respect to the case study-based, peer-learning environment developed in this subject.

The reminder of this chapter is organized as follows. First, to establish the case for an OBOW exam, the prior literature is reviewed relating to cheating in the higher education system and how cheating can be overcome using OBOW assessment. This is followed by details of the subject information and the assessment details that supported the flipped approach to teaching and assessment. The results of the study are then presented, followed by a discussion of the results in the context of higher education assessment strategies. Finally, future directions for accounting educators are presented.

## 2 Literature Review

### 2.1 Cheating on Exams

Cheating on exams is of increasing concern to academics generally and is of particular concern in business disciplines (Smith et al. 2002). In a discipline such as accounting, where there is a professional expectation that accountants should "protect the public from financial and legal mistakes" (Smith et al. 2002, p. 46), the ethical implications of academic misconduct are significant.

Studies of cheating and academic dishonesty in higher education are well-established in the literature (see, e.g., Bloland 2005; Hard et al. 2006; Hudd et al. 2009; Kincaid and Zemke 2006; McCabe et al. 2006; McCabe and Trevino 1995; Schmelkin et al. 2008). In these studies, misconduct, or cheating, in examinations is often defined as copying other students' answers, helping other students, and using crib sheets (Sierra and Hyman 2006). In written assessment tasks, cheating is considered to have occurred in the case of plagiarism, when work submitted is done by other students, and in the case of collaboration among students where the task was intended to be an individual assessment (Sierra and Hyman 2006). William Bowers (cited in McCabe et al. 2006), as one of the earliest scholars to investigate academic misconduct among students, reported that 66 % of undergraduate business students in 99 schools across the USA had cheated at least once in the academic year. McCabe and Trevino (1995) re-examined this issue more recently, again conducting a survey to investigate cheating among business school students. They reported that around 67 % of students who responded to the survey admitted to cheating once or more in their undergraduate degrees. Thirty-eight percent of respondents were considered "active cheaters" who admitted to cheating at least three times, and 15 % were "active" exam cheaters (McCabe and Trevino 1995, p. 208). A 2009 survey reported on the cheating behavior of 50,000 undergraduate students from 60 colleges throughout the USA and found that approximately 70 % of students had been involved with cheating during the course of completing their degree (Hudd et al. 2009).

In order to prevent or detect cheating and promote academic integrity in high education systems, many academicians have proposed different strategies, such as using a combination of honor codes and course warnings, offering special incentives, and building an ethical community (see, e.g., Bing et al. 2012; Briggs et al. 2013; McCabe et al. 2006). However, methods of cheating are constantly changing and becoming more sophisticated. For example, researchers have noted that emergence of the internet has also increased cheating at an alarming rate and advanced cheating techniques make academic dishonesty more and more difficult to detect (Kincaid and Zemke 2006; Rosile 2007).

Taking an alternative view on the definition of cheating, Jerry Harvey, a professor of organizational behavior, argued that defining cheating in a traditional way as giving or receiving aid from others is "unethical, immoral, and consequently, educationally unsound" and would destroy students' ability to acquire collaborative skills (Harvey 1984, p. 1). "Cheating," in Harvey's (1984) view, can make a positive contribution to peer-learning, enhance student performance, and increase students' ability to collaborate in educational and professional domains. For Harvey (1984):

> You may take the examination alone, with another person, or with as many other people as you would like. I frown on cheating. In fact, I go blind with rage if I catch anyone cheating. I define cheating as the failure to assist others on the examination if they request it.... You may refer to notes and reference materials during the exam. You may bring friends, relatives, or associates to help you. You may also bring equipment such as typewriters, computers, musical instruments, sewing machines, cookstoves, cameras, or any other contrivance which will provide assistance to you in your work. You may not cheat. If possible, have fun. If not, be competently miserable. (Harvey 1984, p. 6)

In defining cheating in this study, Harvey's (1984) concept of cheating as an alternative approach to peer learning in accounting education is followed and tested. For Harvey (1984, p. 3) "requiring that students work in lonely isolation from one another also thwarts the expression of synergy and teamwork." Testing and applying this approach is unique in accounting and therefore provides valuable insights of team work and critical skill development which is of importance in a postgraduate degree subjects.

## 2.2 OBOW Exams

The traditional three hour examination, or closed-book examination, has long been used in university for end-of-course tests (Macdonald 2002; Phillips and Lowe 2003). The usefulness of this type of exam, however, has been questioned by several studies. For example, Williams (2004, p. 934) argued that closed-book exams do not assess deep understanding of concepts, and instead encourages students to "cram" the night before the test, and then "data dump" in the exam, with "little knowledge retention" thereafter. Similarly, Phillips and Lowe (2003) noted examination format tests the students' ability to answer questions at abnormal speeds and under significant levels of stress, without making adequate reference to sources of information. They also argued that students' marks may end up depending on luck or memorization rather than deep understanding of the concepts examined (Phillips and Lowe 2003).

Williams and Wong (2009) and Lam et al. (2007) reflected on the traditional exam format and noted that it has not kept pace with the information-and internet-focused-age that most students will be immersed in following their studies. In response, researchers have urged educators to reconsider of the traditional exam format and have proposed a format known as the Open Book Open Web (OBOW) examination (Amanullah et al. 2013; Lam et al. 2007; Williams and Wong 2009) and other forms of mobile learning and teaching (Evans 2008; Fraga 2012). The innovation of the OBOW examination is that computers, tablets, and other electronic devices are allowed to be used during examination time. This type of examination represents a significant departure from the traditional format, because it "takes full advantage of the rich media sources available through the world wide web" (Williams 2004, p. 934). For example, by using an authentic assessment question, students have opportunity to produce an answer that clearly shows "what they know rather than what they don't know" (Williams 2004, p. 934). These types of questions, and the method of answering them, also promote a learning experience which is reflective of the skills likely to be required in the workplace. An important characteristic of OBOW examinations is that questions are presented as unstructured, "real world" problems that need to be addressed by the *application* of knowledge (Amanullah et al. 2013; Williams 2004; Williams and Wong 2009).

One of the notable benefits of OBOW examination, as noted by Williams and Wong (2009), is that it minimizes student cheating during the examination period. Lam et al. (2007)conducted a survey to investigate cheating in OBOW exams and found that half of the students surveyed did not believe that it would be possible to cheat in this type of exam. This is most likely because the authentic assessment approach used in OBOW examinations provide highly contextualized assessments which make copying difficult (Lam et al. 2007; Williams and Wong 2009). Further, students have less opportunity to obtain a "ready-made" solution online (or via other means) because the task requires the application of concepts and theory to a particular problem (Lam et al. 2007; Williams and Wong 2009). A submission procedure could also be established to minimize cheating, such as the use of plagiarism software, which enables easier detection of academic misconduct (Williams and Wong 2009).

Despite its benefits, the use of the OBOW examination approach has been largely confined to online business schools. To explore the effectiveness of this approach in a campus-based environment, this research applies the principles of a flipped classroom and examines the use of a flipped assessment task in the OBOW format. In doing so, this study extends the advantages of classroom-based peer-learning to the assessment forum. This combination addresses Harvey's (1984) call for examination methods that provide students with the opportunity to learn to solve problems in the most effective way, even if that means that, according to conventional definitions, students "cheat" by collaborating to achieve the best possible solution (see also Selsky 2000). Following Harvey (1984, p. 10), the notion of flipped assessment in this study means that students are encouraged to "refer to notes and reference materials during the exam," and "bring equipment such as computers" in order to assist them to complete the task.

## 3 Subject Information and Assessment Details

### 3.1 International Accounting

The subject of this study is *ACCY905 – International Accounting* (hereafter ACCY905). ACCY905 is a theory-based postgraduate subject taught within the Master of Accountancy program at the University of Wollongong. The international accounting arena is fast-paced and ever-changing with issues such as globalization of accounting regulation, international transfer pricing, and tax avoidance schemes, and large-scale money laundering operations frequently making news around the world. The aim of ACCY905 is to expose students to the existence and consequences of these international accounting cases and foster a peer-based research culture within the classroom that encourages independent learning and critical thinking. The cohort had a limited number of students from both domestic and international backgrounds including: two Australian students, one Indonesian student, and two Chinese students.

#### Integrating Case Studies and Peer Learning: Within Semester Assessment

The assessment for ACCY 905 is organized into three main tasks. The first involves seminar participation, the second is a research project which is sub-divided into three parts (research proposal, research presentation, and research essay), and the third assessment in the final exam. For the first assessment, a series of recent journal publications covering key issues is the international accounting space are assigned as weekly readings in place of a textbook.

Students learn from the first week that they will not experience the traditional "sit and listen" lecture-style. Instead, students are required to prepare a one page summary that critiques each of the readings assigned for the week's topic and come to class ready to interact. Student participation is not welcomed, it is expected. Initially, the submitted summaries are just that: summaries rather than critiques. Student participation is not offered readily; it must be requested, and there is little evidence of critical engagement with the subject material. However, once students become comfortable with their role as an active learner, and recognize the classroom as a "safe space" in which to explore ideas and opinions, momentum gathers. Summaries become critiques and participation becomes conversation that is spontaneous instead of forced. There is an atmosphere of collaboration as ideas are exchanged and perspectives proffered.

The first "scaffold" of the research project is introduced in the first week of semester, with students encouraged to read widely and develop a research case study of interest to them. By the fourth week, a research proposal is submitted that outlines what will become the major project for the semester. The proposal can be developed with the assistance of the subject coordinator in order that its scope and breadth is appropriate. Extensive feedback is given to students 1 week following submission so that the research project can continue in a timely manner. In week six of the semester, students are required to present their research proposal to the class. This second "scaffold" in the research project is important for two reasons: first, it enables students to practice their presentation skills and learn how to pitch an idea in a short period of time; second, it assists in the development of a collaborative community because all students come to know each other's topic. As the third "scaffold," students must submit a final research paper of not more than 3,000 words on their selected topic. Again, students work closely with the subject coordinator to stay on track both in terms of time and content. The three parts that comprise the research project comprise 60 % of students' overall mark for the subject. The final task of this subject, the main concern for this study, is the final exam, which will be described in the following section. The description of these assessments and their relative weights are shown in the Table 1.

## 3.2 The Final Exam

The final exam for ACCY905 combined the researched benefits of OBOW examinations with the peer-learning approach adopted throughout the semester. It was anticipated that students would benefit from an approach to assessment that reflected the style of teaching and learning applied in the subject. To that end, the pedagogical approach adopted in the subject was followed closely. In the first part of the exam, students were presented with a broad topic, in this case the *Dodd-Frank Wall Street Reform and Consumer Protection Act* (see appendix for further

**Table 1** ACCY905 assessment tasks

| | Assessment Tasks | Assessment Due date | Assessment Description | Weighting (% of overall mark) |
|---|---|---|---|---|
| | Seminar participation | Each week from week 2 to 13 | Students provide a one page summary that critiques each of the set readings for the week. Students are expected to contribute to class discussion based on the readings and summaries. | 10 |
| Research Project tasks | Research proposal | Week 4 | Students are required to prepare a research proposal on a case of their choice, but within the broader scope of issues studied in this subject. | 15 |
| | Research proposal presentation | Week 6 | Students are required to present their research proposal. | 15 |
| | Research essay | Week 10 | Students prepare an essay of not more than 3000 words that builds on the research proposal submitted in week 4 and presented in week 6. | 30 |
| | Final examination | Week 13 | See section 2.2 and the appendix for specific details | 30 |
| | Total | | | 100 |

details), and placed in the role of a research expert with 1 week to submit a manuscript that addressed one aspect of the Act and its potential effect on global stakeholders.

The format of this first stage of the exam was essentially an OBOW style with students permitted to draw on all resources available to them (Nonacs 2013; Williams 2004; Williams and Wong 2009). On the due date, each student's manuscript was shared with the entire class. The following day was "exam day" and students came to class as usual except that their assigned reading for the week was each other's manuscript. Consistent with previous weeks, the beginning of the exam involved a collaborative discussion of the manuscripts with opinions and ideas exchanged among students and between students and the instructor. Following the discussion, students were presented with a task that required them to decide on one or two key stakeholders from among those identified in the manuscripts and prepare a stakeholder report which examined the effects of the Act on those stakeholders. Again the OBOW style was adopted with students permitted to work as one group, in smaller groups or pairs, or individually, as well as access any materials available to them (e.g., the internet, class readings, other peers, the teaching team). Finally, the third part of the final exam required students to prepare a written reflection documenting their experiences and concerns with any aspect of the subject and the exam. These final exam tasks are summarized in Table 2 below.

**Table 2** ACCY905 final exam tasks

| Final exam tasks | Assessment time | Assessment type | Description | Weighting (% of overall final assessment) |
|---|---|---|---|---|
| Task 1: Research report | 6 days | OBOW | Students prepare 2,000 words report based on their selection of one provision of the Act, identifying a maximum of three stakeholders and analyzing the effect of the provision on these stakeholders | 60 |
| Task 2: Stakeholder report | 2 h 10 min | OBOW. Students able to work individually or with peers | Students and instructor spend approximately 30 min discussing the manuscripts submitted for Task 1 and considering key stakeholders. Students then have 90 min to prepare the stakeholder report | 30 |
| Task 3: Reflection | 24 h | Individual | Students prepare a one-page refection on their experience in ACCY 905 | 10 |
| Total (final exam marks were weighted to a mark out of 40 % as the contribution of this task to the total assessment marks for ACCY905) | | | | 100 |

These previous sections have explained the peer-learning approach adopted in ACCY905. The value of case study-based learning was also highlighted. An additional benefit of the case-based approach adopted in ACCY905 is that students were given significant autonomy in the selection of the case used for their research project. The case-based theme was continued into the final exam, where students were presented with another case which enabled them to draw on many of the aspects investigated in the subject during the semester. The following sections provide evidence of student satisfaction with respect to the peer-learning approach and case study method of teaching used in this subject.

## 4 Student Satisfaction

### 4.1 The Flipped Classroom

As noted above, active engagement was expected of students throughout the semester. Based on a critique of assigned readings, students participated in discussion with each other and with the instructor. Student feedback on this aspect of the flipped classroom was positive:

> I liked the weekly format of having readings for each week that we wrote summaries for based on what we thought was important. I prefer this method rather than having to answer a set of weekly questions because I feel I absorb the readings better (Student B).

> The task of writing a summary of the assigned readings each week was my favourite part of the subject. Although it was stressful to read, understand and make comments about the papers, the process pushed me to think more about the topics rather than simply accepting what the author says so that I could participate in class discussion (Student D).

From these comments, it is evident that the students experience in the subject was enhanced. By replacing the traditional question and answer homework format with a discussion-based seminar, students gained confidence by participating in class discussion, and critical thinking skills were developed via the exchange of opinions with peers (Boud 2001; Collier and McManus 2005; Harvey 1984).

An important feature of this assessment task is the incorporation of marks for preparation of the summaries and participation in class. Because students were aware that marks could be earned by actively engaging with their peers, they were motivated to obtain a deep understanding of the weekly readings (McDowell 1995).

> Knowing that we would discuss the readings in class was a strong motivator for us to go through the readings in depth so that we could link them to the issues discussed in the lecture (Student A).

An unanticipated but important outcome of the flipped classroom was the enhanced learning experience that resulted from the cultural and professional diversity of the student cohort. When the approach for ACCY905 was initially designed, there was a concern that international students might be unwilling to participate because of language concerns. While comments described the approach as “stressful” and “difficult,” all international students noted that they felt their communication skills had improved by being part of class discussions.

## 4.2 The Flipped Final Exam

When the idea of the “flipped” exam was pitched to the students, the reaction was skepticism, surprise, uncertainty, and confusion. Nonacs (2013), who used the “flipped exam” approach for his UCLA Behavioral Ecology class, reported similar reactions from his students. Also consistent with the results from Nonacs’ (2013) students, the final exams submitted by the ACCY905 cohort were well-researched, carefully-considered manuscripts along with stakeholder reports and reflections that demonstrate the value of the flipped approach for the enhancement of student learning.

> The format and content of the final exam is very interesting, challenging and informative, which gave us a memorable experience (Student A).

> The final exam format was reflective of the way we had undertaken our study of the subject during the semester but it is also reflective of how the day in the life of an accountant can play out (Student B).

> I suppose everyone will agree that this style is more relaxed than the traditional paper exam (Student C).

> The final exam is very distinct and innovative (Student E).

In line with studies by Harvey (1984) and Selsky (2000), the majority of students were extremely positive about this experience. The new exam environment, described as “interesting, challenging, innovative, relaxed,” along with the quality of exams submitted, indicates that the flipped approach to examination is beneficial in terms of the student experience as well as student learning outcomes.

In contrast to the researcher’s expectations, when students were given Task 2 of the final exam, requiring them to produce a stakeholder report either individually, in pairs, or as a group, only two students (one Australian student and one Indonesian student) chose to work together. They moved to a separate room to prepare their joint report. The two Chinese students also moved to a separate room but they chose to submit individual reports even though they shared their individual ideas. Only one student (Australian) remained in the exam room to complete the task alone. The behavior of the students was surprising to the teaching team:

> I expected that students would elect a “leader” who would manage the process of answering Task 2 as a group. I was certain that they would join together to prepare one report. I can hardly believe that five students have divided themselves into three groups to prepare four reports! (Team member C).

> Given the development of the cohort as a group throughout the semester, I was sure they would work together (Team member A).

There are three reasons that may have contributed to students’ decisions to address Task 2 of the exam in this way. First, the students that worked alone may have been discouraged by the possibility of the “free-rider” effect negatively influencing their final mark (Joyce 1999; Yamagishi 1988; Carpenter 2007). Second, there may have been a “culture” effect contributing to the decision of the Chinese students to leave the group and work alone. As noted by Carlson and Nelson (1994, p. 2) and Carson and Nelson (1996), the “face-saving” culture which pervades Chinese behavior may have contributed to the students’ choice to work alone unless specifically asked to join the main group. Third, Nonacs (2013) notes the potential for “lone wolves” to work individually, believing that they would score a higher mark alone rather than working with the group.

As expected, the students who joined together to approach the task had an enjoyable and rewarding experience:

> I was thrilled to have done it with one peer; I think we merged it together well (Student B).

> I like this exam format. I definitely learned something new from my peer - about the topic itself, the way my peer thinks, and also insights into my peer’s character. This allowed me to learn academic things while in the same time assisting my self-developing through interaction with others (Student E).

These students considered that addressing the task as a group, or in pairs in this case, would assist in reducing work load, developing ideas, while also enhancing their learning and understanding. One of the students that paired up found it difficult to understand why the rest of the class separated to work alone:

> I was a bit disappointed that we did not do it as a group I think we would have learned more from each other's topics if we did. Group dynamics are interesting to observe and I think our class could have worked well together (Student B).

For the students who chose to submit individually prepared reports, their reflections provided some explanation of their choice to work alone:

> The reason I chose to work alone was because I want to test my exam writing technique (Student D).

> . . .some people may good at writing while others may have better performance when he or she is speaking. . . [However], English is not [my] first language so individual work is the better choice (Student C).

These comments are reflective of the "lone wolf" mentality (Student D) and the Chinese face-saving culture noted above (Student C). In addition to reflecting on the peer-based approach of the final exam, students commented on the benefits of the OBOW format. "Being able to use search engines and other resources enabled us to find the relevant points and achieve a higher level of accuracy because we did not need to rote learn everything and then put it down on paper (Student A)."

> The benefit of this type of exam is that we do not have to deliberately memorise everything we have learned. Instead, we were given a "fresh" topic to apply our knowledge (Student C).

> The process was more learning-oriented than exam-oriented because we had an opportunity to practice our reasoning and critical thinking skills as well as knowledge application (Student C).

Based on these comments, it is evident that the OBOW exam format significantly improves the student learning experience. The pressure to memorize material is reduced, marking a significant improvement in the potential for deep learning. The OBOW format, combined with a case-study approach, helps students to make connections between theoretical backgrounds by using a highly contextualized task. The assistance of technology and the potential for collaboration with peers also enables students an authentic learning experience that is reflective of workplace practices.

## 5 Future Directions

This study reports on a pilot project which extended the flipped classroom approach to the final exam in a postgraduate accounting subject. Consistent with the flipped approach to teaching, the final exam permitted students to use all intellectual tools available to them in order to prepare the best possible answer.

In adopting a flipped approach to the final exam, an OBOW format was applied in two sections of the exam. First, the "take home" part of the final exam allowed students to use any resources to solve a highly contextualized problem to prepare a report. Second, conducted in a final exam setting at the university campus, students prepared a stakeholder report and were again able to draw on a broad range of resources including their peers, teaching staff, the internet, and the university library. This exam format enabled students to engage with a specific problem and use all of the knowledge gained throughout the semester. In this way, students were given the opportunity to gain a deeper appreciation of the concepts explored during the subject, rather than having "cram" and then "data dump" on the exam day (Phillips and Lowe 2003; Williams 2004; Williams and Wong 2009).

A student satisfaction questionnaire confirmed the results of previous studies (Williams 2004; Williams and Wong 2009) that indicate that this particular learning and assessment approach reflects the highly contextualized nature of the workforce and enables students to apply relevant skills and knowledge. The students that participated in the pilot project demonstrated a high level of critical thinking development across the semester, which was enhanced by the international nature of the cohort. Instead of shying away from in-class interaction, the international students were instrumental in providing cultural context to particular issues and enhancing the learning experience for the entire group. This shows that innovative teaching methods using technology can enhance student development, learning experiences, and engagement for students from different cultural backgrounds (Zhang 2012).

This project highlighted the importance of the role of the teacher in the context of peer-based learning approaches. By providing a structured but open learning environment, a flipped approach enables the teaching team to encourage student collaboration, while also recognizing and addressing the possibility of "free riders" taking advantage of the learning and assessment style (Harvey 1984; Tielman et al. 2012). This also reduces the temptation to cheat because students are given freedom to explore their ideas (Harvey 1984). In the context of assessment, the teacher can focus on assisting student development rather than working as a detective to prevent students from cheating.

This approach to learning and assessment demonstrates the gains in student development that can be made when there are no restrictions related to source material and when the only matter at hand is achieving the best possible answer (Nonacs 2013; Harvey 1984). The study highlights the potential of using flipped learning approach in accounting education and there is an opportunity here to apply such approach at different universities in different cultural and social contexts across different disciplines including accounting.

There are some limitations to this study that provide opportunities for further research. The sample size for this study was small; however, given the success of the pilot, future research could consider larger accounting classes either at the undergraduate or postgraduate level. Second, this study only focused on one course – international accounting, an accounting theory based subject at a postgraduate level. Thus, it is difficult to generalize results to other accounting subjects, whether they be technical or theoretical, or at postgraduate or undergraduate level. This research provides an opportunity for other accounting educators to implement and replicate this study for larger classes and in different subjects.

## 6 Cross-References

► Characteristics of Mobile Teaching and Learning
► Transformation of Traditional Face-to-Face Teaching to Mobile Teaching and Learning: Pedagogical Perspectives

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# Use of Short Message Service for Learning and Student Support in the Pacific Region 13

Bibhya Sharma, Anjeela Jokhan, Raneel Kumar, Rona Finiasi, Sanjeet Chand, and Varunesh Rao

## Contents



**Abstract**

The Pacific island communities face challenges such as digital divide, shoestring budgets, and escalating costs in the delivery of quality education to the people. In addition, the widely scattered nature of islands and communities requires proper communication infrastructure for the learners to access education. This chapter heralds the emergence of mobile learning (mLearning) initiatives in higher education in the Pacific region. It focuses on the introduction of mLearning at a University in the Pacific islands, which developed a fit-for-purpose mobile-learning infrastructure that primarily utilized the short message service (SMS). The university hosts an in-house setup open source SMS gateway that facilitates its custom-made SMS services. The SMS services developed serve the purpose for notifying students with important course information, exam timetable information, course mark information, and library book due dates, and students could also attempt quizzes in their courses via SMS. These SMS services are mostly provided as support services to overcome the challenges faced by the learners in the Pacific community.

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## 1 Introduction

Mobile learning or mLearning is a concept arising from the global emergence of mobile technology and the acceptance of the use of mobiles by the general population to provide assistance in various aspects of their livelihood. In the learning and teaching processes, mLearning invariably allows for just-in-time, just-for-me, and just-enough learning to the users. According to Brasher and Taylor (2004), mobile learning is defined as “any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies.” With mobile devices being cheap, widely available, and educationally interesting compared to desktop and laptop computers, they are more likely to be accepted by learners. To the learners mobile devices offer several communication channels such as email and voice and text messaging and wireless access to educational materials and resources (Traxler and Kukulska-Hulme 2005) and social media.

Mobile learning in developed countries such as the UK has seen a massive growth in the recent years (Oller 2012). According to MobiMOOC (2011), the UK MoLeNET program (a program for the implementation of mobile learning) has been supported with more than $25 million in funding by government and academia, and it involves more than 40,000 learners in 104 different projects involving 147 colleges and 37 schools. Also, in the USA mobile-learning programs either provide mobile devices to students directly or allow students to bring their own technology (BYOD) given that 75 % of teenagers have mobile phones as stated by Wallace and Madden (Tsinakos 2014). A number of mobile-learning projects such as Qualcomm’s Wireless Reach and On-the-Go have been very successful upon initiation. The aim of these projects was mainly to escalate student access to educational content and enhance communication between instructors and learners through online tools and resources (Tsinakos 2014).

On the other hand, in the developing countries, the potential for mLearning is comparatively lower. In Africa and the Middle East, the number of mobile-learning projects is low showing that the mobile learning is still in its infancy (Tsinakos 2014). There are isolated cases, for example, the Kenyan government piloted a project to send bulk SMS to primary school teachers in remote rural areas (Traxler and Kukulska-Hulme 2005). Motiwalla’s study in 2007 found that mLearning tools were better suited for institutions in developing countries due to its nature of flexibility, cost effectiveness, and very convenience to these institutions which are populated by students who are categorically different. Moreover, with the current trend in technology, the quick adoption of new technologies by the younger generation means that mobile devices are becoming effective tools for learning. In the Pacific the reach of telecommunications is wider than that of the Internet; mobile learning can be a feasible, plausible, and an effective learning tool in the region where learners find difficulty in accessing learning materials from their learning centers due to poor Internet connectivity (Finiasi et al. 2013).

The University of the South Pacific (USP) has explored the benefits of mLearning for the Pacific region and how it would work on the three pillars of mLearning – just for you, just enough, and just in time – to make learning easier and more accessible to students keeping in mind the various limitations and restrictions, some unique to the Pacific region.

## 1.1 Mobile Devices in the Pacific

In the Pacific region today, growing public evidence suggests that ubiquitous mobile devices, especially mobile phones and more recently tablet computers, are being owned by a large percentage of people who use it for various purposes that the devices and their applications have to offer. The vast increase of mobile ownership in the region is accredited to the better call/SMS rates, affordable data packages, its simple yet exciting features, changing lifestyles, and a growing need for connectedness (Ulfa 2013). The increasing usage of Facebook and other social networking sites also contributes to the growing percentage of mobile ownership and usage in the Pacific. In the modern age, the mobile devices are in the midst of communication as "staying connected" is a part of the social need.

The mobile technology has grown parallel to the Internet, and now these devices can be used to connect to the Internet. An added excitement is that while there is a sharp decline of costs in the technological market, the mobility, portability, high speed, and storage capacity attributes of the devices are very attractive. Due to the high demand of mobile devices, the value for a phone would be depreciated within a short period of time from its original release date. Hence the region is usually inundated with older versions which are available at very affordable prices, although there is also a demand for the latest and high-end mobile devices.

Figure 1 gives the mobile subscriptions for selected Pacific island countries from 2000 to 2013. The trend shows the rapid increase in the number of mobile users and is following trends similar to that of Asia, Europe, Commonwealth of Independent States (CIS), Africa, and the USA. More information about global mobile trends can be obtained from the ITU website (ITU 2014).

## 1.2 USP Mobile Learning Initiative

The USP has a student population of approximately 30,000 (Dashboard and Business Intelligence System – USP 2014) and comprises 14 campuses and 9 centers spread over and owned by 12 member countries – Cook Islands, Fiji Islands, Kiribati, Marshall Islands, Nauru, Niue, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, and Vanuatu (Jokhan and Sharma 2010). See Fig. 2.

As the member countries struggle with their priorities, there are additional challenges of low and intermittent electricity supply, low Internet penetration, high cost of Internet and telecommunications, lack of financial resources to develop and maintain the ICT infrastructure, and low spending power of the people. Despite

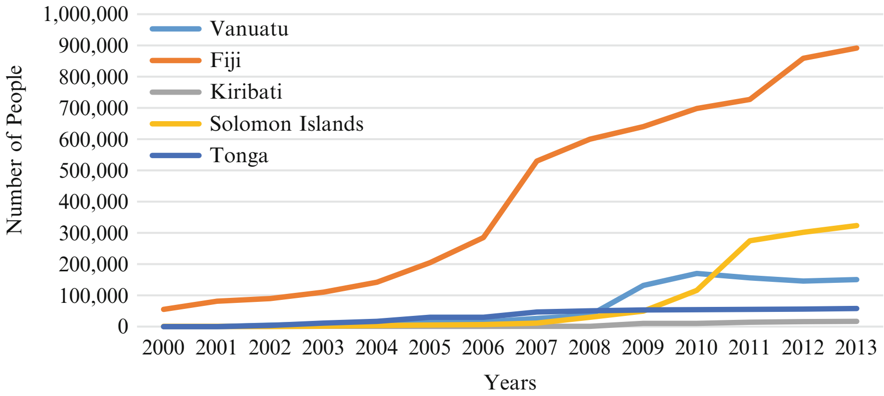


**Fig. 1** Mobile subscriptions in the Pacific region (Source: International Telecommunication Union 2014)

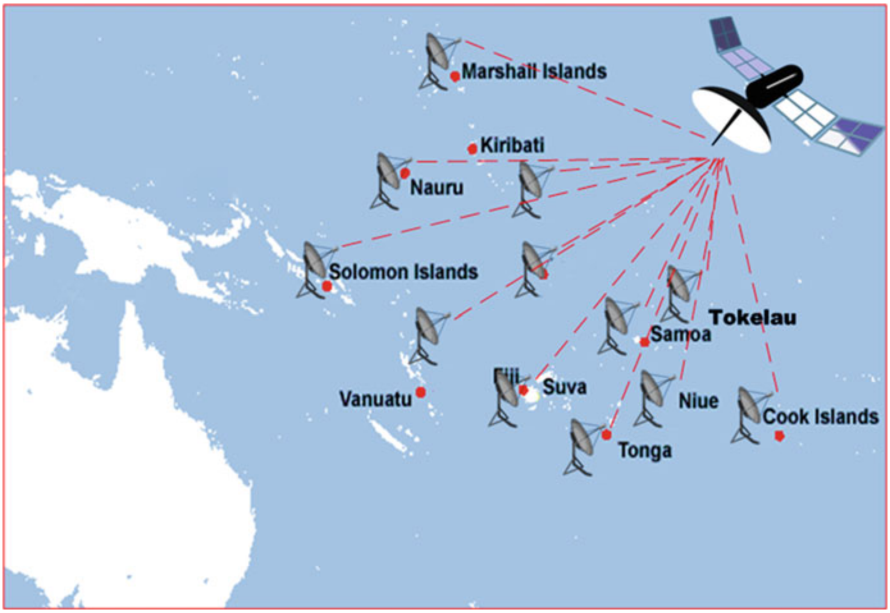


**Fig. 2** USP member countries connected throughout the Pacific region

these challenges, it is imperative that USP reaches its students in all its member countries with the opportunity for quality education.

Each member country houses at least one campus, varying significantly in size and student population. The main campus (Laucala Campus) is based in Suva (Fiji Islands) (Jokhan and Sharma 2010). The USP students study through various modes, namely, day-to-day classes, referred to as face-to-face mode; print mode mostly for flexible education; full-time online, referred to as online mode; and finally the blended mode which is a mix of face-to-face and online or print deliveries. Most of the courses and programs offered in the region are administered and facilitated from the main campus. The smaller centers are part of the larger campuses spread in remote locations or on the smaller islands in some regional countries.

Notably, the regional governments, NGOs, and the World Bank (ICT Overview 2014) have indicated the need for the developing countries to embrace and leverage on ICT to provide feasible, cost-effective solutions to important issues such as entrepreneurship, shared prosperity, digital divide, and sustainable development and economics.

For USP, it is not only a matter of availability and accessibility to education for its students but also an attempt to create global citizens. The university owns and runs its own telecommunications system, known as the USPNet. This chapter concentrates on the work carried out in the USP with the development of the technologies for mLearning for the Pacific region and illustrates the successes of the SMS-based applications in its teaching and learning processes and the student support services.

## 1.3 Types of Phone in the University of the South Pacific

An initial survey carried out in 2011, with a response by 834 students, showed that a significantly large percentage of students (68 %) owned 2G phones compared to smartphones. This survey led the technical team to focus on the development of SMS-based applications as the SMS feature would be readily available on both 2G and 3G phones, and almost all students would benefit from this. However, the students' preference and possession of mobiles are shifting more toward smartphones as the survey carried out in 2013 indicates an increase in smartphones and a decrease in the possession of 2G phones. The 2013 survey was carried out with 1,245 students of the university (Finiasi et al. 2013).

The 2014 USP MOODLE logs show that Cook Islands has 121, Fiji 14,392, Kiribati 450, Marshall Islands 118, Nauru 75, Niue 9, Samoa 443, Solomon Islands 2,213, Tokelau 3, Tonga 788, Tuvalu 147, and Vanuatu 1,263 registered student mobile numbers.

Another survey conducted in 2014 with 1,399 student responses has shown a further rise in the number of smartphones in the university. The percentage of smartphone users has increased to 43 % in a year's time, and more accurately it increased by 13 % in a span of 4 years. Interestingly the increase seems to be occurring steadily with the USP students. A meaningful extrapolation certainly heralds the beginning of smartphone and tablet computer era for the Pacific region, although a little delayed compared to the developed countries.

Also, as shown in Fig. 3, students' possession of tablet computers was also observed, and this comprised mainly of iPads and Android tablets. This large percentage of tablet users in the university can be attributed to the introduction of

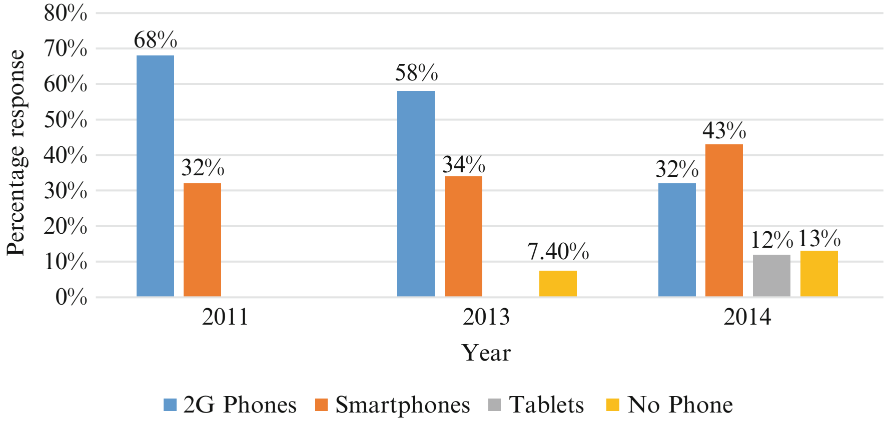


**Fig. 3** Mobile devices with students in USP

the tablet learning project (TLP) by the university in 2013, in an attempt to support students' online and print learning (Kumar et al. 2013).

## 1.4 Evolution of Mobile Learning at USP

With students of USP more widely scattered with less access to learning materials and poor Internet connectivity, connecting within the classroom can be difficult.

Considering the large student ownership of mobile devices, the diversity in the region, socioeconomic background of the students and parents, growing popularity of ICT tools and technologies, and finally that the university already has an established eLearning system (MOODLE), the idea of deploying mLearning to facilitate and support teaching and learning was deemed to be an important one. Through this goal, the university adopted the initiative to deliver learning services and content via mobile devices.

The very first use of a mLearning tool was the SMS notification service in semester 2 of 2011, in the two first-year science courses (mathematics and information systems). The pilot run in the online mathematics course showed an increase in the assignment submission rate from 68 % to 83 % and an increase in its pass rate from 54 % to 73 % when timely SMS notifications were sent to students compared to not sending students these notification in a previous assignment (Sharma et al. 2011). In a survey, students said the reminders were helpful and reminded them to turn in their assignments. In parallel, the Centre of Flexible Learning carried out a survey within the university securing important information on ownership of different mobile devices and which mLearning services students wanted to be introduced in USP. Work carried out by these two groups served to provide an insight into the development work required based on the unique challenges of the Pacific region.

## 2 Short Message Service for Students

The short message service (SMS) is a service mechanism designed to send and receive short messages over a mobile network. It began in Europe in 1992 under the Global Systems for Mobile Communication (GSM) specifications, and today it is one of the most successful and prominent wireless data services over mobile networks (Brown et al. 2007). The SMS messages have a limit of 160 characters per message with a 7-bit encoding and 70 characters per message with a 16-bit Unicode format. Today, the Third Generation Partnership Project (3GPP) is responsible for the maintaining of SMS standards. The SMS feature is supported in all 2nd-, 3rd-, and 4th-generation phones which make it an ideal communication app for the region.

### 2.1 Short Message Service Gateway

An SMS gateway is a messaging software that can allow sending and receiving of SMS from/to computer systems (preferably servers) to/from mobile phones. An SMS gateway presents a number of benefits to institutions, organizations, and their stakeholders. Firstly, for educational institutions, it can be used to enhance the teaching and learning processes. So in 2009 highlights were on how an SMS gateway was setup in Hong Kong Institute of Technology and specific applications programmed to promote mobile learning in the institution (So 2009). Secondly, such gateways can be very useful in times of disaster. Disaster authorities and organizations can send out immediately disaster warnings and evaluation plans which are also cheap and do not depend on electricity or the Internet. One recent model built is the SMS-based flood monitoring system which potentially provides timely notifications to the affected residents and the relevant authorities on the height of flood waters (Azid and Sharma 2012). Finally, an SMS gateway enables a two-way communication where users can also request relevant information on their mobiles by sending SMS.

As an example, the USP has integrated an open-source SMS gateway named Kannel (Kannel 2014) into its own telecommunications system to meet the SMS needs. Kannel has been installed and configured on a server running the Linux operating system and is hosted in university premises. It communicates with the mobile service providers and SMS centers (SMSCs) to receive and send SMS to its users. The SMS gateway is configured to work with the mobile network providers in the region and thus is able to have a connection established with the mobile service providers SMSCs. Figure 4 illustrates the SMS gateway architecture at USP.

The two-way communication applications allow the user to send SMS requests to the application, and then the application appropriately sends an SMS response to the user. This tool is ideal in the education ecosystem where information is warranted on a frequent basis while keeping within the shoestring budgets, with reference to students as well as the university. The university has entered into contractual agreements with two local mobile service providers and has a common short code assigned by both the providers where students use this short code to send out SMS.

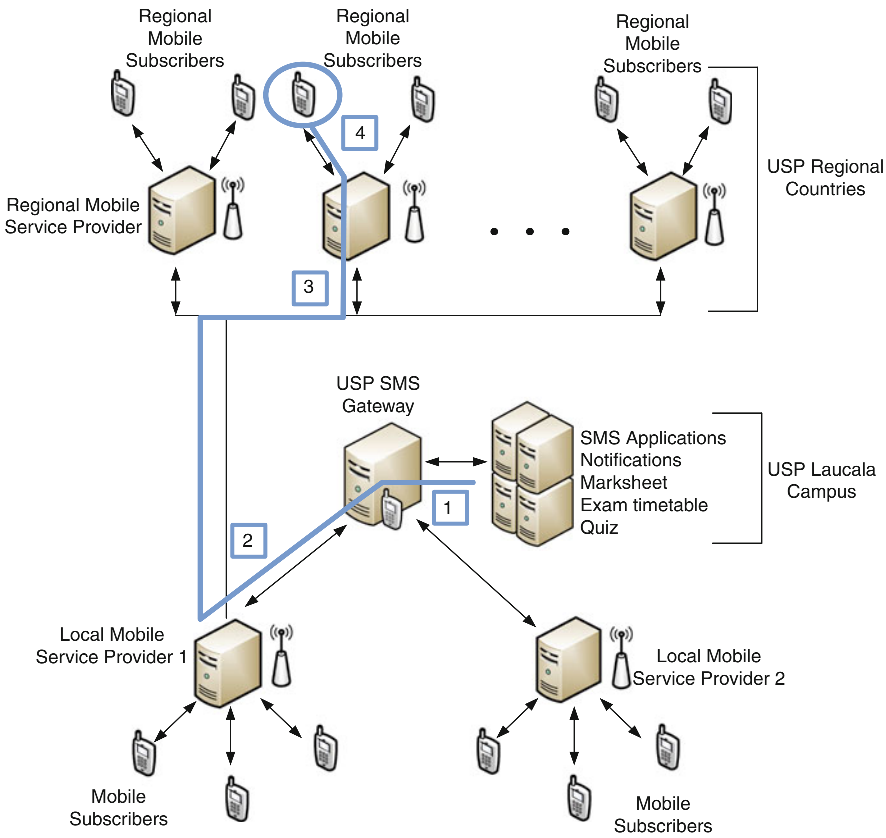


**Fig. 4** The SMS gateway architecture

For a proof of concept (PoC) on the how the in-house SMS gateway facilitates distribution of an SMS to users, an SMS notification from a course instructor to his students is given below. The series of steps corresponds to the path and numbers shown in Fig. 4 and is for the one-way communication applications.

1. The course instructor uses MOODLE to send out an SMS notification to a group of selected students who can be situated in any of the campuses and centers where the course is offered. As a PoC only an SMS traversing the network to a single student is considered. From the SMS notification application, the SMS travels to the SMS gateway.
2. The gateway decides on which SMSC to send the SMS based on the recipient's phone number. The SMSC is located at the mobile service provider's network. Here, for example, it is identified that local mobile service provider 1 will handle the SMS.
3. Once an SMS is received by the service provider at its SMSC, it decides whether the SMS is intended for a local number or regional number. For this case, we

have the recipient in the regional campus; thus the local provider forwards the SMS to the regional mobile service provider.

4. The regional mobile service provider sends the SMS to the recipient – the student whose phone is connected to the network via cellular technology.

## 2.2 SMS Application Architecture

The SMS application architecture was designed after the deployment of the SMS Kannel gateway. The design of the architecture is such that all the SMS applications are directed to a single short code "6013." This common short code was obtained from both the service providers so that it is easy for students to remember and utilize. The architecture for the SMS application system is shown in Fig. 5, and the functionality of the design is described later for the one-way and two-way communication.

The main advantages of this design are:

- Modular applications – the applications developed are separate applications running on a server. The failure of one application to run will not affect the other applications unless the fault is affecting all applications at once.
- One-way and two-way communication – the design allows for both one-way and two-way communication applications to run and be accessible by users.
- Link to multiple mobile networks – the gateway can be easily linked to more than one mobile network thus allowing communication to flow from/to users of any mobile subscriber identity module (SIM) cards.

### One-way Communication

A one-way communication involves sending out SMS from an application only. This communication system is used for the SMS notification application. The following steps, further illustrated by Fig. 6, are taken for the one-way communication in order to send out SMS notifications to students:

1. The instructor uses the MOODLE web interface of the application to write a SMS and send it to the recipients.
2. The SMS is passed from the application to the SMS gateway.
3. The SMS gateway sends the received SMS to the mobile service provider network(s).
4. The mobile service provider(s) sends the SMS to the recipients.

### Two-Way Communication

A two-way communication involves a user sending an SMS request to an application and receiving an SMS response from it. Here we consider a scenario where a student requests for a service from the SMS exam timetable application. The following steps, further illustrated by Fig. 7, are taken for the two-way communication:

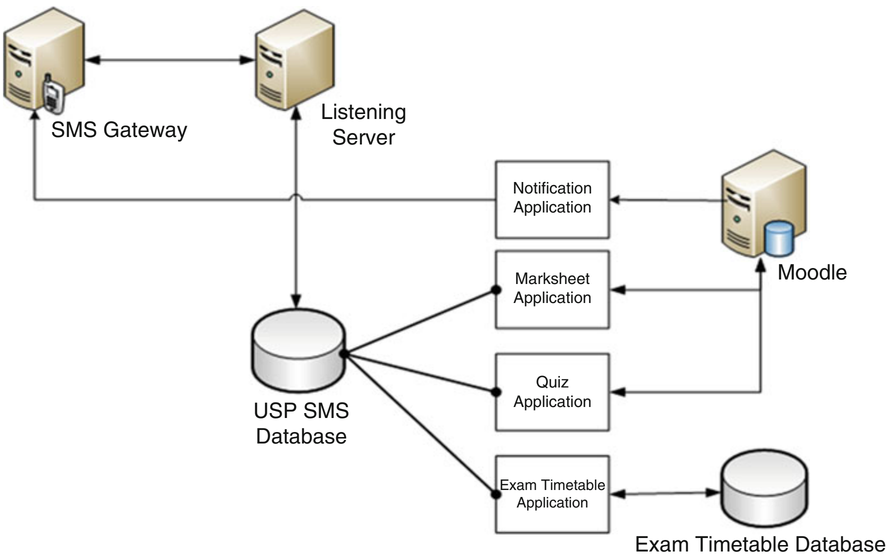


**Fig. 5** The SMS application architecture associated to the SMS gateway

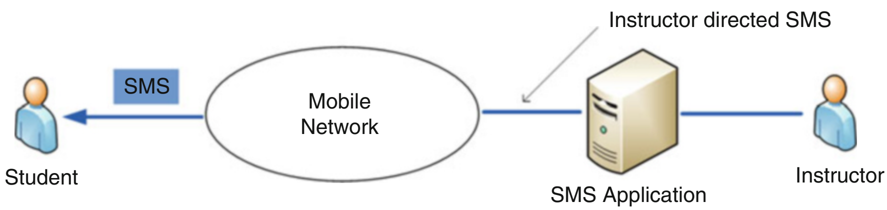


**Fig. 6** A one-way communication for SMS application

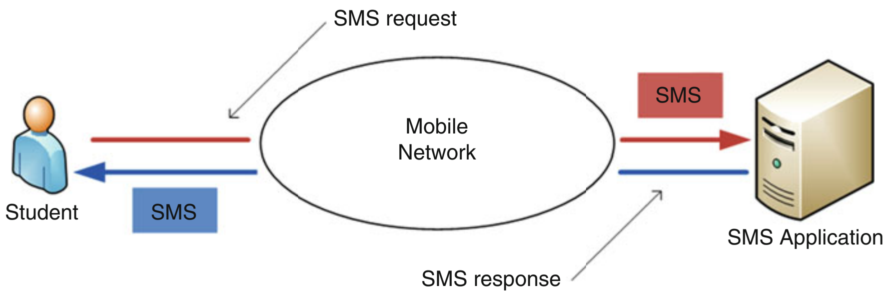


**Fig. 7** A two-way communication for SMS applications

1. The student sends an SMS request in a specific syntax to the short code, and that is received at the SMS gateway.
2. The listening server fetches the SMS from SMS gateway and writes it to the SMS database.
3. The specific application which is continuously polling the SMS database fetches the request SMS and processes it for the appropriate response. In the case of the SMS exam application response, the examination timetable and other important information such as seat numbers and venue, corresponding to the student identification, will be fetched. The application may also have to query external database(s) to get a response.
4. The application prepares a response SMS with the student's exam timetable information and writes it back to the SMS database.
5. The listening server fetches this new response SMS and passes it to the SMS gateway.
6. The SMS gateway then sends the received SMS to the mobile service provider network.
7. The mobile service provider(s) sends the SMS to the recipients.

## 3 SMS Applications and Their Usage

This section essays the different SMS applications designed and implemented in the USP. It also considers the usage and advantages of each application and the student feedback.

### 3.1 SMS Notification Application

The SMS notification application was the first mLearning application that was introduced by the university. The one-to-many application is a feature of MOODLE, and facilitators of courses on MOODLE have access to this application. The instructors or facilitators can send an SMS notification by typing out a 160 character or less SMS on the web interface of MOODLE and send it to all or a selected group registered in their courses. Figure 8 shows a snapshot of the SMS block that an instructor uses to send out SMS to the students. Once the SMS is sent from this web interface, it will be sent to all those students who had registered their numbers on MOODLE.

The SMS notifications have been used by instructors for important announcements to their students. An instructor can send out an SMS as a reminder for upcoming tests, release and due dates for assignments, cancelation of tutorials and lectures, and changes to schedules. The SMS notification application has been very effective for the university and useful for its students mainly because SMS can reach students at places where there are no internet facilities and students

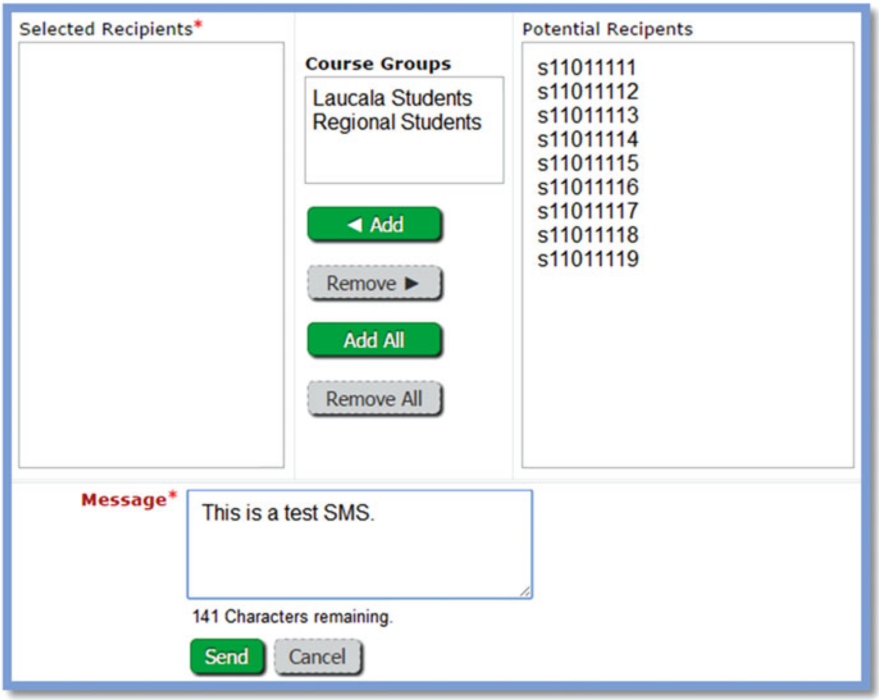


**Fig. 8** Sample SMS block on MOODLE

can receive SMS with the possession of a mobile phone with no cost incurred by the recipients. The university has secured significant concessions from the mobile service providers through contractual agreements and bears the full cost of SMS notifications. The university has also extended the service to other support sections. Table 1 lists the main sections within USP with reasons for the usage of the SMS notification service.

In 2013, the SMS notification service was available to the university's preliminary, foundation, and first-year courses – a total of 95 courses. The usage of SMS notification amounted to more than 249, 000 SMS sent to the different groups of students. In 2014, the service was expanded to include all undergraduate students and students enrolled the TVET arm of the university.

## 3.2 SMS Marksheet Application

The SMS marksheet application is another unique and exciting app developed in-house which integrates the marksheet – an electronic repository of marks on MOODLE to SMS. The application allows students to access marks of assessed tasks contributing toward their continuous assessment of flagged courses using the SMS feature of their mobile phones. Once the course coordinator feeds the course

**Table 1** University support section using SMS notification service

| Sections | When to send out SMS |
|---|---|
| Campus life | For special events on campus. For example, USP Open Day, social events, orientations |
| Student administrative services | For deadline and due dates concerning registrations and fees |
| Campus directors | For urgent messages such as changes to schedules, for students in local campuses |
| Marketing office | Mobile marketing of university |
| Emergency working group | For natural disaster awareness, early warnings, and closure of university |

marks into the MOODLE marksheet and activates the retrieval of this information via SMS (along with the access of MOODLE marksheet via web), the students can access their marks using SMS.

Since a student's mark is confidential, a validation test is carried out by the application in order to confirm that the user identified by the phone number which is stored in the user's profile database is indeed requesting for his/her own marks.

To obtain the course marks, a student has to send a specific syntax SMS to the university SMS short code of 6013. The syntax is given below with an example:

Marks[space]<Student_ID>[space]<Course_Code> e.g. Marks s12345678 AF101

where the student ID number s12345678 has requested for the marks for course AF101. This request and the reply received from the database are captured in Fig. 9. It is also noted that if students use the wrong syntax in the request SMS, the SMS request is dropped by the application, but information is logged.

Figure 10 shows the number of SMS requests that were received from the students in semester 1 of 2013. The app secured a high buy-in and acceptance from the students. However, since the service is free, the students use the app repeatedly and sometimes unnecessarily. Currently, the technical team is working on making this app sustainable and cost-effective.

## 3.3 SMS Exam Timetable Application

The SMS exam timetable application is a request-response application just as the SMS marksheet application. This application enables the students to send the request SMS and receive their exam timetable as an SMS response. The application is activated a week before the examination period. The application can be accessed by sending a request SMS to 6013. A specific syntax SMS is needed to be sent to 6013. The syntax is given below with an example:

Exam[space]<Student_ID>[space]<Course_Code> e.g. Exam s12345678 AF101

where the student with ID s12345678 has requested the exam timetable for course AF101. This request and the reply received from the database are captured


**Fig. 9** A mobile screenshot of the SMS marksheet application

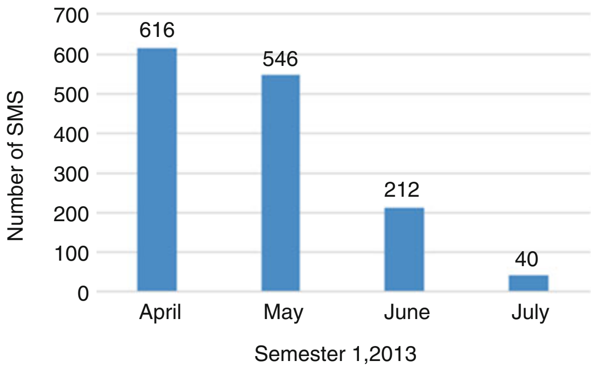


**Fig. 10** The SMS marksheet application statistics for Sem. 1 of 2013

in Fig. 11. The user can also omit the course code and would be receiving the exam timetable information for all courses he/she is enrolled in the semester. No authentication is needed for this service.

The application has benefitted many students, and now the university rarely has students miss their final exam because of reasons such as not being aware of the dates, times, and venues for the exams. Figure 12 shows the number of SMS requests the students sent and SMS responses coming to them containing their exam timetable information. The service is viewed as one of the best and most utilized applications introduced in the university. Students commented that they enjoyed the service and found it useful.

### 3.4 SMS Quiz Application

Recent years have witnessed a significant increase in the percentage of mature age and working students enrolled in USP; in 2014 this stands at 35 %. As a

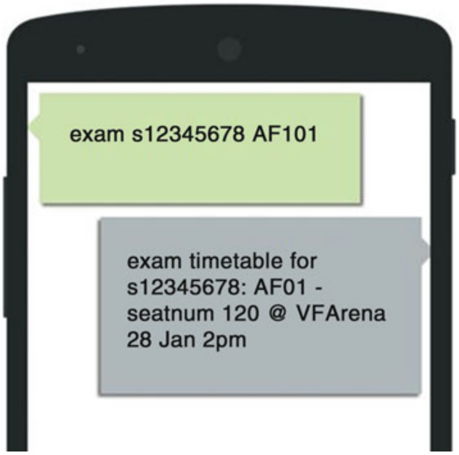


**Fig. 11** The exam timetable application statistics for 2013–2014

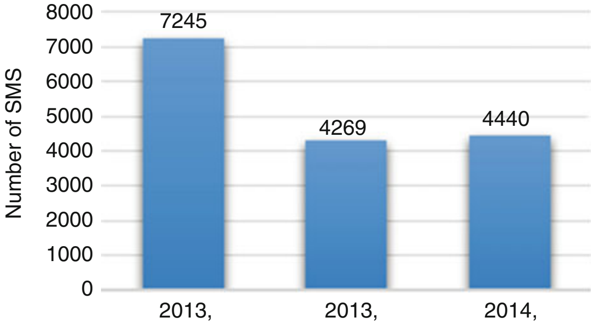


**Fig. 12** A mobile screenshot of the SMS exam timetable application

consequence, there is a growing expectation to take more assessments outside of classrooms, irrespective of the modes of delivery of courses. To take these real-time assessments to the cohort, the university has ventured into the SMS-based quizzes. The SMS quiz application is a two-way communication system designed to provide quiz in a form of questions having explicit answers. There are no open answer questions in the quizzes.

The quiz application is used for the following:

a. Short assessments – can take place either inside or outside classrooms or even be facilitated inside and outside classrooms in parallel, depending on the need. Currently, USP has trialed out the application in some courses for short quizzes inside and outside classrooms, together with an option given to students to either take the quiz using mobiles or use the traditional pen-paper approach.
b. Receive on-the-spot student feedback in a classroom – the quiz can be opened to a class by the instructor to get *just-in-time* feedback on a recently taught concept by posing a few questions in class and letting the students attempt the quiz. The instructor can then decide whether to advance or spend more

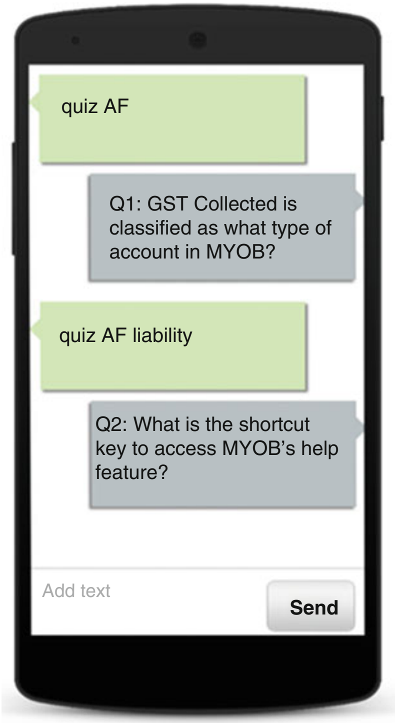


**Fig. 13** A screenshot of SMS quiz

time with the particular concept. This subject evaluation tool will be introduced in USP in 2015.

c. Promotional activities – mLearning team has been mandated to take marketing to mobile devices and actively help out during the university-wide promotional activities such as open day, orientation day, and parents and partners event, to name a few. The quiz is activated for a specific period of time for different stakeholders to attempt and win prizes.

To access the SMS quiz application, students send a SMS to the university short code (6013). The SMS message to initiate the quiz follows a simple syntax of "Quiz QuizCode." The QuizCode is used to refer to a particular quiz the student wishes to attempt. In the screenshot example in Fig. 13, the quiz code is "AF."

The SMS quiz application would then appropriately fetch a question and send to the students, and the student can then send the answer by typing in the quiz command, followed by the quiz code and finally the answer. For assessment purposes, each student is identified by the mobile number they register in the number database. Ideally, the session is terminated when the student has finished the quiz, and a response with the score is provided by the application to the student. Figure 14 illustrates the process described.

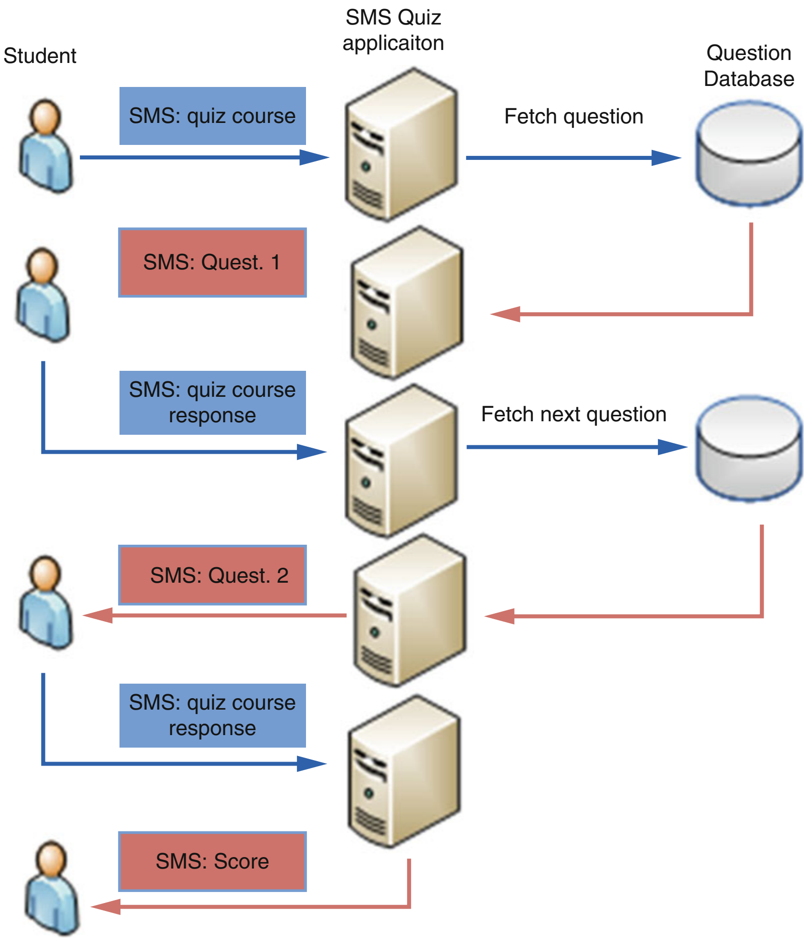


**Fig. 14** SMS quiz message flow

Figure 15 shows students in a first-year mathematics course using their mobiles to take the SMS quiz. It was found in the courses that about 80 % students preferred to take the quiz using the mobiles.

### 3.5 SMS Library Application

The SMS library application was developed to send the university's library alerts and notifications to the users through SMS. It is used for alerts like sending item due notice in advance, book reservation approvals, and book renewal messages. The application developed reads all emails sent to it from the library for alerts mentioned earlier. The application extracts the relevant information and formulates

**Fig. 15** The students using SMS quiz application in a first-year mathematics course

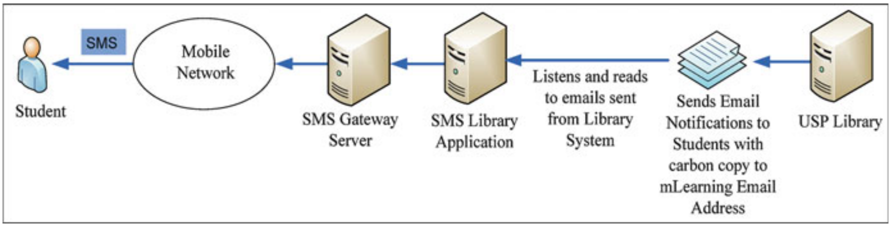


**Fig. 16** SMS library application process

a SMS to be sent out to the student. This makes it easier to notify students. Even if a student forgets to check his/her email, he/she would still be notified via the SMS. This benefits the students to avoid paying overdue fines, they can know if their reservation was successful or not, and books will be returned on time for other students to borrow. Figure 16 briefly illustrates how the library application works.

## 3.6 SmartDial

The SmartDial feature has been adopted by the university as an alternative to the SMS short code system. SmartDial uses Unstructured Supplementary Service Data (USSD) – a service provided by a number of mobile service providers. The SmartDial feature avoids any typing errors by the students that may occur while using the specific syntax method. The SmartDial system uses menus and can

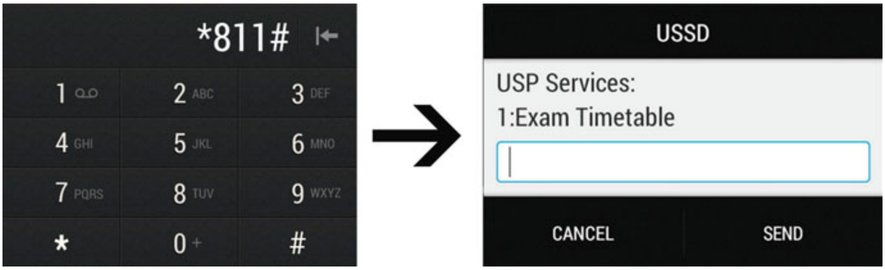


**Fig. 17** Screenshot of the SmartDial service

have multiple SMS services as items on the menu. The university has reserved the short code *811#, and students need to dial to this number to use this service (see Fig. 17).

## 4 Student Feedback

In order to gauge the effectiveness of the SMS services and applications, continuous feedback from students has been very important. Various approaches can be deployed, which includes online questionnaires through MOODLE, emails, and SMS surveys. Students appreciated the usefulness of the service, highlighting accessibility and lack of costs to students.

Figure 18 shows the general feedback received from students on different SMS applications from an online survey carried out in 2014, with a sample of 1,426 students. We see that receiving notifications and exam information through SMS were perceived to be very useful to students. Nonetheless, the reason why many students that did not use the SMS quiz application and hence remained neutral in the survey was because the application was piloted in only a small number of courses.

## 5 Suggestions for Future Applications

The student surveys carried out in 2012–2014 have progressively indicated a significant increase in the percentage of smartphones. However, strong ownership and usage of basic mobiles still persist which validate the need to continue work on SMS-based services and learning support for the students. Invariably, SMS services still provide that immediacy and mobility that allow us to better reach our learners. The SMS-based notification, marksheet, exam timetable, library, and quiz applications have been developed based on students' recommendation, but with growing awareness and acceptance of mLearning, students are coming up with suggestions for more applications. A couple of applications in consideration include accessing final grades and locating classrooms through SMS. While the former will need

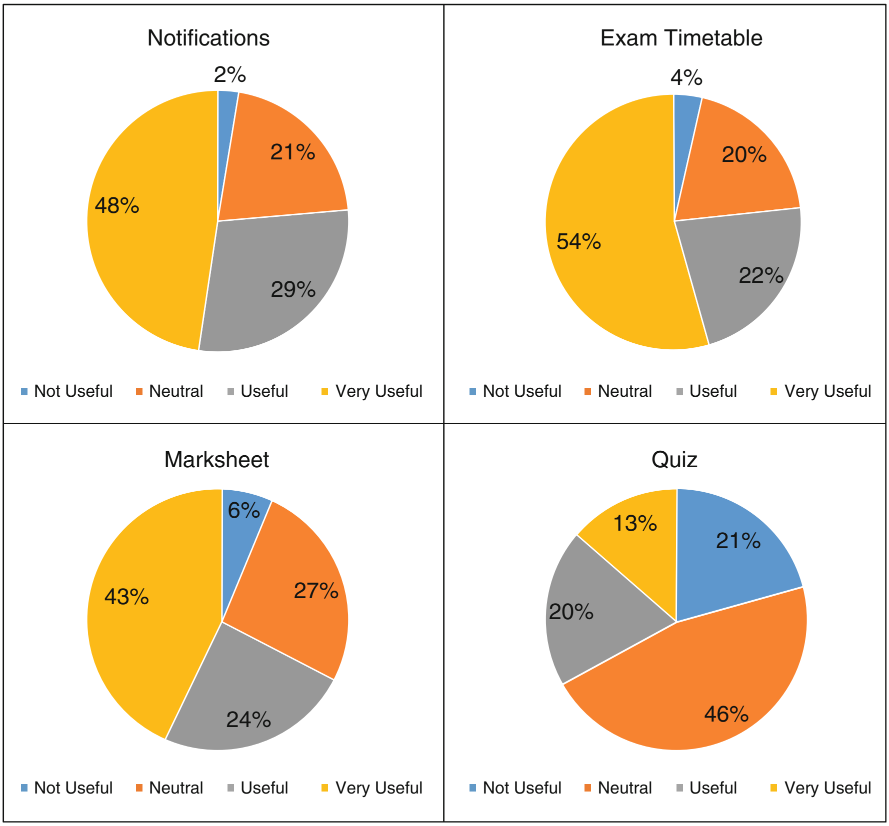


**Fig. 18** Usefulness of SMS applications (Source: data collected from mLearning surveys in USP)

careful consideration of security and confidentiality issues, the latter is to be piloted in the beginning of the new semester in 2015. Students especially freshman and visitors would greatly benefit from such an application.

While most SMS services designed have been based upon students' recommendation, additional requests are sporadically received from academic and support sections as mLearning and SMS-based services make their presence felt in the university. There is a request logged for new SMS services such as automatic staff leave from HR, campus life information such as careers fair, counseling services, IT services outage, and emergency notices, for example, tsunami warnings, earthquakes, and political uprisings, to name a few major ones.

Students have also requested Android versions of the aforementioned applications and some new ones (course finder) as well as the web-based applications (edutainment modules) which are currently running in the university. While USP has a few apps such as edutainment modules and course finder already in operation, it is expected to introduce others in the coming semesters.

### 5.1 Supporting Mobile Learning Projects

Another institutional ICT project carried out under the banner of mLearning was the use of tablet computers to facilitate and enhance flexible learning for students based in the region campuses. The project – known as the *Tablet Learning Project* – was carried out in 7 of the 14 USP campuses situated in 5 countries: Fiji, Tonga, Samoa, Vanuatu, and Kiribati. Around 600 students studying courses via flexible learning modes (print and online) in 2013 benefitted from this initiative. The major aim of TLP was to make flexible learning through a distance easier for students based in the regional campuses. In the first phase, the tablets were setup as an electronic repository of course materials and educational applications suited for the disciplines. The second phase, after security internet availability issues have been addressed, will be implemented in 2015 to enable students to enjoy inter alia all the SMS applications though their tablet computers.

## 6 Future Directions

The Pacific region inherits an array of challenges and opportunities due to the geographic isolation, nonuniform secondary school education, English being the second or even third language, student diversity, shoestring budgets, varying teaching resources, and lack of infrastructure to outline the major ones. Nonetheless, the university continually seeks to adopt from outside or design in-house efficient and cost-effective pedagogical tools and technologies to meet the expectations of its member countries in the region. To make education more accessible and flexible, USP has been integrating ICT in education in the recent times.

Some of the landmark ICT tools include smart classrooms, Moodle-based early warning system, online mathematics diagnostic test and remedial activities, and online and blended courses. More recently we have witnessed the introduction of mobile learning, denoted as mLearning – the “next big thing” in learning for the Pacific region. The mLearning is seen to be an indispensable weapon in the ICT armory which inter alia helps establish a learner-centered education system providing more power and responsibility to the learners.

The student surveys carried out in 2012–2014 have progressively indicated a significant increase in the percentage of smartphones. However, strong ownership and usage of basic mobiles still persist which validate the need to continue work on SMS-based services and learning support for the students. Invariably, SMS services still provide that immediacy and mobility that allow us to better reach our learners. Work on SMS applications will continue strongly in the future. It must also be stated that there is a definite shift toward ownership of smartphones in the university; hence, work on web-based applications and Android versions will be carried out in parallel in the coming semester.

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# Transformation of Traditional Face-to-Face Teaching to Mobile Teaching and Learning: Pedagogical Perspectives

# 14

Jan Turbill

## Contents




**Abstract**

Teaching students in a face-to-face context has been and, in many institutions of education, still is the only form of teaching in higher education. However, in the past 20 years, there has been a slowly increasing movement toward transforming the higher education teaching and learning experience from face-to-face to a mobile online learning experience. For most teachers this move is quite a challenge and raises many issues and questions. These include questions such as: What mobile technologies are available to employ? What teaching practices are best to use? Will student learning outcomes be better or worse as a result? And for many the question asked is simply how can this be done? In this chapter a framework for designing and implementing "online" pedagogy is shared. This framework is underpinned by Turbill's (From a personal theory to a grounded theory in staff development. Unpublished doctoral dissertation, University of Wollongong, Wollongong, 1994; The role of a facilitator in a professional learning system: the frameworks project. In: Hoban G (ed) Teacher learning



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for educational change: a systems thinking approach. Open University Press, Buckingham, pp 94–114, 2002) integrative theory of learning and draws on Herrington and Bunker's (Quality teaching online: putting pedagogy first. In: Quality conversations, proceedings of the 25th HERDSA annual conference, Perth, 7–10 July 2002, pp 305–312) pedagogical guidelines. Both are unpacked and explained using a case study that provides the reader with a pedagogical perspective that is both doable and proven to be successful.

## 1 Introduction

In the past 20 years, there has been a slowly increasing movement toward transforming higher education teaching and learning experiences from traditional face-to-face to mobile online learning. For most teachers this move has been quite a challenge and raised many issues, concerns, and questions. These include questions such as: What mobile technologies are available to employ? What teaching practices are best to use? Will student learning outcomes be better or worse as a result? And for many the question asked is simply how can this be done? In this chapter a framework for designing and implementing "online" pedagogy is explored. This framework is underpinned by Turbill's (1994, 2002) integrative theory of learning and draws on Herrington and Bunker's (2002) pedagogical guidelines. Both are unpacked and explained using a case study that provides the reader with a pedagogical perspective that is both doable and proven to be successful.

## 2 Background

Most teachers enjoy their face-to-face teaching in higher education learning. It has been the "tried and true" way of teaching for many decades, and they feel comfortable and confident in this "way" of teaching. Usually the face-to-face approach for large cohorts of students comprises 1–2 h of lectures followed by 1 h smaller tutorial classes. In some cases when the cohort of students is smaller, it is possible to run 2–3 h face-to-face classes. *Teaching Reading* was such a class. The class of usually 10–15 students was developed and designed by a senior academic (who for the purpose of this chapter will be named Dr. Brock) and aimed to explore the range of theories and practices involved in the teaching of reading at the postgraduate level. The student cohort of mostly practicing teachers came together for 3 h "same time, same place" each week for 13 weeks (Redmond 2011). The class had been rated highly by the students for 5 years in each semester of the academic year.

The predictable flow of the 3 h involved:

- Discussion of set weekly readings and tasks in groups of three
- New input provided in the form of "mini" lecture by the teacher
- Collaborative small group workshops aimed to discuss and apply new input

- A whole group sharing and "pulling together" of ideas, outcomes, and challenges
- Review of homework for the following week, clarification of assessments (when needed), and any other issues

Critical to the effectiveness of the class was the assessment practices/tasks that were designed to be accumulative over the 13 weeks. Each week students were required to read and review a set article (between-session readings [BSR]) and to trial and review a given teaching practice (between-session tasks [BST]). They were asked to provide a one-page summary for each, identifying connections to their current and future professional practice. Students used their reflective one pager during the weekly sharing and discussion that always began our class. They submitted their weekly responses for marking every few weeks, and the marks are accumulated into final grades for assessments 1 and 2, respectively. The final assessment required students to review all their responses for the two assignments, reread where needed, and write an evidence-based rationale and teaching plan on the topic "Effective Teaching of Reading in My Context." Overall students and teacher rated the subject as very effective for their learning and for the changes in reading pedagogy that followed.

Students learned a lot from each other as well as from the teacher. They were able to discuss current issues as they arose and keep each other up to date with new reading research and practices. The teacher was able to introduce points of interest from the media and newly published articles as they occurred. As the weeks passed students became a "community of learners" (Barth 1990), sharing personal experiences of family and homelife as well as teaching and learning experiences from their respective classrooms. In any one class there was a range of teaching contexts and experiences. For example, in one class there were three teachers of many years of experience who had taught children from Grade 1 through to Grade 6, two high school teachers both with a science background, two specialist teachers of English, one teacher in his third year of teaching Grade 1, a teacher in the local prison, and another who taught vocational education (plumbing). Such a range of experiences led to rich discussions and many stories.

Therefore when this small but successful face-to-face graduate class was forced to "go online" using mobile technologies, it created a great deal of anxiety and uncertainty for Dr. Brock. There were two key reasons provided for this decision. Firstly, Dr. Brock was informed that the faculty could no longer sustain small classes of 10 or so students, and secondly, it was hoped that the online format would attract both national and international graduate students who were prepared to enroll in asynchronous classes. In particular a small private university in Minnesota, USA, had shown keen interest in offering an online version of this course in their newly developed doctoral program. And so the challenge began for this teacher. Just how does one transform a 13-week effective 3-h face-to-face class into an online format without losing teaching and learning opportunities such as interaction, reflection, sharing, and most importantly collaboration? How does one create the community of learners that was so evident in the face-to-face approach?

At the time there was little published research to guide such a move, nor were there sophisticated learning platforms available today. However, Dr. Brock had just completed her doctoral studies into what constituted effective professional development for teachers. The study developed a grounded theory of pedagogy that led to active and deep professional learning. Dr. Brock believed that this theory could be used as a framework to both guide and support the transformation of her face-to-face class to an online space.

In what follows is a clear explanation of this grounded theory and how it "works." Moreover the principles of this theory are used to demonstrate how Dr. Brock transformed her face-to-face synchronous class to an effective online asynchronous learning experience. Current research is juxtaposed throughout the explanation in order to respond to the many issues raised throughout this transformation. Finally key principles are highlighted in order to provide a sound pedagogical perspective for developing online and mobile learning.

## 3 A Framework for Designing and Implementing "Online" Pedagogy

The model described in Fig. 1 is a visual representation of "an integrative theory of learning" (Turbill 1994, 2002). The theory emerged from research that investigated the "why" and "how" of a highly successful professional learning program for teachers. It can be used as a guide and frame for developing any teaching and learning enterprises. It aligns readily with action learning (Aubusson et al. 2009; Albers 2008) and transformative pedagogy (Meyers 2008) and is underpinned by the principles of social constructivism (Twomey Fosnot 1996).

Briefly, the model depicted in Fig. 1 demonstrates that there are personal (*inside-out view*) and external (*outside in view*) dimensions of learning that need to be considered in any learning enterprise. All learners (students) bring some background knowledge, beliefs, and/or views about that which they are about to learn (*My Personal Theory*) that underpin their existing knowledge, attitudes, and actions (*My Theory in Practice*). This inside-out view is constantly being challenged and informed (or should be) by new information, ideas and input (*The Theories of Others*), and new actions and practices (*Theories of Others in Practice*). Both dimensions are important and need to be valued equally. Critical in the construction of "new learning or knowledge" is the integration between "my inside view" and "the outside view" of that which is to be learned. Key drivers of such integration are the interactive processes that occur through reflection, sharing, and collaboration.

The model dictates therefore that certain structures and processes should be put in place for such interaction and integration to occur. This, in turn, leads to deep learning and understandings that becomes *My Personal Theory*. Langer (1998) refers to such learning as moving toward "mindful learning" in that the knowledge and understandings are said to be "known"; however, the knower is conscious that such knowing will be constantly challenged and changing.

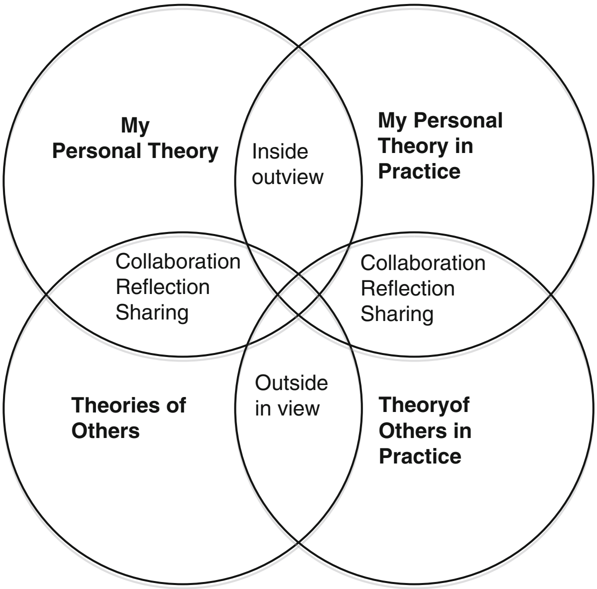


**Fig. 1** An integrated theory of learning (Turbill 1994, 2002)

For such a state of knowing to occur, the structures (e.g., teaching practices, assessments) and processes need to be carefully aligned and indeed synergistic in their operation. Thus the challenge for the teacher, the designer, the developer, or facilitator of that which is to be "learned" becomes choosing the "right" mix of structures and their respective processes so that optimal learning conditions not only exist but are made operational in such a way that they will become synergistic (Turbill 1994, 2002).

With the skillful and judicious selection of structures (teaching practices and assessment tasks), a learning culture is created in which there are sufficient learning processes in place to engage and enable deep learning. These include:

- Time for reflection, both written and spoken
- Time for sharing experiences and responses to readings with peers
- Opportunities for collaborative learning in small groups
- Opportunities to try and/or apply new practices
- Input (new knowledge) through a variety of media
- Readings that support, extend, and challenge the various concepts introduced in the course
- Opportunities to work collaboratively (Turbill 2001)

No one structure is sufficient, and none is more important than another, but together they operate synergistically so that any potential inhibiting factor in the learning culture will have only a temporary lifespan as learners work through what they want or need to know and learn. In such learning cultures, trusting and caring relationships develop. Learners become highly supportive of one another's efforts and understandings. A shared meaning begins to develop among the learners and with it a shared language. This does not mean that everyone has the same views, beliefs, or depth of knowledge – far from it – but it does mean that members of the learning culture begin to understand one another's perspectives. The learning culture moves toward what Barth (1990) calls a "community of learners." Such a community develops a sense of belonging that Lave and Wenger (1991) argue is an intrinsic condition for the creation and sharing of knowledge.

## 4 Principles for Designing and Implementing Online Courses

Having made the decision to go "online," Dr. Brock found there were many more decisions ahead. Before trying to adapt the teaching and learning activities (the structures) she had used successfully in her face-to-face teaching space, it was found she needed to learn just what technologies were available to her and her students in an online learning space, a learning space where students would no longer participate in the "same time, same place" approach. In particular, it was necessary to learn what mobile technologies her institution supported and just how to go about seeking support in knowing what affordances these offered to best enhance her teaching and engage her learners.

Redmond (2011, p. 1051) explains, "The changing nature of both the student body and available technologies have required academics to change their approaches." She offers four categories of teaching and learning spaces, namely:

1. Same time, same place – participants operate in the more traditional face-to-face teaching approach.
2. Different time, same place – participants interact in the same space with all participants, but at a time they choose, for example, asynchronous online discussions.
3. Same time, difference place – participants work independently but, at the same time, use online social media tools such as Skype and videoconferencing.
4. Different time, different place – participants are separated geographically and by time and operate always in asynchronous mode.

The choice of teaching and learning space is contingent upon the range and availability of technology tools and the affordances these offer. Redesigning a face-to-face traditional course using an integrative pedagogical approach underpinned by constructivism also requires changes in roles and responsibilities of teacher and students, use of technology, relationships, and sometimes a perceived change of prestige and power (Redmond 2011).

There are many successful structures that Dr. Brock had used in face-to-face teaching. But which of these would transfer successfully to an online learning space was an unknown in the first instance. Herrington and Bunker's (2002, p. 307) pedagogical guidelines help to address this decision. Their guidelines take into account the affordances offered by the mobile technologies and "assist both academics and instructional designers as they design new online units." Moreover the guidelines can be used as an evaluative tool "to assess the quality of existing online units determining areas of possible improvement."

These guidelines serve as a useful framework to keep in mind as one moves to the actual designing of the online course.

## 5 Building an Online Course

The first step in developing an online course should be to scope out a "big picture" of all the "structures" needed in the course. Figure 2 is such a scoping of the big picture of the online course for the graduate class *Teaching Reading* that Dr. Brock developed. The process of scoping the overview highlighted the many connections between and among the range of structures that had been so effectively part of the face-to-face class and that were highly desirable to be part of an online class. Working through this process also highlighted the areas where there was going to be the need for technology designer support.

Having scoped out the design of the course as a whole, it became apparent that the weekly topics, activities, workshops, and readings for the whole course need to be prepared and "ready to go" before the course began. The teaching space, "different time – different place" (Redmond 2011), required that the logic and flow of the key concepts, workshop tasks, and understandings needed to be clearly written and highly explicit so students could move through the topics with as little confusion as possible. Keeping the guidelines in Table 1 clearly in mind supported Dr. Brock's desire to develop an engaging learner-centered environment with many opportunities for collaboration and real-life tasks and problems in the teaching of reading.

Ten topics were developed to be completed by students in the 13-week session. A predictable navigation pane contained all the above structures and was predictable in that it was used for each topic (Fig. 3).

The *Introduction to Topic* outlined the key concepts covered in each topic. *Workshop Tasks* were designed for students to explore the concepts that were being introduced. Students were required to work through these tasks and respond accordingly. Some topics had only one task, while others had up to four shorter tasks. Students were asked to write their responses online and posted them for all to read *(pink outline indicates students' submitted responses)*.

*Making Connections* provided a summary of the key connections that were deemed important in that topic. Students were asked to add further connections, particularly any pertaining to their workplace. *For the Next Topic* listed Between Topic Reading(s) (BTRs) and Between Topic Activities (BTAs) that students were required to carry out and respond to between topics. The former were set readings that students were asked to respond to using two key questions as a framework:

- What are the key points for me in this article?
- What are the implications of these points for *my* teaching of reading in my particular context?

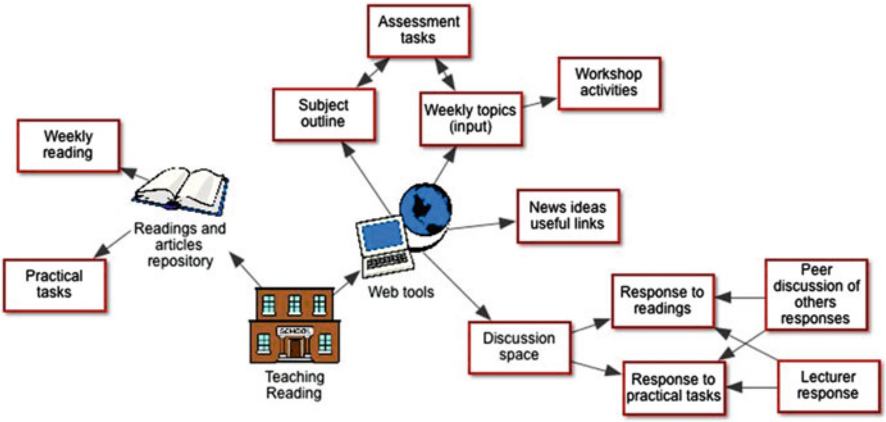


**Fig. 2** Structures in teaching reading course

The students' responses were to be composed in "academic" writing, using appropriate citations and referencing, and posted to the online discussion forum found in *Student Responses*. Where relevant, students were to cite their classmates' comments, as these were perceived as published pieces and thus constituted the "theories of others." Students were also encouraged to make connections between their set readings and the practical activities. These responses in turn accumulated, as in the face-to-face class, into two of the three assessment tasks.

## 6 Running the Course

The first online cohort began with nine students and had mixed results. Both students and teacher found it "a lot of work." All argued that the workload had to be reduced. The discussion space was the typical threaded forum and it became unwieldy and confusing. Students complained that often they could not find their peers' responses, and if they did, there was no time to read them, let alone make any personal comments. The discussion space, it was decided, had to be reviewed and changed. An even more disturbing outcome was that students commented that they tended to feel isolated and did not feel they "knew" their fellow classmates. They certainly did not feel part of an "engaging learning community."

Thus while the assessment tasks were deemed to be authentic and meaningful as Herrington and Bunker (2002) suggest, the opportunities to collaborate with peers and to feel part of an engaging learning environment were wanting. It was deemed therefore necessary to explore new ways of interacting and sharing with each other within the online space.

Thus several "structures" had to be changed. First, it was decided that in the *Workshop Tasks* students would still be required to post their responses to the activities, but they would be no longer required to respond to each other's posts, although they were encouraged to read each other's postings. Second, in *Making*

**Table 1** Pedagogical guidelines (Herrington and Bunker 2002)

| | Description | Examples |
|---|---|---|
| **Authentic tasks** | The learning activities involve tasks that reflect the way in which the knowledge will be used in real-life settings | • Problem-based learning activities using real-life contexts<br>• Learning tasks based in workplace settings<br>• Tasks are complex and sustained |
| **Opportunities for collaboration** | Students collaborate to create products that could not be produced individually | • Tasks are set that require students to collaborate meaningfully<br>• Peer evaluation, industry mentors<br>• Buddy systems employed to connect learners |
| **Learner-centered environments** | There is a focus on student learning rather than teaching | • Teacher's role is one of coach and facilitator<br>• Inquiry and problem-based learning tasks<br>• Activities support and develop students' metacognitive skills |
| **Engaging** | Learning environments and tasks challenge and motivate learners | • Interesting complex problems and activities rather than decontextualized theory<br>• Activities arouse students' curiosity and interests<br>• Activities and assessments linked to learners' own experiences |
| **Meaningful assessments** | Authentic and integrated assessment is used to evaluate students' achievement | • Assessment is integrated with activities rather than separated from them<br>• Opportunity to present polished products rather than simple drafts<br>• Opportunities exist for students and their teachers to provide support on academic endeavor |


**Fig. 3** Predictable navigation pane

*Connections*, it was decided that no response would be required at all. This decision was based on the students' comments that any response they may have posted in *Making Connections* will mostly likely be repeated in their final response. Third, in *Students' Responses* a more organized threaded forum was designed for students to post their structured responses to set readings (BTRs) and activities (BTAs). And finally students were no longer required to respond to each other's postings in this space, unless they wanted to do so.

In order to set up a more informal mode of interaction, an e-mail Listserv was introduced to which students subscribed in the first week of the course. Because - e-mail was perceived as more informal, it was hoped students would be more prepared to "talk" to the teacher and one another as they might do in a face-to-face setting. It was in this space where interaction, sharing, reflection, and collaboration could take place, it was hoped, albeit in an asynchronous space.

To ensure that students began to "know" each other, they were asked to post personal background information in their first week's post and where relevant throughout the course. They were also invited to upload a photo of themselves. Dr. Brock modeled this in the first weeks by sharing information about her weekend, her anticipation in meeting new students online, and, as in later posts, stories about her dog, important events, and so on. Students followed suit and shared their teaching contexts, school happenings, stories about their own children and those they taught, and more. Such "chatter" served an important role in allowing all to "know" each member on the Listserv and thus build a "community of learners." In many cases students who found they lived near each other organized to meet offline over coffee and chat about their work. Those who lived overseas or interstate also developed online friendships by e-mailing and even Skyping each other outside of the class space.

While students' responses to the readings (BTRs) and activities (BTAs) were posted on the designated forum, they were also encouraged to use the Listserv to share key connections, ideas, and questions. This led to some very interesting discussions and debates.

As the facilitator (and if needed moderator) of the Listserv, it was important for Dr. Brock to post (and thus model) relevant news items, web links to YouTube, useful sites, and probing questions and generally to encourage interaction. (It is important to note that social media has now many different mobile technologies that could have been used other than Listserv, and there will be many chapters in this handbook that will provide information about these tools.)

A critical "structure" change was that of the teacher's role. Too often Dr. Brock found that responses to students' questions and comments turned into "mini lectures." This practice tended to deter students from providing comments and input. The literature strongly suggests that it is important that the lecturer **not** be perceived as **the expert** (Burton 1998; Pelz 2004). The course had many "experts" in those who had written the book chapters and journal articles that made up the assigned readings, as well as articles, news items, and so on, that students posted. A teacher's role should be to participate in, mediate, and facilitate student learning in a safe and inviting environment (Meyers 2008). Taking on a more facilitating role rather than an expert role is not easy for teachers. However, many have argued that it is most important that the teacher needs to be the "guide on the side" rather than the "sage on the stage."

## 7 Future Directions

Over the ensuring years, these structures and processes have "worked" in each session's course to build a strong community of learners who are highly engaged, who are willing to share and challenge each other, and who develop

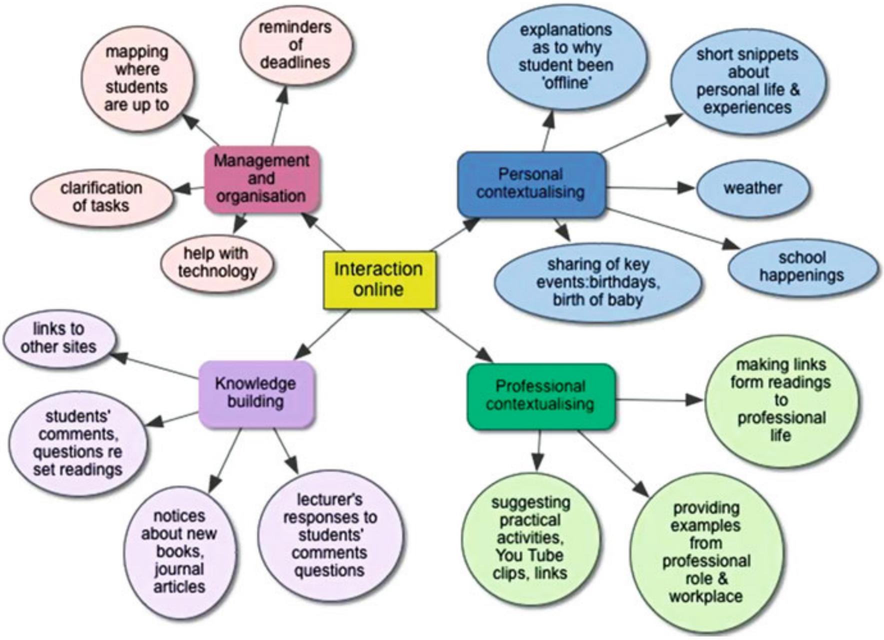


**Fig. 4** Structures involved in effective online interaction

deep knowledge and analytic skills about the teaching of reading (Meyers 2008). While the online space allows for a general "repository" for the input, tasks, and students' responses, the use of interactive mobile tools is critical in bringing together the personal dimension (inside-out view) and external dimensions (outside in view), as outlined in Fig. 1, in order that there are many opportunities to reflect, collaborate, and share. Students who come from various educational backgrounds and geographical locations become online professional colleagues and friends. A foundation of trust develops where students become self-directed and empowered learners. Meyers (2008, p. 220) suggests that online discussions allow students to "express themselves thoughtfully without interruption, which is particularly significant for those at a greater risk for marginalization in [face-to-face] class due to their gender, race, social class or even personality style."

Figure 4 demonstrates an analysis of the nature of interactions that occurred on the Listserv (or need to occur using any social online medium). Each of these four key interactive structures management and organization, personal contextualizing, professional contextualizing, and knowledge building plays a critical and synergistic role in building that foundation of trust that in turn leads to highly effective learning communities.

The case study experiences and theory shared in this chapter suggest that there are several key practical principles to be learned and used in order to design and develop effective mobile teaching and learning. These include:

- Tasks need to be clearly described, with the purpose of each made very clear.
- Assessment tasks need to be clearly described and serve as learning experiences in themselves.
- Communication tools need to be chosen to provide students with opportunities "to get to know" and trust each other in order to become a member of a learning community.
- The teacher needs to be a participant in and facilitator of students' learning.
- The teacher needs to "listen" to students and be prepared to be flexible according to their needs.

The pedagogical perspective explored in this chapter can be neatly summarized by Pelz's (2004) principles of effective online pedagogy:

- Let the students do (most of) the work.
- Interactivity is heart and soul of effective asynchronous learning.
- Strive for presence.

## 8 Cross-References

▶ Characteristics of Mobile Teaching and Learning
▶ Mobilizing PD: Professional Development for Sessional Teachers Through Mobile Technologies

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# Part II

# Development of Mobile Application for Higher Education

# Development of Mobile Application for Higher Education: Introduction

15

Yu (Aimee) Zhang

**Abstract**

Mobile technology plays an important role in the economic development of a country as well as in teaching and learning. The development of mobile teaching and learning programs includes the efforts from course designers, system designers, software developers, teachers, educators, and students. From the industry point of view, it also needs the efforts from many service providers and content providers to implement a good mobile teaching and learning experience. All of these elements are essential for a good mobile teaching and learning program. The people who either worked in front of the classroom or behind the scenes should be appreciated. This chapter introduces some real cases, experiences, and theories in developing mobile teaching and learning programs in different countries. The technical barriers, difficulties, and solutions are also introduced in the following chapters. These invaluable experience and cases shed light on future mobile teaching and learning system design and development.

It has long been recognized that there is a close link between the sophistication of a country's telecommunications systems and its economic prosperity. Although the origins of telecommunications lie in services provided along fixed, terrestrial linkages, the future of telecommunications is increasingly linked to wireless. Mobile technologies have grown dramatically during the last decade. It changed the styles of learning as well as living. While today mobile devices are still used primarily for voice and text message communication, people increasingly also use them to take and send pictures, listen to music, record video, watch TV, play games, surf the Internet, check email, manage their schedules, browse and create documents, and more. The mobile device market is large and fast growing. Telecom service providers, including the Application Service Provider (ASP), Internet Service Provider (ISP), Managed Service Provider (MSP), and Managed Internet

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Service Provider (MISP), provided various services and applications to their users. Content providers, including designers, developers, and educators, developed good curriculums and contents for learners all over the world. They all worked together to provide the best learning experience for learners. All of these elements are essential for implementing mobile teaching and learning. These people who either worked in front of the classroom or behind the scenes should be appreciated for their contributions to the social and economic development of the world.

The fast growth of mobile telecommunications also brought great opportunities for educators to put their teaching materials online and provide personalized education to learners all over the world. It reduced the geographic location barriers, cultural barriers, religious barriers, and language barriers across nations. But it also brought challenges for educators to learn, understand, and adopt all these advanced and changing technologies in their teaching processes. It is widely accepted that mobile technology has changed human's life in many dimensions. But there is always something left to be enhanced, such as security of information, quality of signals, high costs of mobile devices and connections, and merging of new technology in real life. The convergence of various technologies increases the level of service substitution in the mobile telecommunications market. The development of 3G (third-generation networks) and 4G (next-generation cellular wireless access standards) also brought new opportunities for teaching and learning. However, the different types of mobile devices, different protocols for telecommunication industries, different operation systems on mobile devices, different developing languages and various of versions, different regulations and policies in different countries and institutions, different adoption of mobile devices and mobile technology by learners, different environments in different places, and different skill levels of the designers and educators all limited the developing of mobile teaching and learning programs for general learners. Designers and educators from universities, schools, and industries had put a lot of efforts in solving these problems. It is expected that the future technologies and collaborations will bring solutions to these problems step by step.

To develop a good educational mobile application or program, it is important to understand from the initial needs of mobile learning from the students. It helps to design a good structure for mobile learning in terms of curriculum, teaching materials, and system structure for the mobile educational program. Besides these, the engagement of students, adoption of new products and technology, and the safety of contents should also be taken into account. The curriculum designer should work closely with the application developer to implement the contents into mobile software or program properly. The teachers should be equipped with technology skills and knowledge as well as the good understanding of the functions and design of mobile teaching and learning applications and programs. The interactive design of learners' reflection and further improvement is also important for a good mobile learning program. Therefore, in mobile learning programs, designer, developer, teachers, and learner should work together to enhance the learning experience instead of one-way knowledge transfer. Due to the lack of mobile signals in some places and high cost for mobile data transfer in some countries, mobile learning anywhere and anytime is not fully achieved yet. Mobile learning programs or applications should also complement the face-to-face learning in current stage as technologies cannot replace the traditional learning experience. All these problems are expected to be solved in the future.

Some real case studies on the developed and implemented educational program as well as some data collected from industry are included in the following chapters. These cases are from variety of disciplines and different countries. Some of the leading-edge technology or products for education are also introduced in this section to predict the future trends of mobile educational application development. Educators and students are benefited from these mobile learning programs. They also shed light on the future design of mobile educational programs for industry partners and educators from universities, business, and institutions.

In ▶ Chap. 16, "Novel Education Pattern Applied to Global Crowd of all Ages: Mobile Education," Fosse Zhang from Tsing Hua University in China proposed a program that adopted a novel education pattern to global crowd of all ages from health disciplines. A mobile education framework was introduced in this chapter, which consists of two components: an offline summarization system and an online system. Mobile education has many advantages. It can be used for pervasive education, flexible education, efficient education, individualized education, and life-long education. But the performance of mobile learning is also influenced by mobile device, usability, functions, and current mobile technologies. The different users, including educators, parents, and students, were also discussed in this chapter. The author believed that mobile education has a great pedagogical potential and has been recognized by educational researchers. It has an ability to exert interest in learning, expand the learning community, and be helpful to develop life-study enthusiasm in social.

In ▶ Chap. 17, "Construction Safety Knowledge Sharing via Smart Phone Apps and Technologies," Dr. Rita Yi Man Li discussed the importance of safety knowledge in mobile educational programs. Construction accident rates are high in many places, leading to high compensation, loss in manpower, and extension of time. Accidents may happen due to complex equipment and tools, outdoor operations and fast changing design, and poor workforce safety behaviors and attitudes on sites. Generation Y (born between 1982 and 1995) is also known as Generation Why, Generation Next, the www generation, the Millennium Generation, or Echo Boomers. They grow up in a media and technological-saturated world, used internet more than watching TV. They used more mobile technologies than any other age groups. They most common type of mobile communication software they use are Line (in Korea), Wechat (in China), and Whatsapps (in Hong Kong). But they also had comparatively shadow experience and knowledge and may easily become victims on sites. This chapter listed the factors that lead to construction accidents for this particular generation. Two construction safety cases from Korea and one case from USA are studied in this chapter. In the end of the chapter, the author suggested that young construction workers should be educated by using the latest mobile technologies in view of the case studies in the USA and Korea and the popularity of mobile technologies. This chapter introduced a negative influence from mobile knowledge safety issue for special group of learners. It shed light on future design of mobile learning program as well as mobile regulations and policies too.

Dr. Sharon Rees, Dr. Clint Moloney and Dr. Helen Farley showed how mobile technologies facilities teaching and learning in a very traditional learnt by seeing and doing nursing education in ► Chap. 18, "Mobile Learning Initiatives in Nursing Education." Mobile learning has changed nursing education, providing learning to nurses when and where they need it and in a manner that achieved positive learning outcomes. The authors argued that mobile learning through YouTube and augmented reality offer the best of the traditional way of learning combined with time and cost efficient means of technology use and greater theoretical knowledge. SMS and online learning also helped reaching nurses in rural and isolated communities. Nurses can learn at a time and place suitable for them. Many isolated trials have occurred in nursing education over the years with the use of PDAs. This chapter adopted a grounded theory approach and investigated nurse's current use of mobile technology and their beliefs around mobile learning. The chapter also explored how and when nurses are undertaking continuing education, with the discovery of how they personally resource their learning. The authors also indicated that organizations should taking into account the obstacles and privacy issues when adopting mobile learning in workplace. Combined mobile technology with social media in mobile learning for health education was also discussed in the chapter. The authors indicated that artificial intelligence (AI) agents will play an important role in future mobile teaching and learning. Although there are still many concerns of adopting mobile devices and technologies for health education, such as privacy issues, costs of learning, and using mobile devices in clinic areas, the authors believe that mobile learning will start to be used more for education within nursing. Some interactive applications not only assist learners from health discipline but also help spread the knowledge to public learners and individuals who are interested in this area.

In ► Chap. 20, "Uniqueness in Mobile Teaching Environment Design Methodology," Dr. Chih-Hung Li, Zinian Li, and Yi Lu from Nan Tien Institute introduced the use of mobile technology in teaching and learning in a totally new area – for religions teaching and learning. As the designers for the first higher education institution in Australia for Buddhist education, the authors adopted the most up-to-date technology and way of teaching for students to learn as they need. The teaching method was combined with face-to-face delivery and interactive communication through all sorts of multi-media networks. The authors were also encountering some difficulties during developing and implementing processes, including the users' resistance, inaccurate cost forecasting, inability to foresee the risks, etc. The problems are very common in all mobile development (or software development) projects. Therefore, the authors proposed a framework from theoretical bases to solve these problems. This chapter discussed the framework from six different aspects: institution development scope, business objectives, course content cost, teaching resources, targeted student, and institution's technology acceptance level. The authors also gave some useful suggestions for designers and developers for future mobile learning programs. This chapter broadens the use of mobile technology in different places and institutions. Mobile technologies can across geographic location, cultural barriers, religion barriers, and political barriers and benefit all the learners from anywhere.

In ▶ Chap. 19, “Tutors in Pockets for Economics,” Dr. Aimee Zhang and Jun Hu introduced the mobile learning project for Economics discipline and the design of extended mobile learning framework for all other contents in the future. This chapter also introduced the design, development, implementation, and evaluation processes of this project. Tutors in Pockets (TIPs) is designed as an assisting teaching and learning tool for economic subjects with a flexible framework. It suits any smart mobile device that supported multimedia materials, such as video, audio, picture, web-link, and text. To implement a better “anywhere” and “anytime” mobile learning system, both online and offline functions are important in the structural design. A picture is worth a thousand words, while an animation is worth millions of words. “Simplify knowledge” was the key idea for the content development in this project. All the threshold concepts are developed into animated cartoons or cartoons in real case studies to increase the interests of learning and reduce the barriers for first year students in the university. These materials were designed for mobile devices in smaller size and less text words (for smaller screens and less reading time on mobile devices). To provide an equal access to students using other mobile devices (not IOS or Android mobile platforms) and students without a mobile device, the teaching materials are also used in lectures and tutorials. Student feedback was collected through both face-to-face interviews and online surveys. The results showed that this project had a positive influence on students’ learning efficiency, understanding of complex conceptions, long-term memories, correcting of some misconceptions, engaging in discussion with other students and teachers, and performances in subjects. Both students and educators had agreed that they are benefited from this project. Different mobile learning projects and programs may be developed by different computer languages and established on different operation systems or mobile operation systems, but all of them performed as a knowledge transfer channel to help students and learners understand better the concepts and course contents as well as facilitated teachers and educators with better or more convenient ways in their teaching and communicating with students. Technology is a tool for teaching and learning. It should assist teaching and learning just like normal chalks and blackboards. A good mobile teaching and learning system should be based on solid knowledge base, proper curriculum design and system design, good understanding of the students’ needs, prompt communication between students and teachers, and continuous enhancements and improvement due to proper suggestions and feedbacks. No technology can perform as a good teaching and learning platform without these important elements.

# Novel Education Pattern Applied to Global Crowd of all Ages: Mobile Education 16

Jing Zhang

## Contents



**Abstract**

This paper gives a detail that introduces about mobile education. Firstly, this article provides an overview of mobile education. Secondly, this paper introduces the mobile education application framework in the education industry. At present, it is accepted and can be utilized in many ways in the education industry. Through the review of this paper, these factors have prompted to further research due to its potential in making teaching and learning more attractive and promising. Further, the relation and differences between mobile education and traditional education are put forth. Finally, users of mobile education are also studied. This article reveals in mobile education that the need for usage of technologies increases day by day today when information and accession to information gain importance. In fact, mobile devices are smaller and smaller. Technologies of mobile education provide a chance of lifelong learning for people.

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# 1 Introduction

Today, information technologies (IT) and mobile communication technologies develop rapidly and are increasingly impacting the whole world. Researchers and developers worldwide have put their efforts into the design, development, and use of information and communication technology to support teaching and learning (Lucke and Specht 2012). Mobile education is a component by pedagogical way, technological disciplines, and challenging ideas currently. As the characteristics of ubiquitous learning, we shall call it as pervasive education.

The people are in a learning community now, and knowledge is not only acquired from teachers and learning materials, but also the spread of knowledge comes more from the Internet. Learning is a social and collective outcome that is achieved through conversations, the spread of knowledge, and social networking.

As the explosion of knowledge and education content change rapidly, lifelong education has become a requirement of modern society. The number of students outside the classroom of the traditional education is increased. In addition, the learning time and place these people have are not fixed (e.g., sales staff). Students also hope to acquire school notification and communication when they are on a holiday, go out, etc. These are difficult to realize in the current educational methods.

Therefore, this paper will describe mobile education as a relatively new tool in the pedagogical and a widely used teaching method. The development of computer technology to the communication bandwidth and computational power of mobile devices, the cost of wireless mobile devices, and its penetration rate will influence the development of mobile education, especially even more so in China.

# 2 Overview of Mobile Education

## 2.1 Mobile Education and Traditional Education Methods

In our age, with the development of computer technology, great changes have taken place in the traditional educational pattern. Distance education wins support among the people, people leave school, and many people who cannot accept formal education will choose this way of education. At the same time, the lifelong education is paid more and more attention. Mobile education has much more advantages than traditional education methods, and mobile education can be used to support traditional education as well as distance education (Bulun et al. 2004). For several years, the astonishing digital information technological advance changed our day-to-day life. We have seen that an increasing number of people have fully adopted it in adult education (Ceobanua and Boncub 2014).

In education field, informatics technologies used have progressed rapidly and dependably, and this progress revealed the notion of mobile education. The most important advantage of mobile education is the access of the student to demanded information, and he/she is independent of time and environment. That is to say, the notion of mobile education also promotes traditional technological progress in education.

## 2.2 Mobile Education Framework

With information technologies and mobile communication technologies developing rapidly, mobile education system is a continuous improvement of systems engineering in Fig. 1. Previous mobile education system consists of four main parts: mobile communication network, the Internet, mobile equipment, and server. In the basic framework of mobile education, a variety of mobile education platform was built in order to realize the diversification of mobile teaching and can also be a constructivist-mobile education environment.

Zhang and Hu (2015) study a complemented mobile assist teaching application – tutors in pockets (TIPs) – which allows students to learn concepts within 5 min anywhere and anytime. Through the online survey, the results show that TIPs have a positive influence on students' performances (Fig. 2).

Guangbing Yang et al. (2013) study automatic text summarization for mobile education support. The overall system architecture of this mobile application is presented in Fig. 3. The entire application consists of two components: an off-line summarization system, which implemented our summarization solution, and an online system, which was built as a portal to provide summaries as reading

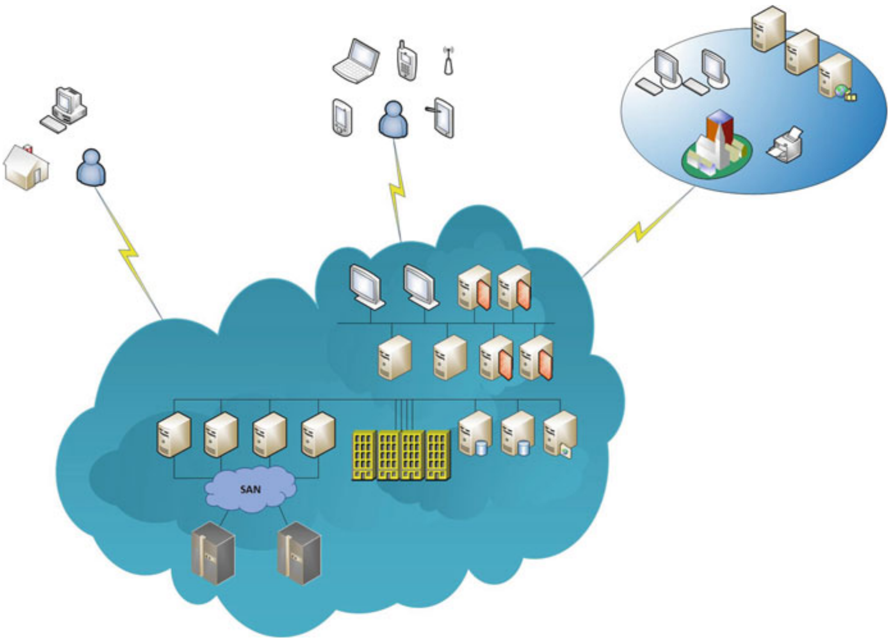


**Fig. 1** Mobile education system model

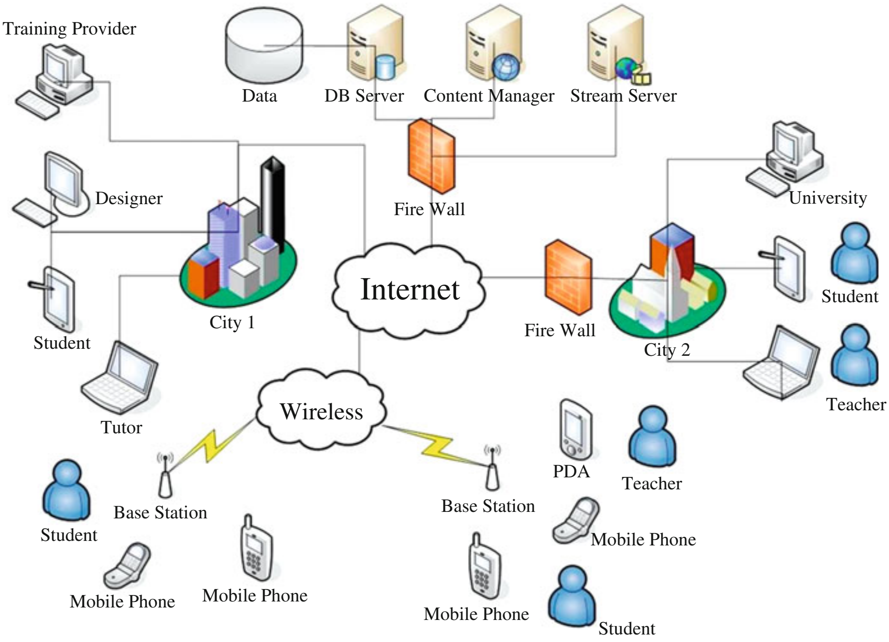


**Fig. 2** Sketch map of tutors in pockets (TIPs)

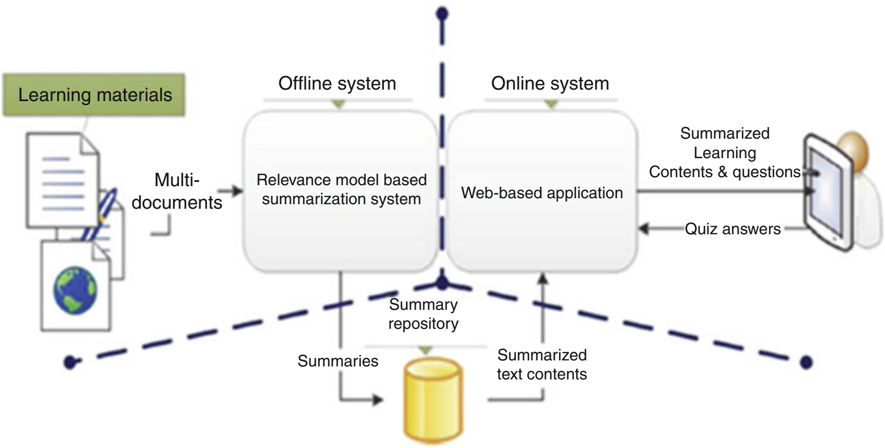


**Fig. 3** The overall system architecture of the mobile application (From Yang et al. (2013))

materials and questions to learners, collect learners' answers, and record time used for these answers. This aims to assist learners to summarize learning content and improve the efficiency of learning.

The research of Po-Han Wu et al. (2011) showed that conducting mobile learning activities for clinical nursing courses have the effectiveness and are helpful

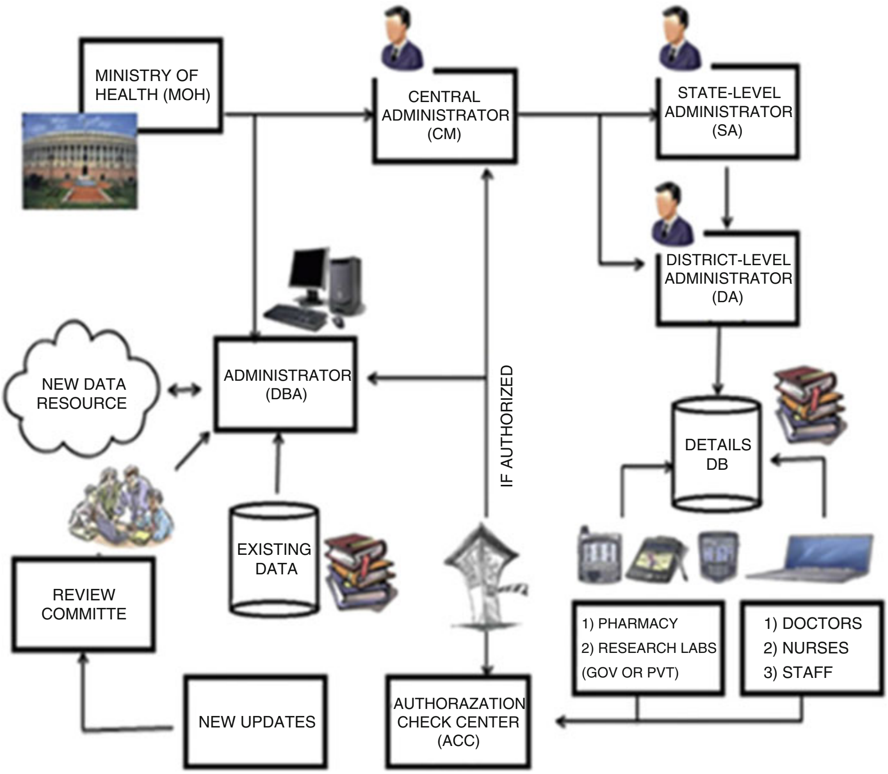


**Fig. 4** Continuing mobile medical education architecture. BTS base trans receiving station, DBA database administrator

to students in improving their learning achievements. They study a repertory grid-oriented clinical mobile learning system shown in Fig. 4, which is developed for a nursing training program with the assistance of the mobile learning system. Thus, the nursing school students are able to learn in an authentic learning scenario, in which they can physically face the target patients, with the personal guidance. It was found that most students showed favorable attitudes toward the usage of the mobile learning system and their participation in the training program. The mobile learning system can guide the students to observe and identify the status of target patients in the real world with the help of wireless communication and mobile and sensing technologies. Students can reconstruct their knowledge and experiences via interactions with the learning environment and observations of the target patients in the real world and supplementary materials from the learning system to support them.

## 2.3 Advantages of Mobile Education

As a specific type of learning model, mobile learning is individual learning which is supported by various types of computer technologies. Mobile learning embraces many characteristics, but it is unique in terms of flexibility of time and location (Peters 2007; Zhang and Hu 2015). Mobile learning (m-learning) can also play a significant supplemental role within formal education (Cheon et al. 2012).

### Pervasive Education

Due to the rising popularity of mobile devices globally, the use of mobile education has become a pervasive phenomenon. The mobile education can help people of poverty area improve the literature addressing education inequality issues and efforts to fight illiteracy in order to promote the development of regional economy (Kima et al. 2008). Mobile education technology can promote the inclusion of students with various disabilities in education (Bjeki et al. 2014), such as autism (Emir Husni 2013). The pervasiveness of mobile education is not only reflected in user of mobile education but also in the space of mobile education, such as in some university which provides information for students or parents to visit their virtual campus (Pastiu 2013).

### Flexible Education

With the advancements in mobile technologies, many fields are affected especially in education area, which is no longer confined to classrooms and face to face. As long as they have the required hardware and network infrastructure, learners have the freedom to study at any time in different locations. M-education provides further flexibility for the learner to learn anytime and anywhere on the move (Cavus and Al-Momani 2011). Both educator and students expressed a positive attitude toward mobile education. Given the rise of the Internet and mobile devices, multiple new learning methods have been developed. Mobile education is no longer a concept, learning community is gradually created and advanced, and a knowledge community can be constructed by people of diverse backgrounds. By using mobile device and application, students can really personalize and diversify their learning processes, and all tasks can be rapidly completed in real time.

### Efficient Education

Learners will become more active in communication and learn much better when they own the learning tool as they consider it useful. Besides, it enables an educator who shares the information to contact more students who are independent of time and location with the usage of mobile devices in education (Korucu and Alkan 2011). In mobile education, practice courses are implemented as technology into tradition courses, comply with modern teaching methods, and increase the practice experience of students in an innovative learning environment; a practice learning approach is used that was originally adopted as a basic teaching strategy at schools. During the learning process, the students worked in teams to analyze and discuss by using tablet PCs. The instructor can timely guide students to complete their practice. Meanwhile, by using teamwork, the students make plans accordingly, collect the required information, and make decisions simultaneously.

#### Individualization Education

In the modern society, the traditional fixed learning does not meet the needs of learners, but in a mobile education, learners can choose learning time, place, and content according to their own needs; learning progress can also be self-paced and depends on self-determination, so as to realize the individualized learning.

Although traditional in-class learning is a method of authentic learning, it is difficult for the teacher to provide full personalized learning support to every student, especially when a large number of students are gathered in the same class (Hwang et al. 2009).

Pachler et al. (2009) pointed out that the individualization education has strong implications for autonomous learning. High levels of personalization would mean that the learner is able to enjoy an authentic learning, action learning, and experiential learning, leading to a strong sense of ownership.

In independent learning environments, the teacher and students all could use the camera feature to record videos; the relevant documents and files were uploaded. Then, using the Internet enables each of the students to view shared information and rapid information searches; these both increase the level of interaction among students, making the learning process enjoyable because students can share information and communicate with each other.

#### Lifelong Education

Along with the application and development of 3G mobile communication technology, mobile devices will become more and more popular, which will greatly expand the range of education, promote the development of the learning society, and provide a lifelong education.

Indeed, as increasing numbers of learner take advantage of mobile education, the effect of mobile education to different education groups is an issue to be researched in order to provide lifelong learning.

Modern society is a society of lifelong learning, and mobile education broadens the users of education, which improve the quality of the whole society. Traditional fixed learning also hindered the education opportunities, but mobile education will enable ubiquitous learning and open learning, and the learning is no longer a student's patent.

## 3 Factors Influencing Mobile Education

There are many factors influencing the application of mobile education. The influential factors were classified into four main categories: mobile device, mobile technology, Internet state, and cost.

### 3.1 Mobile Device

With the progress of mobile communication technologies and the facility of Internet connection almost everywhere, most of "smart" mobile devices are now capable of handling multimedia easily and effectively. Mobile devices such as personal digital assistant (PDA), mobile phone, and tablet PC are nowadays more convenient than before. They are coming with major improvement in memory storage, interactivity features, and high data transfer speed. A number of studies have found that function of mobile device impacts advantages of pedagogical perspectives (Chen et al. 2003; Denk et al. 2007; Zurita and Nussbaum 2004). Wu et al. (2011) have pointed out that convenient and practical mobile devices can complement the lack of a traditional learning environment, encouraging student confidence and active participation in the learning process. Characteristics of mobile device depend upon a number of factors, such as:

#### Usability

From the usability aspect, mobile learning tools are small, light, and portable. For example, smart phones are combined devices and possess both computers' abilities and mobile phones' abilities. Smart phones' sizes are between PDAs and mobile phones. Most of smart phones have touch screen and especially suitable for the elderly and children. Additionally, because of the progress of a new generation of large screen mobile phone, the mobile phone is more and more suitable for mobile learning. These features make the learners feel at ease as learning is no longer constrained in the classroom.

#### Functional

Functionally, learners really need that the devices can provide instant and spontaneous information and can help learners to quickly search specific questions (Bidin and Ziden 2013). Another function is continuity of study. It is an important aspect that the learning is able to continue without the constraints of time and space. That is to say, learners may use their mobile devices to acquire information and learning material that they need, and they do not necessarily need to stop. Indeed, learners can communicate at various places.

Learners can use the mobile phone, PDA, intelligent mobile phone, and other portable mobile devices to transmit information in a moving state video, data, and other information communication. Mobile learning makes the teaching and learning occur whenever and wherever possible, more convenient, and flexible.

### 3.2 Mobile Technology

With the advancements in mobile technology, on the one hand, learning is no longer confined to classrooms. On the other hand, the teacher through the simulation of the actual environment makes the students into the teaching scene in order to improve their comprehension and achieve the desired learning outcomes. Mobile technology and wireless communication technology are closely linked. Several main technologies are introduced in the following.

### Virtualization Technology

Mobile education shows great potential for future teaching and learning in educational institutions. Virtualization technology is a kind of technology that is the fusion of mobile education and traditionally educational settings. On the one hand, on-site settings enriched with information technology allow for much tighter integration of online activities; on the other hand, virtual settings are sent back into the classroom and integrated with face-to-face activities. Indeed, virtualization technology has been integrated in the educational arena. For example, Chan and colleagues (2001) built a community-based network learning models to cope with issues related to the applications of networks in education. The virtual learning environments have been enabled teachers and students to communicate via networks. These environments can build and organize learning communities for distance education or for both on campus and distance education. In the future, virtualization technology will be in normal operation in mobile education.

### Mobile Augmented Reality Application in Education

The development and rapid increase in mobile device usage have made mobile augmented reality (MAR) became possible. Nowadays, MAR is in its infancy globally, and previous mobile augmented reality (MAR) is more focused mostly on games or simulation. MAR has potential and impact on mobile education as latest technologies. MAR can merge virtual and real worlds together in order to improve the quality of teaching and learning activity.

Azuma (1997) argues that AR has three basic criteria:

1. Combination of real and virtual
2. Interactive in real time
3. 3D registration of virtual and real objects

Today, a number of available MAR experiences and applications have been increasingly receiving attention. As MAR has a vast potential implications and benefits especially in learning environment, expect that there will be many more researches on MAR in the future.

### Cloud Computing

What is cloud computing? The generally accepted definition of cloud computing comes from the National Institute of Standards and Technology (NIST). Cloud computing is a broad term. Cloud computing has already gained a wide acceptance. It is currently the most new way of providing and consuming IT services as technological innovation since the advent of the Internet. Cloud computing has a potential to reduce the cost of economics of IT. In essence, cloud computing is able to quickly and automatically aggregate various cyber sources. In the mobile education building, data center infrastructure is a capital-intensive and expensive operation. However, cloud computing can easily recycle and repurpose resources to reduce costs.

At present, cloud computing is divided into three types: software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS) (Fig. 5) (Table 1).

## 3.3 Online and Off-Line

Many systems for mobile devices are an online/off-line service that provides a training, learning, and evaluation methodology, supported by the most recent mobile technology.

There are two kinds of status between mobile devices and servers, that is, the instant communication status and non-communication status. The instant communication can also be called online status, and then there is a connection of mobile devices to a server. The learners can remote synchronous mobile learning, update data, and communicate whenever and wherever possible. Of course, another status is known as off-line status; this status of mobile device is not connected to the network, so there is no communication cost, but in off-line status, learners need to download the network learning resources that are temporarily stored in the mobile device in order to continue learning, which requires the mobile equipment to have enough storage space.

## 3.4 Cost

Mobile device purchase cost is a deciding factor for educational use. Nowadays, the price of laptop computers is lower than desktop computers, and they have much more features of being portable and plug and play than some desktop. Mobile phones are minicomputers, which offer a variety of features and functions that are beneficial to students and teachers in the classroom. Additionally, a recent report (Madden et al. 2013) indicates that 78 % of teens and 91 % of adults own a mobile phone. Mobile phones are mainly used to communicate vocally and send and receive messages. With the emergence of new generation communication technology (3G, WAP, GPRS, EDGE, SMS, etc.), mobile phones possess instant displays, videos, moving images, and communication via e-mail. With the popularization of 4G technology, the price of communication technology further reduces. At the same time, the rapid development of cloud computing further reduces the construction cost and improves the development speed of mobile education.

# 4 Users of Mobile Education

## 4.1 Educators

Educators are always looking for a new way to teach students. Mobile education is considered as having potential for pedagogical applications and not only has garnered much attention but also is becoming increasingly widespread. In mobile

**Fig. 5** Three types of cloud computing: SaaS, PaaS, and IaaS

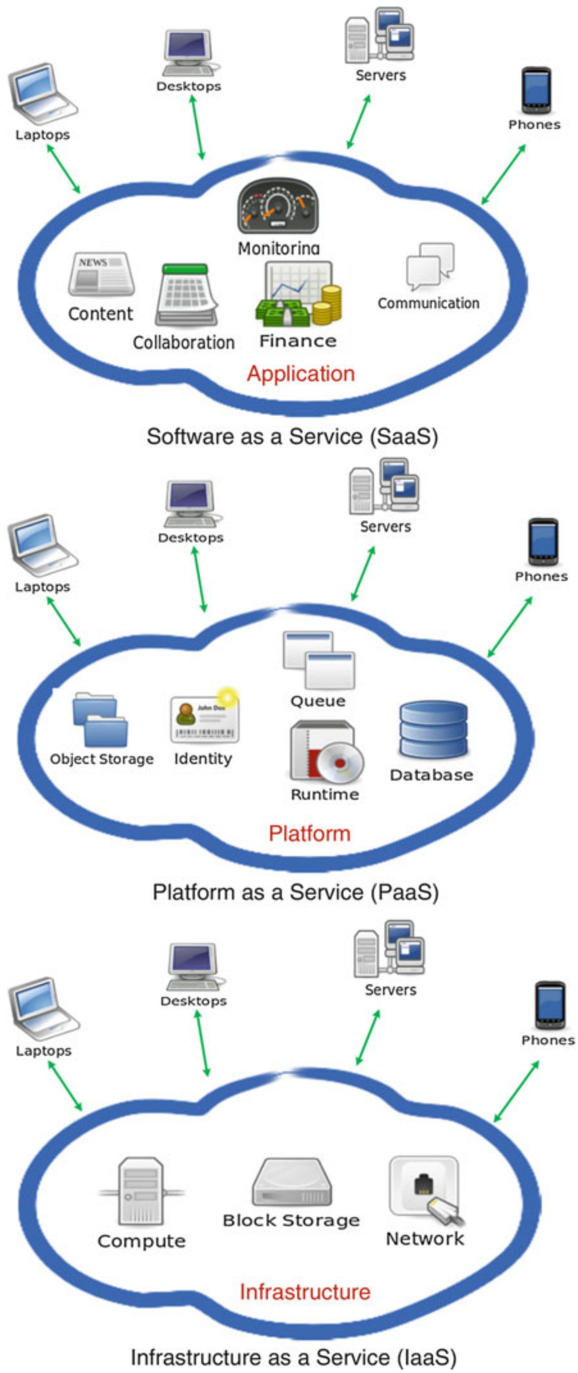

**Table 1** The multiple comparisons of SaaS, PaaS and IaaS

| | SaaS | PaaS | IaaS |
|---|---|---|---|
| Definition | SaaS is a business functionality that you can gain to use it | PaaS is a application/framework that you can leverage to build something on | IaaS is essentially a computer/server that you can remote desktop to the box and you manage everything else |
| Characteristics | • Web access to commercial software<br>• Software is managed from a central location<br>• Software delivered in a "one-to-many" model<br>• Users not required to handle software upgrades and patches<br>• Application programming interfaces (APIs) allow for integration between different pieces of software | • Services to develop, test, deploy, host, and maintain applications in the same integrated development environment. All the varying services needed to fulfill the application development process<br>• Web-based user interface creation tools help to create, modify, test, and deploy different UI scenarios<br>• Multi-tenant architecture where multiple concurrent users utilize the same development application<br>• Built-in scalability of deployed software including load balancing and failover<br>• Integration with web services and databases via common standards<br>• Support for development team collaboration – some PaaS solutions include project planning and communication tools<br>• Tools to handle billing and subscription management | • Resources are distributed as a service<br>• Allows for dynamic scaling<br>• Has a variable cost, utility pricing model<br>• Generally includes multiple users on a single piece of hardware |
| Differential | SaaS applications are designed for end users, delivered over the web | PaaS is the set of tools and services designed to make coding and deploying those applications quick and efficient | IaaS is the hardware and software that powers it all – servers, storage, networks, operating systems |

(*continued*)

**Table 1** (continued)

| | SaaS | PaaS | IaaS |
|---|---|---|---|
| application area | E-mail, financial management, customer service, and expense management | A collaborative platform for software development<br>A platform that allows for the creation of software utilizing proprietary data from an application<br>Some examples of PaaS include Google App Engine, Microsoft Azure Services, and the Force.com platform | Servers, storage, network, and operating systems |

education, the teacher's role is as a facilitator, coacher, and co-learner. Her/his responsibility is to help and guide learners throughout their knowledge acquisition and get their participation and feedback instantly, both in the classroom or at distance (Hamdani 2013).

Today, teachers are facing growing pressure to interact with their students via network. All teachers, regardless of their age, need instructional models to effectively integrate new technologies (Ertmer 2005). Additionally, they need training on how to effectively use the technology to support student learning (Bitner and Bitner 2002). That is to say, even if educational application providers' platform (EAPP) can help teachers easily apply new technology to build network learning communities and increase interaction frequency and quality both during and after class, the teacher also needs a lifelong learning involving new curriculum design, quality assurance and management, and pedagogical and administrative tasks.

Not only have teachers always looked to adopt new technologies into their classroom to enhance student learning experience, but also teachers can increase communication and cooperation with parents through mobile technology. Thus, most educators consider mobile devices as important learning tools with a vast range of classroom applications, such as audio and video recorder, digital camera, the Internet, e-mail, educational apps, etc. (Johnson et al. 2012).

## 4.2 Parents

In societies, education of family plays an important role in shaping the future of child's life. The schools and other institutions of education are beneficial, supporting, and complementary for the family, because no other schools and institutions can give love, trust, confidence, morale, and warm family environment that are necessary for child's development as much as her family. Undoubtedly, the parents know their children best, and they can give very useful information to the teacher. Thus, they can cooperate in solving the children's problems (Genç 2005).

Mobile education system can help establish a healthy interaction between teacher and parents, which will enable the children to become more easily recognizable; child-related problems encountered can be solved more easily.

The conducted survey (Özdamlıa and Yıldız 2014) approved that majority of parents have mobile device and confirms that parent's opinion on the usage of mobile devices in an educational purpose is generally positive. Parents stated that they can take education and information from concerned people of school with mobile technologies on child's development and education. Also, they specified the necessity of communicating with mobile technologies to take school-family cooperation to an advanced level.

Teachers can increase communication and cooperation with parents through mobile technology; thus, the children become more easily recognizable, because parents can give very useful information to the teacher. In addition, parents can be informed through mobile learning about the school-parent collaboration.

### 4.3 Students

Although traditional in-class learning is a method of authentic learning, it is difficult for the teacher to provide full personalized learning support to every student, especially when a large number of students are gathered in the same class (Hwang et al. 2009).

Mobile education is becoming increasingly important from kindergarten to senior high school education. The teacher can add mobile education to the activities made by the students and thus can increase the student's motivation. Mobile education offers students flexible and collaborative learning methods anytime and anywhere (Holotescu and Grosseck 2011).

With the development of wireless networks and sensor technologies recently, researchers have been encouraged to develop computer-assisted learning environments or web-based learning environments. It is a learning environment with both authentic and virtual resources. The students can interact with the digital learning system outside the classroom and extend their learning experience to the authentic learning environment, and the learning system can detect and record the learning behaviors of the students in the real world (Hwang et al. 2009).

## 5 Conclusion and Future Research Directions

Nowadays, the people can now whenever and wherever possible learn through the Internet, and numerous pieces of information are consolidated through the processes of discussion, communication, negotiation, sharing, and exchange. Cabrera and Cabrera (2005) pointed out that community members enhance their level of knowledge by sharing knowledge, that is to say, it is truly a knowledge sharing. Hendricks (1999) noted that knowledge sharing is a process of communication. When learning new information or sharing knowledge with others, a person must use the knowledge rebuilding process to achieve a meaningful learning experience. Nooteboom (2000) indicated that knowledge sharing can create value. The knowledge gathered through interaction can be beneficial, introducing novel elements to enhance the intellectual assets of an organization. Assimakopoulos and Yan (2006) noted that organizations must share knowledge to remain future oriented.

The quality of human capital is crucial for the progress of society. China' strategy puts a strong emphasis on education and training. The aim of modern education is to improve the quality of education and enlarge the scale of education. The rapid evolution of information technologies and mobile communication technologies has changed the traditional educational pattern; especially they have created new opportunities for improving the quality of teaching and learning experiences. Actually, a traditional method of education was face-to-face teaching. The teacher is responsible for all the arrangements and conveys learning activities (de Freitas et al. 2010). The integration of mobile technology and education has influenced and revolutionized the way we teach and learn. On the one hand, the teacher can provide an exciting, realistic, authentic, and extremely fun learning environment. On the other hand, there has been a tremendous increase on learner's engagement and level in understanding the learning content. Moreover, mobile education also can enhance real-time interaction between the educator and learners, even between learners and learners.

Mobile education indicates the use of mobile devices as cognitive tool to promote higher-order thinking skills. Mobile device can identify the subject of information and extract important ideas from the discourse, which is helpful to gain a better comprehension to the learning materials. Ozdamli (2011) indicated that the teachers are willing to implement mobile education applications in support of the traditional education. As assistants or tutors, teachers can develop innovative pedagogies with mobile technologies, which enhance teaching and learning in higher education, especially in outdoor education such as campus, museums, or zoos and make further teaching staff professional development. Sohaib Ahmed's (2013) study proved that mobile education could boost students' motivation and interest and could help them gain a better understanding. In conclusion, most of previous studies showed a positive impact and encouraging results; mobile education has a vast potential implications and benefits especially in life learning. The mobile education tremendously will impact the mode of all education globally over the next few years.

With the development of wireless networks, one pedagogy model of community-based learning has been established to enable teachers and students to communicate via networks, such as WebCT. As establishment of an education environment with both authentic and virtual resources, the students can interact with the digital learning system outside the classroom and extend their learning experience to the authentic learning environment (Hwang et al. 2008).

Mobile education is an education method where the learner and teacher are not fixed or in a predetermined place or take advantage of learning and teaching opportunities offered by mobile technology. Mobile education supports a wide range of application field, but mobile education also has many challenges.

Mobile devices have been integrated into daily education and show development in terms of portability and functionality, for example, PDA and smart phone are preferred by most of the people. Characteristics of mobile devices are perceived as helpful to support mobile education. Mobile devices have the features and properties such as portability, social interactivity, connectivity, context sensitivity, and individually summarized learning content (Huizenga et al. 2009). Although it has multiple benefits in using mobile devices such as cameras and recorders in the classroom, there are many barriers that must be overcome. For example, students encountering technical difficulties tend to stop using mobile devices.

Today, as the highly fragmented mobile technology landscape and rapidly evolving standards, there is no single solution to make content working for every possible mobile device. It is not only both time-consuming and expensive, but also educators are forced to design new learning content or reformat existing learning materials for delivery on different types of mobile devices in the processing and delivery of learning content (Chang et al. 2011). Although the data shows that all aspects of the society have been carried out in various areas of mobile education, with technological progress, there is still a tremendous demand for further research and development. As technology progresses, the aim in mobile education is to inspire various interested people, including developers, educators, institution instructors, and mobile operators.

Mobile education has a great pedagogical potential and has been recognized by educational researchers in terms of promoting the quality of teaching and learning activity. As mobile education is a new education ways, the affordances and benefits to support learning were worth to discuss. Mobile education has an ability to excite interest in learning, expand the learning community, and develop life-study enthusiasm in society. The effectiveness of mobile education can be further extended when it combines with newly mobile device and innovative technology.

## 6 Cross-References

► Tutors in Pockets for Economics

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# Construction Safety Knowledge Sharing via Smart Phone Apps and Technologies 17

Rita Yi Man Li

## Contents



**Abstract**

Construction accident rates are high in many places, leading to high compensation, loss in manpower, and extension of time. Numerous research sheds light on the causes of factor which lead to construction accidents, such as human error, hot summer, tight schedule, young age, and lack of knowledge about safety. As previous research found that (1) there are more generation Y coming across accidents and (2) many of this generation members are expert users of mobile technologies and there is a lack of research on construction safety knowledge via various apps. This chapter aims at reviewing the construction safety knowledge sharing via various mobile apps.

It wasn't that long ago that the most exciting thing you could so with your new mobile phone was to download a ringtone. Today, new iPhone or Android phone users face the quandary of which of the hundreds of thousands of apps (applications) they should choose. It seems that everyone from federal government agencies to your local bakery has an app available.... (Godwin-Jones 2011)

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> According to the European Agency for Safety and Health at Work. . .the construction is the most dangerous industry in terms of occupational safety and health. At a worldwide level, the construction workers are three times more likely to die and two times more likely to suffer injuries at work than the average of the workers in all other activities. (Vitor et al. 2014)

## 1 Introduction

Construction industry is one of the most hazardous industries Worldwide (Shin et al. 2014) and construction accident rates are high in many places. Many contractors have to pay for high compensation costs. In Hong Kong, monetary compensation in 2006 alone reached HK$39,643,353. Construction accidents also lead to an extension of time due to the loss in manpower and insurmountable paper work. Nevertheless, accidents are not caused by any one dominant factor. Rather, it is often of the view that construction safety is a complex issue with heaps of different factors under different circumstances, locations, and nature of the job. Accidents may happen due to complex equipment and tools, outdoor operations and fast changing design, poor workforce safety behaviors and attitudes on sites (Li and Poon 2007; Li 2012a, 2015) (Table 1). They may also happen when there is a lack of relevant information about the potential hazards on sites. As construction methods selection process on site is based on individual knowledge, hence, the construction industry needs to understand how to store, identify, obtain, share, and use the knowledge (Ferrada and Serpell 2013). Le et al. (2014) and Mitropoulos et al. (2005) posited that a lack of safety knowledge is a major reason which leads to high construction accident rate on sites. This is because some accidents occur due to the violation of prescribed defenses (Mitropoulos et al. 2005). Effective safety information and knowledge exchange, therefore, is important to lower the dangerous occurrence of safety risks, accidents, and hazards. In Korea, the safety information module (SIM), the safety semantic wiki and safety knowledge module are used to share the construction knowledge. SIM is a tool which is developed for construction engineers and other stakeholders to share accident and risky incident data. Safety semantic wiki template (SSWT) is a tool to enhance collaboration between construction safety ontology technologies and semantic wiki web to allow users to (1) share safety knowledge and information and (2) classify them in a simple and easy way without the needs of computer background. In SKM, accident information is examined and polished by the domain experts. It provides users an easy and a convenient way to share information about the causes and prevention of accidents by communicating and uploading the relevant documents. On the other hand, some of the previous research suggested that younger construction workers with relative shadow experience were more accident prone than the others. And to improve poor safety performance on sites, learning from mistakes is important (Chua and Goh 2004). Hence, younger workers have higher chance of having accidents on sites due to inadequate experience and knowledge accumulation with regards to safety issues on sites.

**Table 1** Factors which lead to construction accidents/affect safety performance (Note: this table is an updated version of Li and Poon (2013))

| Factors which lead to construction accidents | Supporting literature |
|---|---|
| Lack of safety knowledge | Li (2006), Atkinson et al.(2005),Mitropoulos et al. (2005), Le et al. (2014), Li(2015) |
| Materials handling | Irumba (2014) |
| Stress at work | Irumba (2014) |
| Young age | Li (2006), Chi et al. (2005) |
| Human error | Garrett and Teizer (2009), Zhi et al. (2003) |
| Lack of training | Chan et al. (2004), Debrah and Ofori (2001), Liu et al. (2007) |
| Migrant workers | Debrah and Ofori (2001) |
| Poor safety attitude | Toole (2002), Teo et al. (2005), Yu et al. (2014) |
| Poor safety climate | Li (2015) |
| Poor relationship with the crew | Debrah and Ofori (2001) |
| Fatigue | Chan (2011) |
| Poor Housekeeping | Haslam et al. (2005), Toole (2002) |
| Improper/inadequate protective equipment | Toole (2002), Eliufoo (2007), Haslam et al. (2005), Cheng and Wu(2013) |
| Structural failure | Hintikka (2011) |
| On site work complexity/unsafe working condition | Choi et al. (2011), Chockalingam and Sornakumar (2011), Shin et al. (2014) |
| Hot Summer | Hu et al. (2011), Chan (2011), Navon and Kolton (2006) |
| Hecticschedule | Debrah and Ofori (2001) |
| High level of subcontracting | Debrah and Ofori(2001), Rowlinson (1997), Toole (2002) |
| Size of companies | Lin and Mills (2001), Holmes (1999), Lingard and Rowlinson (1994) |
| Separation of design and build in building project | Kongtip et al. (2008), Arocena and Núñez (2010) |
| Legislation, regulations and various aspects of legal system | Rowlinson (1997), Chockalingam and Sornakumar (2011), Chan et al. (2004) |
| Usage of traditional methods in developing countries | Chun et al. (2012) |
| Workers' salaries are paid by piece rate | Debrah and Ofori (2001) |
| Low spending on safety issues | Debrah and Ofori (2001) |

Generation Y, who were born between 1982 and 1995, has comparatively shadow experience and knowledge and may easily become victims on sites (Li 2012a). Generation Y is also named as Generation Why, Generation Next, the Millennium Generation, and Echo Boomers. They grow up in media and technologically saturated World, use internet more than watching television. They also use more mobile technologies than any other generations (Li 2012a). They view, gather, and collect information from internet more than reading newspaper, books, and magazines and watching TV. They also use more mobile technologies than any other age groups. The most common type of mobile communication software use are Line in Japan, WeChat in China and Whatsapp in Hong Kong. WeChat was launched by Tencent in January 2011. It is a kind of software which allows users to send pictures, voice messages, video quickly and text via the mobile phone's internet and supports group chat online. As of 15 January 2013, the number of WeChat users exceeded 300 million (Wei and Ke 2014). Many of them are generation Y users.

In fact, Li and Poon (2009) suggested that there were more generation Y workers who came across accidents and ended up in court. This generation is also called the www generations as they know the use of the World Wide Web better than their previous generations. The popularity of other mobile devices such as smart phone also increased the internet users substantially in places like Hong Kong and Singapore. Whilst traditional internet users only access the internet via the heavy computers, generation Y can access the internet easily via mobile devices nowadays almost everywhere. As previous research on construction safety mainly focuses on the causes of construction accidents, various construction safety measures, few have studied the safety knowledge sharing by this particular generation (Li 2012a). This book chapter aims to fill this gap of research.

## 2 The Role of Internet in Recent Years

In recent years, the cyberspace interacts with urban space, disrupts and collapses traditional enclosures. The popularity of fixed internet in 1990s eases the process of communication, sharing and receiving knowledge via World Wide Web. Moving from one place to the others becomes increasingly virtual than physical. In recent few years, the popularity of smart phone and mobile internet allows us to communicate everywhere, in public transportation, theaters, schools, shopping malls, and so on. The idea of mobile internet combines two of the most important innovations in recent decade: mobile phone and the internet. A combination of both not only provides much convenience to us in everyday lives activities, but also powers economic growth and media transformations in the US and South Korea (Li 2011, 2012a). The popularity of Samsung and LG products in South Korea, for example, opens heaps of job opportunities in recent years. In the same vein, the Apple company in the US offers lots of new positions, not just in the US, but also the places which sell the iPhone.

Nowadays, almost 40 % of the adults use internet, e-mail, and instant messaging devices via mobile technology. They use nonvoice apps for mobile devices more in recent years, especially the young adults between 30 and 49 years old. Young adults between 18 and 29 year olds, in particular, are more likely to use their mobile phones for other mobile data applications, such as sending e-mails, taking photos, or surfing through the Internet. As construction workers often work in different sites rather than a fixed office, some workers may then be isolated from site safety information and knowledge. As safety information on sites at different stages, safety planning and management is usually kept in the site office. All these imply that mobile safety knowledge sharing shall play important roles in the modern days and the near future (Li 2012a).

## 3 Knowledge: An Economic Perspective

Knowledge is a broad and abstract notion which brought epistemological debate since the classical Greek era. Current knowledge management literature points out that researchers define knowledge from different perspectives. Knowledge can be regarded as valuable commodity for an organization in knowledge economy and can be manipulated externally (e.g., buy from outside) or internally (e.g., create within organization) (Li and Zhang 2010). Alternatively, knowledge can be categorized into tacit and explicit. The former one is complicated as it belongs to individual, nonconcrete, vibrant, and specific. On the other hand, explicit knowledge is a kind of codified guidelines and hence is easily transferred and reusable in a consistent manner (Li 2012b).

General knowledge is essential to economy and social system. In Hayek's paper with regards to knowledge in society, he rebuts the possibility of a centrally planned society where the relevant knowledge is concentrated in one place. New knowledge is obtained in two different ways:

1. Observing the nature (whether by research or by less formal procedures)
2. Learning from others which is subdivided into
   (a) Intended learning (communication and education)
   (b) Inferring the knowledge of others by behavior observation (Arrow 1994)

The productivity of particular tasks and occupation depends on the knowledge we have (Becker and Murphy 1992). As each of the individuals hold a specific area of knowledge and there is division of labor, the level of economic progress depends on technological and human capital's growth. Apart from economic growth, the importance of knowledge to an economy is that it provides a rational economic order (Becker and Murphy 1992). Precious research also linked the relationship between specialization and knowledge. For example, engineers in the early nineteenth century were not highly specialized. The growth of industries according to new technologies and greater knowledge of science during the nineteenth and twentieth centuries led to the birth of many engineering specialties. The British Institute of Civil Engineering started their own society in 1818; the mechanical engineers emerged in 1847; the electrical engineers and automobile engineers emerged in 1871 and 1906 respectively. Chemical and other specialized societies started over the past 90 years. The economics, engineering, and medical sector showcased much of the growth in specialization that emerged due to an extraordinary growth in knowledge. Teams' sizes enlarge, workers become more specialized, and experts over a specific area of skills grow as human capital and technological knowledge increase. Adam Smith recognizes there is significant relationship between knowledge and specialization. He suggests that the division of labor is flourished in countries that enjoy the highest degree of development in industry and improvement. Although workers in modern economies are well equipped with complicated technologies, a typical worker also commands very small share as compared to the total sum of knowledge used by the economy. It is the extensive cooperation among these highly specialized workers enables the advanced economies to utilize huge sum of knowledge. Nevertheless, the specialized knowledge of workers is not simply given and acquisition depends on incentives. This is why Hayek emphasizes on the role of markets and prices in combining the specialized knowledge of different workers efficiently in rich and complex economies. By means of price system, not only a division of labor but also coordinated resources based on knowledge has become possible (Becker and Murphy 1992). The "Jack-of-all-trades" is less useful than specialists with advanced technologies and skills. As the growth in knowledge depends on investments in human capital, new technologies and basic research, the incentive to invest in knowledge depends on the level of task-specific skills as well as the degree of specialization. Therefore, there is mutual relationship between knowledge and division of labor. Greater knowledge increases from specialization's benefits and thus optimal division of labor in turn. This explains why workers become expert in narrow ranges of tasks as knowledge grows and countries progress. Increase in specialization in turn raises the benefits from knowledge investments, so that growth in investments specialization in knowledge may nurture economic development (Becker and Murphy 1992).

The peculiar character of the problem of a rational economic order is determined precisely based on the premise that the knowledge never exists in concentrated or integrated form, but as the dispersed bits of incomplete and frequently contradictory knowledge which all the separate individuals have. It is a problem of how to secure the best use of resources, a problem of how to utilize knowledge that is not given to anyone in its total but piecemeal, incomplete, and often contradictory (Hayek 1945).

Asymmetric information suggests that individuals possess unequal sets of information. Information has to be transmitted from a knowledge holder to a receiver. Sometimes, costs are paid from an information transmitter, for example, the postal costs. Therefore, information is often kept by an information holder who does not need the information but decline to transmit to others who want to receive it. Knowledge holders are unwilling to share their information and there is a lack of communication channels (Li 2012a). While it may be difficult to solve the first problem, it is no longer a problem to tackle the second one nowadays. Communication and computation technologies breakthrough allows innovative and flexible forms of learning and knowledge sharing via mobile devices, such as mobile phones and tablets which allow users to send messages to the others. Besides, electronic databases offer an excellent channel to share safety information. Furthermore, generation Y often use mobile technologies. They are expert in sharing knowledge via network in mobile devices. For those who are interested in mobile apps, several safety apps are now available for them. Alternatively, they may learn safety information via e-books which

1. Substantially reduce the heavy weights of the thick books
2. Make keywords search also possible

Nevertheless, there are limitations in mobile technologies. Many information sharing methods rely on different input requirements as well as different output formats (Li 2012a).

## 4 A General Overview on Mobile Apps for Communication Used by Generation Y

Good development in telecommunication sector is important for economic growth of a country (Khan 2010). The most common type of mobile communication software they use are Line (in Korea), Wechat (in China), and Whatsapps (in Hong Kong). WeChat is launched by Tencent in January 2011. It is a kind of chat software to send pictures, voice messages, video quickly, text via the mobile phone's internet, and support group chat online. As of 15 January 2013, the number of WeChat users has already exceeded 300 million (Wei and Ke 2014). Similar and popular software is WhatsApp. WhatsApp is a cross-platform mobile messaging application which allows users to exchange message via smart phone. It utilizes the internet data plan for web browsing and e-mail. Moreover, the marginal cost of sending a message is zero. It also allows us to chat as a group. Each of the typed conservation can be seen by the others in the same group. WhatsApp users can also send audio and video media messages to contact people in different geographical areas (Li 2012a). Line is a South Korean-Japanese app for instant messaging on personal computers and smartphones to exchange video, text messages, audio, graphics, hold free audio or video conferences and make free VoIP calls (Line Corporation 2014). Line was launched in Japan in 2011, with 200 million users only 6 months later (Lukman 2013) (Table 2).

Modern knowledge sharing via mobile apps has become possible. Knowledge can be shared via interactive apps in an interesting way. Furthermore, various mobile technologies such as tablet PCs or iPAD allow apps that include computing Mobile System Analysis and Design to examine the level of satisfaction with regards to mobile learning (Hussin et al. 2012). In view of the above, mobile apps have been used to replace some of the traditional knowledge sharing methods which include lectures, textbooks, and face-to-face interactions.

## 5 Case Studies on Mobile Safety Knowledge Sharing

Case study refers to an intensive research of an event and individual. It allows researcher to obtain in-depth information from detailed descriptions of observed behaviors and events. Although the major problem of case study lies in the breadth of study, a case study could be unique that may increase validity of findings. Multiple case studies are used instead of single case study in this chapter

**Table 2** Details about Line, WhatsApp, and WeChat

| Types of communication tools | Platform | Advantages |
|---|---|---|
| Line (Line Corporation 2014) | Mobile: Android, BlackBerry, iPhone, Windows Phone, Nokia Asha, Firefox OS<br>PC computer: Windows, Mac OS | 1. Exchange free instant messages with one-on-one or group chats. LINE is available in all smartphone devices such as iPhone, Android, Windows Phone, Blackberry, Nokia and personal computer<br>2. Real-time video calls with friends are free<br>3. A wide range of emotions is available for users to express their feelings. It allows users to share photos, voice messages, up-to-date information, knowledge, contacts, videos, and location information easily with friends (Line Corporation 2014) |
| Whatsapp (2014) | iPhone, BlackBerry, Android, Windows Phone, and Nokia | 1. Once it is downloaded, it is free to chat with 3G/EDGE or Wi-Fi<br>2. It allows users to send images, videos, and voice notes. It also makes group chats with friends and contacts possible<br>3. There is no marginal cost to send Whatsapp messages as long as they have Whatsapp Messenger installed<br>4. Usernames and passwords are not required. Whatsapp works with users' phone number, which is similar to SMS, integrates flawlessly with the existing phone address book and connects friends automatically<br>5. With push notifications, Whatsapp is always connected tousers' address book<br>6. Whatsapp saves messages offline and users can retrieve them during the next application even if they miss the push notifications or turn off the phones<br>7. It shares location, exchanges contacts, and customs wallpaper. There are notification sounds, precise message time stamps, and e–mail chat history (APP Tomato Market 2014) |
| Wechat (Tencent 2014) | iPhone, BlackBerry (OS5.0 or above, 10), Android, Windows Phone, NokiaS40, Symbian Kewboard, Symbian Touch | 1. There are sticker gallery, voice, and group chat<br>2. Users can invite friends to a WeChat group chat through QR code<br>3. By selecting "Social" and then "People Nearby," WeChat allow users to add people nearby as friends |

as single case study often falls prey to over generation results or selection bias (Li and Poon 2013).

## 5.1 Two Case Studies in Korea

Some of the construction safety personnel agree that mobile ITsis a modern effective way to share safety knowledge in modern era. In Korea, short message service (SMS) helps to interpret and manage safety issues on sites. Users can input the location where the device is installed, supervisor's name, contact information, and their responsibilities. There are ID codes in the devices which allow the site manager to identify their locations by codes. Authority in each location, safety officers and the supervisor are able to obtain the information via mobile phone (Li 2012a). In another example also from Korea, the mobile safety system is made up of

1. The mobile screen outputs of risk update interface (RUI) to register the risk process in the middle of the screen
2. Take operation interface (TOI) of the prototype sliding mode variable structure (SMVS) on the right side of the screen, showing augmented safety information after registration
3. The risk registration process using RUI and location matching in the left screen (Li 2012a)

A question and answer game (QAG) is also designed for construction safety education on sites. Workers get access to the game and then the user identification interface automatically displays the relevant safety education games which are related to his work. The QAG was developed and tested, where worker navigates his virtual job site by controlling with joystick, keyboard, or mouse. Workers have to make decision on what-to-do next for the risky scenario. The system calculates the number of correct answers. Finally, the system shows the information about the accidents as well as the correct measures if the worker chooses a wrong answer so as to improve workers' safety knowledge. Nevertheless, some people concern that they are not familiar with three dimension information and it is quite difficult to control the movement. Moreover, time, information, and temporary facility need to be integrated to operate the system (Li 2012a).

## 5.2 Case Study in the US

In the USA, there are three free apps which provide useful occupational safety and health information. For example, the Wireless Information System for Emergency Responders (W.I.S.E.R.) shares knowledge with regards to explosive potential, reactivity, and PPE. First Aid by the American Red Cross integrates with 911 and workers such that they can call EMS from the app any time. By using a modified

**Table 3** Aims, objectives and functions of the app (Perry 2014)

| Name of the apps | Functions |
|---|---|
| Wireless Information System for Emergency Responders (W.I.S.E.R.) | 1. It assists workers in handling hazardous material incidents<br>2. It provides useful occupational safety and health information on reactivity, explosive potential, PPE, fire procedures, storage, toxicity, environmentalclean-up, chemical properties, treatment, carcinogenetic, health effects, occupational safety, health standard, and disposal<br>3. User Profiles allows users to inform the app according to their current situation such that relevant information about the incidents' emergency responds can be provided |
| First Aid by the American Red Cross | 1. It integrates with 911 and workers can call EMS by using the app any time<br>2. Simple step-by-step instructions guide workers the procedures of first aid<br>3. Instant safety information access anytime in the absence of internet connection |
| Easy Lift app | 1. By using a modified version of the NIOSH lifting equation, it provides the user a maximum safe weight under various lifting scenarios by following the following three steps:<br>It calculates the maximum safe lifting weight according to the NIOSH lifting equation in absence of WiFi<br>It indicates where the workers' lift should begin<br>It estimates the hours of lifting per day and the number of lifts per minute |

version of the NIOSH lifting equation, it provides the user a maximum safe weight for various lifting scenarios by following three steps (Perry 2014) (Table 3).

## 6 Future Directions

Although construction safety is a complex issue and it is impossible to eliminate all the causes of accidents with one single method, previous research showed that lack of the relevant safety knowledge is one of the major causes of accidents. As many of the construction accidents victims are generation Y workers, this paper suggests that young construction workers may be educated by using the latest mobile technologies and apps. In view of the case studies in the US and Korea and the popularity of mobile technologies, it is expected that construction safety knowledge can be shared through smart phone technologies and apps. In the future, it is expected that the use of smart phone shall increase as the increase in production in different areas.

## 7 Cross-References

- ▶ Adoption of Mobile Technology in Higher Education: Introduction
- ▶ Business Models for Mobile Learning and Teaching
- ▶ Characteristics of Mobile Teaching and Learning
- ▶ M-Learning and U-Learning Environments to Enhance EFL Communicative Competence
- ▶ M-Learning: Visible Approach for Invisible World
- ▶ Mobile Education via Social Media: Case Study on WeChat
- ▶ Mobile Learning and Engagement: Designing Effective Mobile Lessons

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# Mobile Learning Initiatives in Nursing Education

# 18

Sharon Rees, Clint Moloney, and Helen Farley

## Contents



**Abstract**

Mobile learning is a very exciting approach to learning that has the possibility of changing nursing education, providing learning to nurses when and where they need it and in a manner that will achieve positive learning outcomes. Coming from an apprenticeship model in the military, nurses have traditionally learned by seeing and then doing. Mobile learning through means such as YouTube and augmented reality offers the best of this traditional way of learning combined with time- and cost-efficient means of technology use and greater theoretical knowledge. Reaching nurses in rural and isolated communities is also possible through these means. This is achieved through the use of SMS and online learning that is able to be used at a time and place suitable for the nurse, enabling them to include learning within their lives in a way that suits them. Many

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isolated trials have occurred in nursing education over the years, starting with the use of PDAs, and although many have shown success, there is not a great deal of research that has been conducted in the use of mobile education in nursing. Considering this research was conducted using a grounded theory approach that investigated nurse's current use of mobile technology and their beliefs around mobile learning. The study also explored how and when nurses are undertaking continuing education, with the discovery of how they personally resource their learning. When looking at trials of mobile learning within nursing education, it is apparent from these trials and the study that nurses are ready for mobile learning and that mobile learning shows great potential as a method for education within the nursing profession.

## 1 Introduction

Mobile learning initiatives have been trialed within nursing education. Although these small trials have been successful, the use of mobile learning within nursing education is not documented to be used widely. What appears in the literature however may not be accurate, as nurses are starting to investigate their own methods of learning through the availability of online education sites via the Internet and also the availability of mobile applications.

To give context to mobile learning initiatives in nursing education, it is important to firstly review how nursing education has developed from a largely apprentice-based model where some learning still takes place toward a tertiary evidence-based model. This has required initiatives using various methods including the beginnings of mobile learning with the use of PDAs.

The chapter will review mobile learning as it has been documented in the literature for use in undergraduate, postgraduate, and continuing nurse education and will also discuss initiatives observed by the authors in current clinical practice. It is difficult when reviewing mobile learning initiatives to look at them in total isolation to e-learning as the lines have blurred between what is considered as e-learning and what is m-learning. Therefore, some aspects of e-learning such as social media and YouTube, as well as the more traditional e-learning methods, will be discussed, as students and nurses will expect to be able to access these via a mobile device.

Mobile learning should not be considered as the only method of education; however, it is a valuable adjunct to traditional learning methods. It provides the opportunity to improve pedagogy, while resources and time for learning are reducing within tertiary institutions and hospitals. The possibilities are exciting with such things as augmented reality offering the possibility of nurses being able to have a more authentic simulated experience with minimal continuing costs to the organization. These opportunities however also present challenges to the organization.

Organizations, when introducing mobile technology into the workplace, will need to overcome obstacles to ensure its safe use for both the nurse and patient.

Privacy and the potential for misuse are major considerations in health and therefore policies need to be developed to ensure the safe use of the technology.

## 2 Background of Nursing Education and Value of Mobile Learning

Over time as long as there have been nurses to care, there have also been nurse educators to train. Traditional methods of nurse training in Australia have stemmed from a militarian style where student nurses would earn their stripes as they learned on the job (Jolley 2007). With the evolution of standards for training and the desire for nursing to become a profession in the 1980s, hospital-based training made the transition to university training. Hence, the nursing degree was borne. This however never did dismiss the requirement for training nurses to have adequate clinical exposure (Bruni 1997). Tied to this evolution was the rapid progression of technology, the Internet, mobile phones, wireless technologies, telehealth, and the more recent smartphones and tablets (Robb and Shellenbarger 2012; Walton et al. 2005).

The education and training of healthcare professionals has been apprised by advancements in information and communication technologies for several decades. Access to these technologies has meant that adult learners now have instant access to information flow (Billings 2005). Hence, a nurse as a lifelong learner now has access to instant evidence-based information on patient care processes and standards. When considering mobile technology literature and associated development, significant trends have emerged. Mobile technology appears turbulent, showing rapid and major developments. These include increased amalgamation of applications commonly called apps into a single mobile device, wider availability of wireless technology, and the reduction of connectivity problems (Neuman 2006; Ortega et al. 2011; Walton et al. 2005).

Expectations from nurses and their learning needs are on the rise, and there is an expectation that academia and healthcare keep up with fast-paced technology evolution (Neuman 2006).

Presently however there is evidence that healthcare are laggards when diffusing such technology (Moloney 2013; Moloney and Becarria 2009). Mobile technologies are not yet primed to be substantial in allowing nurses at all education levels remote access to learning resources. The reasons for this are varied and include low level of student awareness, limited relevance of software, and limitations in the hardware (Gururajan et al. 2005). At the same time, the technology has great potential to meet the needs of these students. The reason for the inability to keep up with the evolution of technology is correlated heavily to evidence utilization barriers. These include but are not limited to patient factors, social context, organizational effects, financial and political interference, communication breakdown, and the innovation itself. For every innovation there appears to be noteworthy factors, including knowledge, skill, time, access to new evidence, and leadership (Moloney 2013).

Ironically the individual learning outside of the healthcare environment attaches importance to remote access learning resources and is already heavily using electronic learning resources on mobile devices (Yudkin 2012). Greater emphasis now needs to be placed on bridging the gap between external independent personal learning activities and those offered in the clinical environment (Whitehead and Lacey-Haun 2008). The university sector is well on its way to achieving this with many nursing programs like that found at the University of Southern Queensland now offered in an external online mobile program. What is not catered for is the postgraduate lifelong learner who has the desire to continue to grow professionally (USQ 2014). Gone are the days where nurses can afford time to attend classrooms. Nurses demand on the job access to information for learning purposes. Universities are working toward developing resources around how and when a nursing student's access learning resources particularly coincide with clinical placement (Ortega et al. 2011; USQ 2014). This growth of expertise will allow the use of the technology to be developed and refined to best cater for nurses in their learning pursuits (Gabbert 2007).

M-learning undeniably needs to be supported with infrastructures inclusive of library and information computer technology services (Billings 2005). M-learning is in need of interdisciplinary collaborative support in moving forward as a future in healthcare information and learning andragogy. There are various healthcare and non-healthcare groups who perceive m-learning development as integral to their role (Yudkin 2012). Software and hardware engineers, academics, and healthcare administrators are good examples. None of these groups can achieve in isolation or implement what is necessary to deliver m-learning. The responsibility lies with a collective of these groups working together to establish effective cooperative practices (Moloney and Becarria 2009; Yudkin 2012).

As technology has evolved the fears and anxieties associated with their use have dissipated. Research evidence reinforces that mobile technologies, specifically the mobile phone, are useful reference tools in the clinical setting, particularly for medication knowledge. It also demonstrates that nurses are using this technology for patient safety in conjunction with fellow health professionals, and creates a cooperative learning community which enables support and knowledge acquisition (Johansson et al. 2012). The importance of mobile learning technology in healthcare continues to intensify with the arrival of electronic records, ground-breaking equipment, and innovative ideas (Billings 2005). Healthcare educators can help nurses operate in this climate of change by providing access to mobile technologies now at the point of care. Current literature supports the use of personal devices in the clinical setting, but is failing to address the diffusion of the technology into what can now be classed as the virtual real-time classroom (Bruni 1997; Moloney and Becarria 2009). M-learning techniques can amplify clinical learning as well as boost classroom and supportive learning. Clearly, the modern-day nurse graduate possesses a variety of technological readiness when entering today's workforce, and modern-day educators in the hospital system now need to acknowledge the trend and seize the opportunity to embrace an education revolution (Johansson et al. 2012; Robb and Shellenbarger 2012; Walton et al. 2005).

Mobile, wireless devices, m-learners, and m-learning require nurse educators to embrace change and revise curriculum structures (Whitehead and Lacey-Haun 2008). Changes are required in the entire cycle of a nurse's lifelong learning including university programs and clinical practice experiences. Education that is responsive to m-learners will be compressed and accelerated. Modern-day nurses demand relevant content for practice, particularly advanced practice. The nurse educators of today need to evolve with the technology that is at their disposal in order to provide timely education in the workplace. The modern-day nurse now demands this and it is no longer optional (Johansson et al. 2012; Robb and Shellenbarger 2012; Walton et al. 2005).

## 3 Mobile Learning in Nurse Education

### 3.1 E-Learning Using a Mobile Device

A grounded theory study conducted in Australia has discovered how nurses view mobile learning and their experiences of mobile learning in the context of continuing education.

The study found that nurses do not view e-learning and m-learning exclusively of each other. It also found that nurses generally were ready to, if not already using, mobile devices for learning. A study in the USA used perceived self-efficacy measures to determine if nursing students and faculty were ready for mobile learning. Their findings added weight to the assertion that students are ready for mobile learning. They found that both groups were ready to learn through mobile applications as generally their perceived self-efficacy in the use of mobile devices was high. It was found that students and faculty currently used their mobile devices to teach and learn informally and this is likely to increase (Kenny et al. 2012). This gives rise to the expectation by students and indeed people in general that if something is available via e-learning, they will be able to access it via their mobile device. This uses the affordance of learning via a mobile device being available at any time and in any location (Shippee and Keengave 2014). The improvements in mobile devices over recent years have made for an improved experience when using mobile devices for e-learning. Issues still remain however in Australia as well as other countries for connectivity to the Internet for a true anytime and anywhere experience (see ► Chaps. 26, "Mobile Learning in Southeast Asia: Opportunities and Challenges," and ► 2, "Characteristics of Mobile Teaching and Learning").

Nursing education in undergraduate, graduate, and workplace learning as with other professions has been increasingly moving toward e-learning (Neuman 2006). Therefore, developers of e-learning need to be designing the education to be available to students via a mobile device. When developing e-learning for use on a mobile device, the developer should ensure that the learning is firstly visible and workable on a mobile device, thus ensuring that the learning platform is appropriate and also the types of programs within the education are appropriate for mobile devices. The nurses within the study indicated they used their mobile devices or would like to use their mobile devices for learning in multiple environments, including while on transport or waiting for children or appointments or just in another location within their home or work. The learning therefore needs to be developed to allow this to occur. Developing the education in discernable smaller portions to enable the learner to complete portions of the education at a time and location suitable to them is one such measure. This enables the learner to allocate their personal resources to place education within their other life commitments. Mobile learning is facilitated by the portability of mobile devices, affording it a distinct advantage over e-learning. Portability is accomplished through devices being small enough to be carried with the learner and wireless and 3G/4G networks removing the need to physically connect to the Internet. This portability facilitates learning anywhere and anytime (Asabere 2012; Shippee and Keengwe 2014). To increase the portability of the learning, the learning modules should also be able to be saved onto the device as connectivity to the Internet cannot always be gained. This will enable the learning to continue as the student potentially moves in and out of Internet connection. The education also needs to be developed so it is not time critical, as in not needing to be synchronous learning. This is also due to the fact that the learner may be moving in and out of Internet connection within the session, have unreliable Internet access, or only be able to access the Internet within the workplace. The Australian study also found that many nurses are currently using their mobile device for just-in-time education in the workplace.

## 3.2 Just-in-Time Education

The most frequent use of mobile learning in nursing education is just-in-time education used in the clinical setting. The study found that nurses frequently use a mobile phone to check on practice. More specifically they use a mobile device to look up medications prior to administration. Mobile devices are ideal for just-in-time education as their portability allows them to be easily accessible to the nurse when the education is needed. Just-in-time education is usually only small bites of information that is needed immediately to allow the nurse to be able to provide patients with a high standard of care at that particular time; however it is also valuable for learning as they are able to then place that learning when it is needed at a later time. Nurses are also accessing best practice sites for their individual specialties through their mobile device within the workplace to determine best practice. This was also found with a US study where mobile devices were used by students to access professional information where they needed it, at the point of care. Students also believed that mobile technologies could improve communication with faculty when they were on clinical placements (Kenny et al. 2012).

Just-in-time education within nursing education is also largely contextual.

### 3.3 Contextual Learning

The portability of mobile devices has enabled student learning to occur experientially with outside "real-life" experience. This experiential learning is achieved by learning being delivered in an environment where the students are able to directly apply their learning (Kukulska-Hulme et al. 2007). In a UK study, nurses viewed a video on their assessment under supervision. The nurses were able to access the learning at a time that suited them and then apply the knowledge when they next performed the procedure, consolidating what they had learned (Clay 2011).

Class interaction can be improved through the use of mobile devices. In another study with nursing students in a UK university, teachers encouraged discussion around course-related YouTube videos shown in classes. The research found that the videos assisted the students with developing critical thinking skills, facilitated deep learning, and also increased their engagement (Clifton and Mann 2011). As has been demonstrated, videos obtained through channels such as iTunes U and YouTube can be valuable learning tools. A problem with YouTube, however, is that the origin of videos needs to be checked to ensure the video is accurate to best practice. This can be addressed by prescribing playlists for students, to enable them to access relevant quality information (Clay 2011; Clifton and Mann 2011; Cuddy 2010). Students unofficially access YouTube to improve their understanding of a procedure.

### 3.4 Mobile Apps

Mobile applications or "apps" have brought about a huge change in how users interact with their mobile devices both at work and in their personal time. Apps are inexpensive to produce and relatively simple to use. They can be readily introduced into the market without being extensively trialed, making them also inexpensive to develop and sell (Johnson et al. 2012).

Many apps are available for nurses; however, it is difficult to fully grasp how often these are being used, as data has not been collected. A search on the Internet however revealed that there are many apps that can assist the nurse with just-in-time information and with their continuing education in general. Apps have also been developed to be used in hospital communication, to assist the nurse in time management and in communication between health professionals, units within the hospital, and patients. It was reported by nurses in the study that nurses are using various apps within the workplace for just-in-time education and also at home mostly for scenario-based education. Educators within the study were also recommending apps to nurses for learning.

Apps developed in the workplace to improve care were adopted in one aged care facility. Within that facility the apps were used by care staff to document patient care and were also used to provide staff with support in dealing with difficult situations. Another app within the facility allowed inexperienced staff to interact with dementia care scenarios that allowed them to gain experience and guidance within the situation without risk to themselves or the residents (Maiden et al. 2013).

## 3.5 Social Media

Social media is a growing area for education; however, it is poorly documented in nursing education. A search through Twitter and on Facebook however presents with many opportunities for learning both for undergraduate and continuing nursing education. Nursing blogs have also become frequent on the Internet. Social media is a promising method of assisting nurses in communities of practice with nurses of similar interests and could also assist students in sharing of ideas and in supporting each other. Schmitt and Simms-Giddens (2012) take this further and suggest that social media is also important to give nurses a professional voice and that having a good understanding of social media will allow students to identify false information and also contribute to new sources of accurate information. Sarah Stewart discusses at length social media especially in regard to midwifery in her blog; she uses the blog to discuss not only personal aspects of her life but also to make comments on issues affecting midwives, with in particular technology. Sarah discusses in her blog the great value social media has as a communication tool and importantly also raises the issue of the need for policy in nursing around the use of social media. She raises an important consideration with the social media that will be discussed later in the chapter, that of the issue of maintenance of professional conduct (Stewart 2013).

## 3.6 Context-Aware/Augmented Reality

This is perhaps the most exciting opportunity for nursing education. It has long been an issue for nurses learning procedures for the first time, as they either need to practice on a human or with a simulation manikin. Both have issues in that with a human there is always risk of harm and a manikin although giving a nurse the experience does not have the same effect as a human by not being able to provide feedback or other supplementary materials (Wu et al. 2012). Augmented reality brings the experience closer to real life and therefore allows the nurse to problem solve and prioritize care. This was demonstrated by a university in Taiwan where students were able to use their mobile device to give realistic feedback when undertaking a respiratory assessment on a manikin. Through the use of a context-aware ubiquitous learning environment, the students were given guidance and feedback that assisted them with their learning (Wu et al. 2012). As the students approached the patient, they were given the patient's history and presenting complaint via their mobile devices. The students then assessed the patient and when placing their mobile phones over the area to be assessed, the students heard the relevant lung sounds. From this they were then able to provide treatment to the patient. Depending then on where their mobile device was placed depended on the information they received. After they completed the assessment, they were then also given feedback on their current level of mastery (Wu et al. 2012). This study found that not only did this approach increase the number of practice opportunities in the same time for the students but also showed the levels of accuracy and smoothness of the procedure was improved in the student group undertaking this method of education compared to a control group using traditional methods (Wu et al. 2012).

## 3.7 Podcasts

Nurses report that podcasts allow the nurse or student nurse to access education while they are undertaking other activities, such as while driving, exercising, cleaning, or even mowing the lawn. As with all methods of education however, this method has its limitations. It has been shown by research conducted in a Sydney university with nursing and business students and found that although the podcast was able to shift the time needed, it was unable to make time (Kaslauskas and Robinson 2012). It should be noted that this was undergraduate students therefore possibly explaining the disparity between them and the postgraduate nurses who were undertaking this form of education while undertaking other activities and where it did in fact make extra time. This same research suggests that some students still prefer to attend lectures in person, rather than the more isolated experience of such methods as podcasts (Kazlauskas and Robinson 2012). Podcasts have been shown to improve nursing students' knowledge and retention in a small study (Abate 2013) giving some evidence of value within nursing education. Given the variances in findings, this gives support to the idea that education should be provided to students using multiple modalities to enable them to use what is best suited to their needs and learning styles.

## 3.8 SMS

Some educators have used SMS messages to enhance students' learning. A project using similar methods was used to teach pharmacology to nursing students. In this study the students received two SMS messages per day regarding medication dosage and indications. It was found that the students receiving the messages had a greater knowledge of medications at the end of the 4 weeks and these results were statistically significant (Chuang and Tsao 2013). Edge et al. (2012) provided information through both audio and visual mediums via SMS/MMS and termed this mobile micro learning. They likened it to an improved flashcard system of teaching. Their study also proved that this style of learning enhanced retention and allowed students to access the materials at a time and location suitable to them. They found that learning was not impeded by distractions or movement of the learner (Edge et al. 2012). It is possible to distribute larger amounts of information to students through tablets such as iPads. In the Iheed report, Callan et al. (2011)

report that one of the main barriers to improving health outcomes for people in developing countries is the lack of trained healthcare workers. In order to reach healthcare workers in remote areas of Africa, mobile technologies are being used as part of distance education programs. In this context, mobile phones are mainly used to send information to nurses and community health workers to supplement printed materials.

Australia also has a large geographical area with many nurses being isolated from opportunities for continuing education. A study conducted by Kidd et al. (2012) confirms this, with nurses in the study stating they have a need for remote area-specific education. Rural nurses need to have a great diversity of knowledge and skills in order to competently address the needs of the people they provide a service for. This can be difficult as they can receive education but not need to apply it until much later, making the details of procedures and processes difficult to recall (Kidd et al. 2012).

An Australian study of nurse practitioners (NPs) found that the least favored method of receiving continuing education was through downloadable case studies for PDAs. It is not known if this discomfort would be translated to tablets or if these technologies would be more acceptable to these nurses. The most favored methods were receiving information via email or using interactive online case studies accessed via desktop or laptop computers (Newman et al. 2009). There have been considerable advances in mobile technologies over recent years and perceptions are changing toward them. Mobile technologies may now be more favored among nurses for the delivery of educational content as they are more likely to encounter these devices in their private lives. In 2009, Newman and colleagues found that NPs practicing in metropolitan areas were more likely to have broadband/network access at work than rural nurses (Newman et al. 2009). Access to broadband is likely to have increased in recent years, in both rural and metropolitan areas. However, the divide highlighted by Newman et al. (2009) is still likely to exist.

## 4 Future Possibilities

As mobile devices become even more integrated into everyday life, their use in nursing and nursing education is likely to also increase. Though they are often viewed with suspicion or dismissed as a fad by traditionalists, their enormous potential to deliver just-in-time information will ensure that their use in the workplace will increase rather than diminish.

Recognizing this potential, education providers are beginning to create their own resources which can be housed on a secure server and accessed via mobile devices at the workplace. In a recent trial in Taiwan, resources such as assessment scales were made available, along with activities designed to develop critical thinking skills. In addition, communication channels were established to allow for learners to directly interact with educators and experts (Lai and Wu 2012). As mobile devices and associated technologies become more sophisticated, the resources available, levels of interactivity, and specificity of the information are likely to become more advanced. The advantage in these kinds of systems is that the quality of the information accessed and provided can be assured.

Mobile applications or "apps" will continue to be popular with both students and professionals. Apps have the advantage that they are designed specifically for use on a mobile device and can leverage the features and hardware of the device including cameras, accelerometers, and speakers. Though apps are able to bring unparalleled levels of interactivity to information retrieval and learning, there are potential issues that need to be considered. In April 2014, a picture-sharing app for doctors and nurses received extensive media coverage. The app allowed practitioners to share photos of lesions with other practitioners and facilitated discussion to aid diagnosis. The app did contain some tools to help conceal the identity of the patient; however, there was no compulsion to use these (Smith 2014). With very little additional information, the patient could be identified from the pictures and many doctors and academics expressed dismay at the lack of guidelines to ensure patient privacy and confidentiality.

In the near future, artificial intelligence (AI) agents may act as tutors or clinical experts, providing advice or up-to-date information as it becomes available. Many business and corporate enterprises are making increasing use of these AI agents to simulate the personal touch through services such as those provided by IBM's Watson. This system, accessed through mobile devices, potentially can help nurses with treatment options and calculate the level of confidence in the options suggested (IBM 2014). These possibilities had been identified in the previous century (e.g., see Turley 1993), yet are only now being realized.

## 5 Considerations for Introduction of Mobile Learning

The students' intention to adopt mobile learning is influenced by many things. Research undertaken in a university in the USA found that students who feel that mobile learning is easy to use are more likely to embrace learning through this medium. This led the researchers to recommend that when including mobile technologies in courses, educators should ensure that students are comfortable with the mobile learning tasks that are intended to be used. They suggested that more complicated mobile learning tasks should be implemented at a later time when students are comfortable with existing mobile learning tasks (Cheon et al. 2012). Taking this into account with the findings from the study, mobile learning would need to be introduced into organizations at a level that is acceptable to the nursing population and/or support given to enable nurses to undertake the education.

Another concern of nurses is the cost of education. With mobile learning this also includes the cost of the device and also the cost of Internet usage. This was also the findings in a study conducted in the USA. When students were asked about their willingness to participate in mobile learning, they were concerned about the potential costs associated with downloading materials (Kenny et al. 2012). If the student is in the university setting, this could be assisted by students being able to download at university and save the education onto their device; however, if the student is external, this is another cost of their education. Similarly in the workplace, allowing nurses to download information at work decreases the need for personal cost; however it also opens the opportunity for misuse of download capability. Cost of the device is another concern and raises the need for education to be available in multiple formats, so as to not disadvantage those that are unable to purchase a mobile device.

Concerns were also raised in the US study about infection-control issues with using mobile devices in the clinical setting (Kenny et al. 2012). This was also found in the Australian study; however, nurses also offered solutions to the issue of infection control. The concern is that the device will be taken into a patient's room, used, and then taken to the next room and used without being cleaned. This is a valid concern; however, it is also an issue for other devices such as equipment for monitors, vital signs, and pens. Some units overcome these issues by having individual monitors for patients and also by having trolleys for the nurse to take to the outside of each room and attending to hand hygiene on entering and on leaving a room, therefore not contaminating the equipment. Infection control is also an issue that needs to be explored for the keeping of electronic records, which will be introduced at some stage within Australia as they have been overseas.

Many nurses are concerned regarding the appearance of using a mobile device in the clinical area. Nursing historically continues to be a very active profession; therefore, if someone is using a mobile phone in a work area, people are uncertain if the nurse is using the mobile for work or for personal use. This is something that the workplace needs to be aware of and put strategies in place to both protect the nurse from being viewed unfavorably and ensure for the workplace that the nurse is actually working and not socializing. Possibilities for this would be to have mobile devices available at the workplace for nurses to use that only have accessibility to sites that are work orientated. Attitudes to mobile devices also need to change with both public perception and within the nursing community.

Policies are starting to be developed within nursing bodies and also health organizations to give guidance to the use of technology in the health environment. Social media gives rise to many concerns with the potential for nurses to share patients' private information and therefore needs to be regulated (Stewart 2013).

## 6 Future Directions

As can be identified throughout this chapter, mobile learning has great potential within nursing education. Isolated studies have proven that mobile learning is a useful tool in nursing education, and although the research is not numerous in nursing education itself, it is consistent with research in other areas indicating that the findings of these isolated studies are indeed valid. Coming from a largely apprentice-based model, nursing has held tight to that beginning despite moving into a university-based program, causing nursing to at times lag behind other professions in regard to technology. It is now time however that nurses are ready to change personally. Change is also eminent due to the change in the health environment requiring high knowledge levels in an ever-changing and cost-efficient environment. Nurses are using mobile devices in their personal lives and informally in their work lives already and so are ready to receive education via this method together with more traditional modes of education. Mobile learning is able to provide education to the nurse at a suitable time and place for the nurse to enable them to fit education into their life. Just-in-time learning is also important for nurses and the mobility of mobile devices allows this to occur. Just-in-time education is important in healthcare to check on best practice and is a very practical application for mobile devices that have the possibility of being readily available when required. Mobile devices are also an ideal choice for contextual learning as it gives the nurse the opportunity to immediately put into practice what they have learned on the device and apply it in the clinical area, reducing the need for one-on-one support of beginning practitioners. One-on-one support is also reduced when the beginning nurse is also able to use augmented reality to practice procedures and scenarios in an environment closer to reality than currently used in simulation and without risk to patients.

Rural nurses although needing a broad range of skills and knowledge have found it difficult to access education, and mobile learning and e-learning have allowed them to access learning in their own community. This has the opportunity and necessity to be increased by improving access by developing education that does not necessitate constant Internet access, thereby allowing them the same potential to learn when and where they want and need to as their city counterparts.

As various organizations and nursing bodies deal with the issues surrounding such issues as privacy, mobile learning will start to be used more for education within nursing. As hospitals move toward online records as have other countries' methods to maintain infection control will also be resolved and mobile devices will become a commonplace within the healthcare system within Australia.

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# Tutors in Pockets for Economics

# 19

Yu (Aimee) Zhang and Jun Hu

## Contents



**Abstract**

Mobile teaching and learning has been adopted in the higher education for many years. Mobile teaching has both advantages and disadvantages when compared to traditional teaching methods. Mobile app provides a good solution as an assisting teaching tool to solve misconception problems. TutorsinPockets (TIPs) is a mobile app designed and implemented in University of Wollongong. It is designed as an assisting teaching and learning tool for economic subjects. The project is designed as a flexible framework for teaching materials, which can be easily expanded into other majors and subjects if needed. Any mobile device supported multimedia materials can be used in this app, such as video, audio, picture, web-link, and text. This app is also designed to be easily connected with

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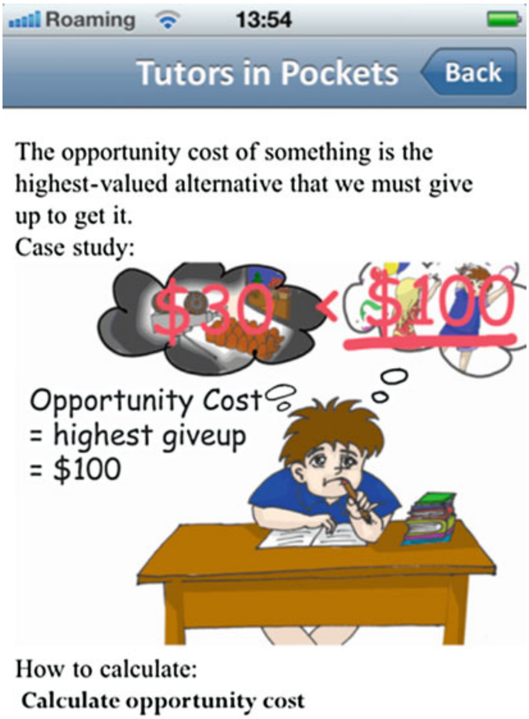
existing e-learning systems and models as a value-added tool. To provide an equal access to those developed teaching materials for the students using other mobile devices and students without a mobile device, the teaching materials are also adopted in lectures and tutorials. Both face-to-face interviews and online surveys are adopted to collect students' and staffs' feedback on this project. The results show that TIPs app has positive influence on students' learning efficiency, understanding of complex conceptions, long-term memories, correcting of some misconceptions, engaging in discussion with other students and teachers, and performances in subjects. Students also agree that it helps them to use small time fractions (such as waiting for a bus) to study at anytime and anywhere.




- Mobile apps can be used as good assisting tools in teaching for new generation.
- TIPs has positive influence on students' learning performances and engagements.
- TIPs is a flexible app with more potentials.

## 1 Introduction

Mobile teaching and learning (M-learning or mobile-learning) has been introduced into higher education for many years (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). It evolves from broadcast to podcast and now we believe it is appcast time. The release of iPod touch and iPad increased the adoption of mobile learning (Cumming et al. 2013). However, the adoption of high technologies in education receives many debates, such as whether they are as efficiency as the traditional face-to-face (FTF) teaching and how to assess the influences of remote teaching. M-learning has both advantages and disadvantages when compared to traditional FTF learning (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). Instead of using M-learning as a substitute for traditional teaching, this chapter presents a complemented mobile assist teaching app.

To facilitate teaching, mobile devices are the same as normal blackboard and chalk. What makes it different are the using styles on mobile devices. The first characteristic of mobile devices is anytime and anywhere (McCombs 2010; Peng et al. 2009; Cumming et al. 2013). However, the reality is this goal is far from satisfied with current technologies and barriers (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). The second characteristic is the flexible access (Mishra 2013). Students use mobile phones in small time slots, such as waiting for friends or on a bus (5–10 min). How to make good use of these short timeframes? A well-designed app should fit into this gap and assist students learning using small time slices (see ▶ Chap. 1, "Design of Mobile Teaching and Learning in Higher Education: Introduction"). Furthermore, the interactive and communicate functions from the original of mobile technology also supports learning process (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning", Zhang 2012a). Mobile learning can also assist special needs from students, personal learning, efficiency learning, team collaboration in learning, in-class learning, self-regulated learning, life-long learning, and learning with social media (see ▶ Chaps. 2, "Characteristics of Mobile Teaching and Learning," and ▶ 25, "Mobile Education via Social Media: Case Study on WeChat").

This chapter presents a flexible app, which allows students learn concepts within five minutes at anywhere and anytime. Tutors in Pockets (TIPs) is a flexible designed mobile app in terms of both content and technology aspects. To study the influence of this app on students' learning, both face-to-face interviews and online surveys are adopted. The results show that TIPs has positive influence on students' performances. Section 2 reviews the literatures and empirical studies on mobile teaching and learning. The design and implementation of this application are introduced in Sect. 3. Section 4 presents the feedback and results of this project. The last section concludes the findings of this project and proposes for future studies.

## 2 Mobile Learning

Students are different today (Alley 2009; Fraga 2012; see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). Ten years ago, the majority of students were local students. But the number of international students increased dramatically in recent years (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). In some subjects, 90 % of students in a class can be international students (see ▶ Chap. 35, "Cross-Country University Collaboration Barriers and Solutions"). Today, students also come to class with their iPads, laptops, and smart phones as well as the skills and knowledge of using them (they may have better skills on mobile devices than their teachers). They search online for evidences and support in tutorial discussions and doing assessments using many online resources (see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning"). They share information, upload photos, discuss questions, and communicate with their classmates and friends online (see ▶ Chap. 25, "Mobile Education via Social Media: Case Study on WeChat"). They download lecture notes, ask for leave, and finish their assessment online (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). They travel more to study in another country, have more skills and knowledge on mobile devices, and are more efficient in learning by searching resources online. Ten years ago, students used a lot of time in library reading books. Does the traditional teaching still suit the new generations? Should the methods of teaching and knowledge delivery be improved to meet the new requirements from students? There is always a fierce debate on traditional face-to-face (FTF) learning or online learning (or mobile learning) (Qiu and McDougall 2013; Fraga 2012, see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). Students are changing and there is always new improvement for teaching and learning too.

FTF learning has some irreplaceable advantages, such as facial and body language in communication, emotional transfer, and active experience (Stewart 2011; Lewin 1948; Kolb 1984). Williams (2009) found m-learning reported lower performance (8 % in average) compared with FTF learning. Empirical studies showed that M-learning still has many problems in terms of technology barriers, performance improvement, and adoption levels to technologies (Doug et al. 2009; McCombs 2010; Williams 2009). The lack of Internet access has been one of the major challenges for the overriding anytime and anywhere of m-learning (McCombs 2010, see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). Some ethics and political reasons are also barriers for the implementation of mobile learning. Some researchers argued that the games and some contents on Internet via mobile devices are not good for students (Prensky 2001; Alley 2009). Mobile learning should also be designed in good presents and structure so they can attract learners as well as or combined with games (Sung and Hwang 2013; Bredl and Bösche 2013). Why does m-learning attract so many attentions from global educators? The trend can be observed from current development and penetration of mobile devices.

The percentage of the world's population covered by a mobile cellular signal increased from 61 % in 2003 to 90 % in 2009, and nearly 80 % of people on the earth were mobile subscribers in 2010 (ITU 2011). And the number keeps increasing with a fast growth rate. The capabilities of mobile devices are greatly enhanced too (e.g., CPU-central processing unit speed, storage space, fast network connectivity support, screen size, and resolution). With more and more advanced mobile devices used by students, there are great needs of mobile learning. In January 2013, education apps were the second-most popular category (after Games), which shared 10.55 % of all active apps on Apple App Store. And 40 billion apps were downloaded from the Apple App Store in early 2013 (Statista 2013). Mobile devices are changing the style of living and the methods of learning (Zhang 2012a, see ► Chap. 2, "Characteristics of Mobile Teaching and Learning").

Mobile technology has been introduced into higher education for many years (see ► Chap. 2, "Characteristics of Mobile Teaching and Learning"). There were 1.5 million educational programs on iPad in USA in 2012 (Cumming et al. 2013). The definition of mobile learning goes into three categories in literature: components and communication style, mobility, and ubiquity (Kukulska-Hulme and Traxler 2005; Peng et al. 2009). Anytime and anywhere became the key words in these definitions. Researchers believe that mobile learning can engage students (Martin and Ertzberger 2013), increase teaching and learning efficiency (Mishra 2013; Keengwe 2013), assist special education (Keengwe 2013; Kennedy et al. 2013; Cumming et al. 2013; Fernández-López et al. 2013), improve quality of teaching (Mishra 2013), improve lifelong learning and self-motivated learning (Sha et al. 2012; Mishra 2013), and increase learning performance (Sung and Hwang 2013; Hsu et al. 2013).

To achieve a real "anywhere," "anytime," and flexible teaching app, it is important to design the system from both online and offline perspective (Zhang 2012b, see ► Chap. 1, "Design of Mobile Teaching and Learning in Higher Education: Introduction"). Tutors in Pockets (TIPs) is a project designed to assist teaching and learning in higher education from a flexible perspective. Instead of competing m-teaching against traditional teaching method, TIPs is designed as an app that is complementing to FTF teaching and assisting students learning process. This project is greatly supported by University of Wollongong and external business partners. The app is flexible designed in terms of both content and technology perspectives. The design and outcomes of this project are discussed in the following sections.

## 3 Design of TIPs

Students are different today (Fraga 2012; Zhang 2012b, see ► Chap. 2, "Characteristics of Mobile Teaching and Learning"). They use less time in library but more time on mobile devices (Qiu and McDougall 2013). They search materials online and communicate online to facilitate their learning and finish an assessment.

The characteristics of mobile access are short time usage (5–10 min) and ubiquity. The screen of mobile devices also fits better with simple contents. Therefore, study materials with less complexity and short content are preferred in mobile learning. As shown in the survey conducted in 2012 (in Appendix A), the majority (81 %) of students who studied economic subjects before have met problems of misconceptions or understanding some of the economic terms in their studies. International students suffered more from this problem (Zhang 2012b). How to assist students in overcoming those barriers in their initial studies and engage them in their economic studies? This was the initial drive of the design for TIPs project. To facility efficient learning, multimedia materials are developed for economics threshold concepts (Zhang 2012b). These teaching materials are designed for mobile app (with short contents and small file size). Problems in real cases engaged student learning (Dabbagh and Dass 2013, see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning"). It also helps students to increase their learning efficiency and understanding (see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning"). To accomplish a flexible extension requirement, TIPs is also designed with separated contents design and app design, which can be easily expanded into any other subject or discipline. The design of flexible contents and extendable application are introduced in the following sections.

## 3.1 Flexible Contents for Mobile Devices and FTF Teaching

Cartoons and animated teaching materials have a significant positively influence on learning efficiency and understanding (Connor 2009; Stephenson and Warwick 2002; Zhang 2012b; Kennedy et al. 2013). They help break the "7 minutes rule" of focus in class (Zhang 2012b). They engaged students into class discussions (Ostrom 2004, see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning") and help remedying the misconceptions (Akamca et al. 2009; Kabapinar 2005; Keogh and Naylor 1999). Multimedia materials also increased learning efficiency dramatically (Zhang 2012b). Some interactive and communication functions of multimedia learning contents are also attractive to students. Combined with external links, other game platforms, or social media, multimedia contents can play more important roles in teaching and learning (see ▶ Chap. 25, "Mobile Education via Social Media: Case Study on WeChat", Bredl and Bösche 2013; Sung and Hwang 2013).

To engage students in economics study and increase their learning efficiency, animations and cartoons in real-world cases are developed for TIPs. To facilitate the mobile access, all the developed animations are less than 1 MB (megabyte) in size, which makes them easier and faster to be accessed. The animations and cartoons are designed in a concise case without long text or verbal explanation to remove the barriers for international students and students with disability. A picture is worth a 1,000 words (Larive 2008, see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning"). A good designed animation is worth millions of words. Mobile devices are also good platforms for multimedia contents with smaller

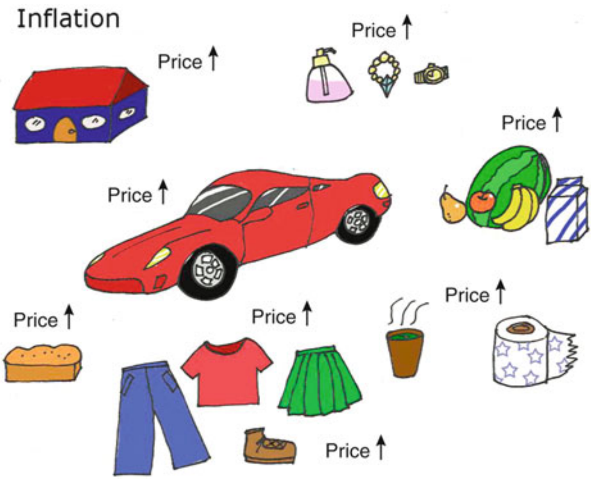



**Fig. 1** Developed cartoons for economics teaching (Source: from Tutors in Pockets in this study)

screens but high calculation capabilities. Figure 1 gives an example of the developed cartoon.

As shown in Fig. 1, this animated cartoon (view animated version in Tutors in Pockets application from Google Play) shows that inflation is a continuous increasing of goods prices with most goods and services on the market. The increasing of only one or several goods prices is not inflation. The price index in each country is usually calculated from the prices of house or accommodation, cars or transportation, foods and drinks, clothing, living materials, luxuries, and others. The price index is used to calculate inflation rate. All of the knowledge and key concepts are included in a simple animation (Zhang 2012b). The barriers of studying the difficult concepts are also reduced by friendly and colorful cartoons. Students can learn as much as they want based on the given knowledge base. They can also extend the readings when they find it interested. In the first version of TIPs, 80 similar animations and cartoons lined to 200 economic concepts were developed for the mobile application (Zhang 2012b, see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning").

To provide an equal access to those developed teaching materials for the students who use different mobile devices or without a mobile device, the teaching materials are also adopted in lectures and tutorials. These developed animations and cartoons can also be used for class discussion or as part of exam questions that help students understand some complex materials or process (Zhang 2012b). As shown in Appendix A, students found these materials have positive influence on their learning, which corrected misconceptions, engaged them into discussion, engaged them in Economic study, helped on better understanding, increased learning efficiency, increased long-term memory, and increased overall performance in the adopted subjects. Due to the interviews conducted in 2012 (Zhang 2012b), lecturers and tutors also found these materials useful in their teaching. Students also indicated that the adoption of these materials made them interested in the subject study


| Demand for X (Coffee) | | Supply of X (Coffee) | |
|---|---|---|---|
| 1. Prices of related goods | | 1. Prices of related goods (produced) | |
| a. Substitutes (Tea) ↑ | ↑ | b. Substitutes (Tea) ↑ | ↓ |
| c. Complements (Milk) ↑ | ↓ | d. Complements (Coffee leaves) ↑ | ↑ |
| 2. Expected future prices ↑ | ↑ | 2. Expected future prices | ↓ |
| 3. Income ↑ | ↑ | 3. Prices of factors of production ↑ | ↓ |
| 4. Expected future income and credit ↑ | ↑ | 4. Technology ↑ | ↑ |
| 5. Population ↑ | ↑ | 5. The number of suppliers ↑ | ↑ |
| 6. Preferences ↑ | ↑ | 6. The state of nature ↑ | ↑ |

**Fig. 2** Using flexible materials in lectures and tutorials (Source: from Tutors in Pockets in this study)

too (see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning"). Designed in small file size, these materials are easy to be used in lectures slides, tutorials discussions, or exam questions as well as in mobile applications. Figure 2 shows a scenario of using these materials in lectures and tutorials.

As shown in Fig. 2, the simple cartoon with table shows a real case study on four basic concepts in economics: substitutes, complements, change of demand, and change of supply. Tea is a substitute to coffee, which means the increasing of consumption on tea will replace the consumption on coffee (for general person). On the other hand, sugar and milk are complements for coffee, which means the increasing of consumption on coffee will also increase the consumption of sugar and milk (ceteris paribus – if all the other things are the same). The table below shows the factors that will change the demand curve and supply curve of coffee. The simple case study helps students understand better how to solve questions in real case or exams. This cartoon also increased group discussion in the class. Students replace the coffee, tea, sugar, and milk with any other goods and services that they are familiar with. They are interested in the subject and concepts instead of learning from a long text paragraph or asked to remember all the possible factors. Students also indicated the cartoon helped on understanding and efficient learning.

The mobile learning method also provided them a quick and easy way to link the knowledge with any searching website or engine with similar concepts or case study. Some of the concepts in TIPs have links to authorized website, such as Reserve Bank of Australia (RBA) or Australian Bureau of Statistics (ABS).

Videos and cartoons are also supported in TIPs. However, due to the size and speed issue in mobile teaching and learning and the high costs of video access without WIFI connection (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"; Zhang 2012a), videos are removed from the second version of TIPs (the function is still active if any video needs to be uploaded or linked in any concepts).

All the developed animations and cartoons are freely accessed by all tutors and lecturers in economics. A total 80 animated cartoons or figures were developed for 200 economic conceptions in the first version. The flexible design of these materials makes it fitting well in lecturers, tutorials, and examinations, which also provide equal access by all students and staffs. The IOS (originally iPhone operation system) version with first TIPs is designed with online part only. Student can access all the text contents in this mobile application. But for any figure or animated materials access, students need to link to the server to download it. Students can learn from the current knowledge lists or search any concept via searching function in the application. Some concepts have tables, animated cartoons, formulas, or videos. And some of them have links to outside authorities (such as Reserve Bank of Australia or Australian Statistics websites). Student can also update their knowledge database by clicking the "update" button in settings page of the application.

It is usually recommended that the students have a WIFI (a local area wireless computer networking technology) connection when they update the application or view videos during study because of the high costs of mobile connection (Zhang 2012a). Therefore, the first version of TIPs are limited by mobile signal and connection to server. This problem is solved in the second version on both IOS devices and Android devices. To achieve flexibility in terms of access anytime and anywhere and extending to other disciplines, the software application is also designed in a flexible framework.

## 3.2 Application Design for Flexibility and Extendibility

Technology problems and wireless access are one of the major problem facing mobile learning (Peng et al. 2009; see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). All of the developed mobile learning applications are limited by the capability of mobile devices and network broadband during the studied periods (Alley 2009; Kwon and Lee 2010; Peter and Gina 2008; Lagos et al. 2007). This project is also limited by current technology capability and wireless coverage in Australia and globally. Wireless coverage and broadband capabilities of these wireless connections are still a problem in some regions (Zhang 2012a). An application with only online or offline function will lose the advantages of flexibility and ubiquity for m-learning (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning").

To implement a better "anywhere" and "anytime" mobile learning system, both online and offline functions are important in the structural design (see ▶ Chap. 1, "Design of Mobile Teaching and Learning in Higher Education: Introduction").

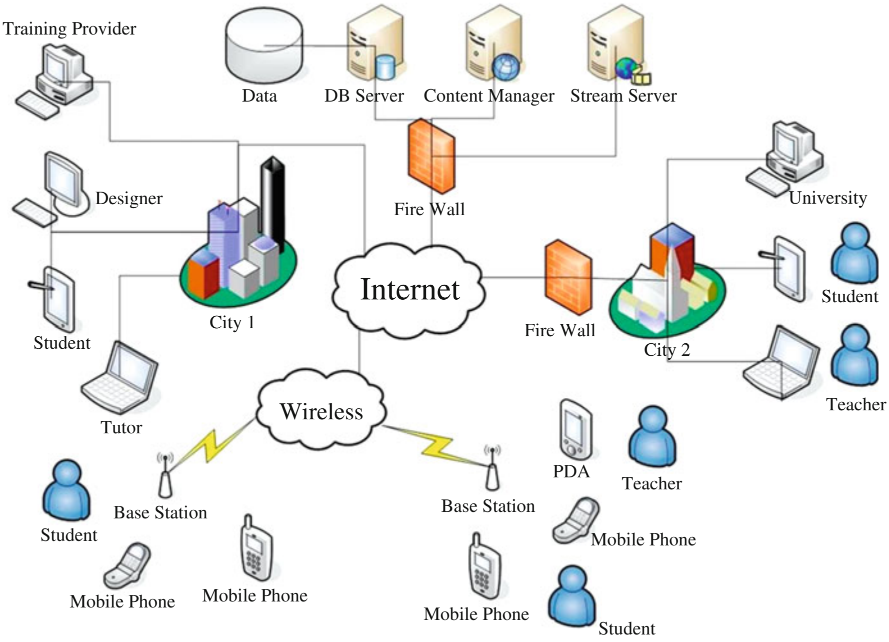



**Fig. 3** Designs of TIPs (Source: from the author)

Therefore, TIPs 2 adopted both online and offline parts in its IOS and Android versions. This provided a switch between online (with wireless connection for download and update) study and offline (without wireless connection for study anytime and anywhere) study functions.

As initial data are installed into mobile devices, users can use the application without wireless connection. But the initial download file size is much bigger than the first version of TIPs. Students are recommended to have WIFI connection when they download TIPs from UOW (University of Wollongong) server or Google Play online application store. Students can search, learn, and review any concepts in TIPs anytime without mobile signal or Internet connection after the download. This function secured learning anytime and anywhere. When there is an update on new contents or database, students need to connect to Internet to download those new database or contents by clicking the update button in the settings page, which will not influence the students' learning process anytime and anywhere. The design of the project implemented learning and access anytime and anywhere. Figure 3 shows the project structural design for TIPs. As shown in Fig. 3, teachers and designers can access the system via Internet in any city or region. Students can also learn from any place with Internet or mobile signal connection wherever the data and content servers are located. This design was adopted in both version 1 and version 2 for IOS and Android versions in TIPs project.


**Fig. 4** UI of TIPs (Source: from Tutors in Pockets in this study)

The project is designed as a flexible framework for teaching materials, which is easily updated or expanded into other disciplines if needed. Any mobile device that supported multimedia materials can be used in this application, such as video, audio, picture, web-link, and text. Structured conceptions are saved on a database (DB) server and can be downloaded into mobile devices as standalone data source. The content manager is on a university web server. Data can be updated by editor anytime through internet upload. The multimedia materials are saved on a stream server. The application also provides web access to external links (such as Reserve Bank Australia website) or online video providers (such as Youtube). End users can update their database by downloading new content from the servers anytime and anywhere. Due to a research on students' mobile devices, there are more than 95 % mobile users in the University of Wollongong use Apple or Android devices (Zhang 2012b). TIPs app is available for Apple mobile devices and Android mobile devices.

To facilitate 5 min learning (efficient learning), functions and contents are designed in a simple format. Each conception in this program consists of definition, multimedia materials, formula, case studies, or external links that can be read within 5 min (see ▶ Chap. 1, "Design of Mobile Teaching and Learning in Higher Education: Introduction"). Figure 4 shows the UI for conception list, learning page, and settings page for TIPs. Figure 4 shows the case of one important economic threshold concept – opportunity cost. This content is composed with a definition of opportunity cost; animation shows a scenario (Zhang 2012b), and a cartoon with formula in a real case study to calculate opportunity cost. All of these materials can be learned within 5 min in hand. Compared with the text case study in economic textbook, the efficiency of learning is greatly improved (Zhang 2012b). TIPs was also designed with a friendly interface with a list of alphabetic ordered conceptions. The search function is very easy to use by users with any key word input at the bottom of the main screen or scroll down by initial letters on the right side of the main screen. The update function is inside the settings page in the right-up corner of the application main screen, which shows the current version of software, current version of database (DB), and contributors' information.

The Apple application project is planned by four stages: course materials design and development (October, 2011 – January, 2012), mobile application design and development (January, 2012 – June, 2012), test and release (June, 2012 – October, 2012), and feedback collection (October, 2012). The second project on Android system was designed from February 2013 to October 2013 for development, testing, releasing, and dissemination with the internal and external team.

Each progress of the projects is conducted and finished successfully under the scheduled time length. As a result, total 110 animations and cartoons for threshold economic conceptions are developed for TIPs 2. Total 204 enhanced economic concepts and case studies are composed into designed database for mobile application. Structured database and system are designed. The mobile application was developed by an external partner (Beijing Oriental Caesar Technology Co., Ltd). Function tests and integration tests are conducted coordinately by the whole team. The application (Apple version) was released to students in August 2012. Application was introduced to Econ101 first year Macroeconomics and Econ306 third year subjects. Interviews for students and teachers were conducted in February 2012 for the developed multimedia materials. Student survey on the mobile application was collected online from August to October 2012 (see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning").

The results (in Appendix A) showed that nearly two-thirds of the surveyed students used using iPhone. There is a strong need for Android system application (13 requests from the survey, nearly one-third of the students who participated in the survey). Therefore, an Android version of Tutors in Pockets was developed in February 2013. The Apple version is available on UOW mobile application site (apps.uow.edu.au) and Android version is available for free download from Google Plan, the online application shop. The project achieved "anytime" and "anywhere" goals by introducing a combination of online and offline parts within the application. Students found the application has very positive influence on their learning (see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning"). The evaluations and results of this project are discussed in the following section.

## 4 Results and Feedback

To study the influence of this application on students' learning, both face-to-face interviews and online surveys were adopted (see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning"). Total 17 interviews were conducted in February 2012 to collect feedback for developed teaching materials. Zhang (2012b) presented the results from the interviews. Another online survey was conducted from October 2012. The results are shown in Appendix A.

As shown in the report (in Appendix A), 4/5 students had some problems in understanding economic terms or conceptions in their studies. There is a great need for mobile assisting tools on basic conceptions. Majority of students (76 % of the surveyed students) agreed that the animations and cartoons helped on better understanding of some concepts or cases (Zhang 2012b). More than half of the students agreed that these materials corrected their misconception problems and helped on long-term memory. Nearly half of the students agreed that the multimedia teaching materials increased their learning efficiency and make them feel interested in their studies.

Majority of the students that used TIPs (84 % as in Appendix A) agreed that this application increased their learning efficiency and help them utilizing the small time slots (such as waiting for bus) to study. More than half the students agreed that it engaged them into discussion with others, helped them study anywhere, and also helped them understand better during the lectures and tutorials. The objective evaluation from students' performances also showed that TIPs and the multimedia materials adopted in class have a positive influence on tutorial marks, essay marks, final exam marks, and overall subject marks. Student groups with TIPs and multimedia materials in class scored an average four marks higher than the groups without introducing TIPs. TIPs also have positive influence on all the individual marks. Students also indicated that "I had no idea what economics is but now I am interested in economics" (see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning"), which was a major achievement from the project. Another reply from disabled student shows the developed multimedia materials were also helpful for students with disabilities: "As a RA student I strongly believe that these cartoons would help, as I learn more from visual examples than reading big words that mean nothing to me" (see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning").

The result of this project has been presented to the Teaching Excellent Committee (UEC and LETs subcommittees), UOW TV, UOW media, economics school seminar in University of Wollongong, and others who are interested in teaching and learning with new technologies and methods. TIPs can be easily adopted by any discipline or subject with its flexible design of functions and database. It is also easy to expand and extend with its flexible contents. It has attracted interests of further collaboration from academics and universities globally.

## 5 Future Directions

TIPs provided a complemented teaching method for Economics teaching. It helped the first year students and international students solving the misconception problems and better understanding. It also increased learning efficiency for all students. Having adopted an online and offline switching design, it implemented real "anytime" and "anywhere" study (see ▶ Chaps. 2, "Characteristics of Mobile Teaching and Learning," and ▶ 1, "Design of Mobile Teaching and Learning in Higher

Education: Introduction"). It allowed students utilizing small time slots when waiting for friends or on transportation to learn some concepts. The new application developed in this study has received very positive feedback from teachers and students. It is expected to increase learning efficiency, help on understanding of basic economic threshold concepts, engage students in discussion and economics study as well as increase their performances in study (see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning").

As a result, TIPs has positive influences on correcting misconceptions, increasing leaning efficiency, enhancing understanding, improve long-term memory, engaging discussion and interests, and increasing performance in subjects (see ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning"). It also helps students with disabilities in their learning (Kennedy et al. 2013; Cumming et al. 2013; Zhang 2012b).

Further projects could focus on mobile communication for students and teachers. New technology or devices can also increase the learning experiences on mobile devices (see ▶ Chaps. 53, "Advanced Image Retrieval Technology in Future Mobile Teaching and Learning," and ▶ 21, "Adoption of Mobile Technology in Higher Education: Introduction"). TIPs can be easily expanded into other disciplines due to its well-designed flexible and extendable structure. It also has a potential to be commercialized in the future.

## 6 Cross-References

- ▶ Adoption of Mobile Technology in Higher Education: Introduction
- ▶ Advanced Image Retrieval Technology in Future Mobile Teaching and Learning
- ▶ Characteristics of Mobile Teaching and Learning
- ▶ Cross-Country University Collaboration Barriers and Solutions
- ▶ Design of Mobile Teaching and Learning in Higher Education: Introduction
- ▶ Mobile Education via Social Media: Case Study on WeChat
- ▶ Student Feedback in Mobile Teaching and Learning

## Appendix A – Survey Results for TIPs

**Did you have any difficulty or problem in understanding some Economic concepts before?**

| # | Answer | | % |
|---|---|---|---|
| 1 | Yes | | 81 % |
| 2 | No | | 19 % |
| | Total | | 100 % |

**Do you use mobile phones?**

| # | Answer | | % |
|---|---|---|---|
| 1 | Yes | | 94 % |
| 2 | No | | 6 % |
| | Total | | 100 % |

**What mobile device(s) you are using?**

| # | Answer | | % |
|---|---|---|---|
| 1 | iPhone | | 61 % |
| 2 | Android and others | | 39 % |
| | total | | 100 % |

**Is English your first language?**

| # | Answer | | % |
|---|---|---|---|
| 1 | Yes | | 21 % |
| 2 | No | | 79 % |
| | Total | | 100 % |

**Do you think the animations or cartoons in this subject have positive influences on the following aspects of your study?**

| # | Answer | | % |
|---|---|---|---|
| 1 | They corrected some of my misconceptions or misunderstandings | | 53 % |
| 2 | They engaged me in a discussion with other students or teachers | | 38 % |
| 3 | They engaged me in Economic study or make me feel interested in this subject | | 42 % |
| 4 | They helped on better understanding of some concepts or cases | | 76 % |
| 5 | They helped on long-term memory | | 51 % |
| 6 | They increased my learning efficiency | | 49 % |
| 7 | They increased my performance in this subject | | 31 % |

**How did TIPs influence your study?**

| # | Answer | | % |
|---|---|---|---|
| 1 | It increased my learning efficiency | | 82 % |
| 2 | It helped me study anywhere | | 64 % |
| 3 | It helped me study utilizing the small time slots (e.g. waiting for bus) | | 82 % |
| 4 | It helped my lecture/tutorial study | | 64 % |
| 5 | It made me feel interested in this subject | | 73 % |
| 6 | It engaged me in a discussion with other students or teachers | | 55 % |
| 7 | It increased my performance in this subject | | 45 % |

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# Uniqueness in Mobile Teaching Environment Design Methodology

# 20

## A Case Analysis on Nan Tien Institute

Chih-Hung Li, Yi Lu, and Zinian Li

## Contents



**Abstract**

This is a theoretical methodology, aiming to provide practical guidance by establishing a series of consolidated frameworks for designing a mobile teaching environment (MTE) tailored to a specific institution's settings. This paper also tries to apply the proposed theory to reality by providing a case study on Nan Tien Institute (NTI) so that a practical guidance will be given to NTI for its MTE's implementation.

It is the authors' understanding that by no means there would be a standardized designing method in MTE, which is usually sought after by MTE designers as their convincing reference. As a matter of fact, under the magic of age of standardization, MTE designers tend to follow the empirical experience, rendering one of the critical points ignored – uniqueness that their institution holds, which will be incarnated in this paper as the major benchmark.

The intention of the framework is to help MTE development methodology designers to reorganize and reexamine the institution's information regarding MTE for the precaution and proactivity.

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The frameworks are constructed based on their uniqueness in various dimensions; however, this does not deny any other form of methodology in this regard. It is well advised that any other form of methodology should take a close consideration of the uniqueness for its validation.

Upon the placements on frameworks, a concept of “weight” is introduced to leverage the varied importance of the proposed uniqueness. This is used to quantify the result of placement as a whole. An application on NTI was provided to exemplify the ideas.

It should be noticed that this paper aims to provide quantitative solution, yet it is based on qualitative data due to the insufficiency of validated data. Therefore, the further follow-up researches are welcome to contribute to this database establishment.

## 1 Introduction

Nan Tien Institute (NTI) is an institution established by Fo Guang Shan International Buddhist Order from Taiwan and registered with the Tertiary Education Quality and Standards Agency (TEQSA) of Australia to provide tertiary education to students all over the world. It is also one of the five higher education institutions funded by Fo Guang Shan International Buddhist Order.

NTI’s goal is to:

- Provide quality higher education in the twenty-first century for local and international students.
- Nurture compassion, creativity, adaptability, flexibility, and morality in students through a holistic approach to learning.
- Enrich cultural and community life and promote the philosophy and harmony of Buddhist wisdom in public life.
- Encourage students and staff to work cohesively in harmony and make a constructive contribution to humanity and society.
- Provide a conducive environment for learning and foster self-awareness and self-education, applying the philosophy of Buddhist wisdom in daily life.

In September 2010, NTI became a higher education provider and started the class of the first group of students on March 2011. To achieve our goal above, NTI tries to provide the most up-to-date technology and way of teaching for students to learn as they need. Also as a new institution, NTI tries to follow the trend of cloud computing era to provide the online education to students who learn by distance. The trend of teaching method is changed from the single way of face-to-face delivery in the classroom to interactive communication through all sorts of multimedia networks. Students will learn from any environment as long as they can reach the material of what they want to study.

There are several factors making NTI a unique institution. Firstly, the number of the courses is limited; thus NTI is continuously enriching its course structure. Secondly, the disciplines of courses are unique in order to be distinguished from the courses of other educational institutions. The third is that the geographical location of NTI is not in the high-density population area. Local student number growth will be limited by the size of regional community. Furthermore, NTI is sponsored by the charity donation of devotees, which is reliable yet may not be sufficient for exponential growth in its initial stage as a commercialized institution.

Online education through MTE seems to be a way to resolve the challenges NTI has and also be following the trend of education transformation in the world.

As a new and unique institution, the first attempt is to discover a way of how NTI can conduct an online education with limited resources and geographically disadvantaged situation and other disadvantages.

In this paper, we, as the MTE development methodology designers, have been encountering several difficulties, such as user's resistance, inaccurate cost forecasting, inability to foresee the risks, etc. The authors believe these issues are universal to education industry; therefore, this paper is established to deal with them and is summarized to propose a systematic methodology to fit in institution's uniqueness, with application on our own.

## 2 Methodology: Framework Establishment

This section reincarnates the idea and theory of the foundation for this paper by establishing a set of frameworks. These frameworks aim to provide MTE development methodology designers the guidance of how to properly and correctly understand a specific institution regarding MTE according to the parameters summarized through uniqueness.

These frameworks are formed with two axes each, of which reading is qualitatively presented for simplification of placement operated by MTE development methodology designers.

The uniqueness the MTE development methodology designers should take into consideration may vary by different situations; therefore, the uniqueness itself can be uniquely tailored. However, the following six aspects (Berge 1998; Bocchi et al. 2004; Goodyear et al. 2001; Ko and Rossen 2010; Kim and Bonk 2006; Murphy et al. 2011) are suggested as the basic and fundamental uniqueness in education sector/provider:

1. Institution development scope
2. Business objectives
3. Course content cost
4. Teaching resources
5. Targeted student
6. Institution's technology acceptance level

The above list ranges from the strategic level to the operational level, with inclusion of both institution and technology dimensions. They are universal to most of the education providers, yet each education provider has unique situation that draws attention to.

It is important to understand that currently it is costly to accurately quantify the impact or risk in the frameworks created below, and the dimensions used in the frameworks are, by no means, fixed. MTE development methodology designers are encouraged to justifiably develop their own frameworks with dimensions.

## 2.1 Institution's Development Scope

Regardless of the industry, the institutional development scope has been one of the most critical and inevitable factors to consider when an institution is about to make a change or planning the future (Ko and Rossen 2010). However, what really matters when bringing on the table covers various aspects, such as the institution positioning, market competition, financial situation and timeframe, etc. (Allen and Seaman 2011). Institutions have to be able to identify and understand all these factors and come up with the scope that is practically reflective to the reality.

The period for this scope, which stems from business and is becoming increasingly sensitive to IT or technology industry, has been given more attention from authors' perspective based on empirical research (Park et al. 2013; Stark 2011). Given that the technology is continually shortening its lifecycle, it is more reasonable and realistic to scale the scope timeframe within 3–5 years. MTE, as one of the extended applications from information technologies, may need to update and enhance its settings (including institutional structure and technological infrastructure) to adapt into the possible new trend after the current period, as modern technology is evolving and revolutionizing much more quickly than expected (Hayes et al. 2012). By that time, MTE development methodology designers may need to review the scope and provide a rebalanced guidance accordingly.

However, going into all the aspects in this would increase the complexity exponentially along with every dimension added. Thus, as mentioned before, discussing two aspects is more ideal in order to achieve a purpose-oriented and practical placement for institutions. Indicated in previous studies (Lorz and Willmann 2013), scope and size have drawn more attention over the years throughout various industries and therefore have been chosen in this framework for the vertical axis and horizontal axis, respectively.

The current size of the institution is considered critical when institutions are planning to develop an MTE. The MTE's establishment generally brings changes to the education providers in aspects such as institutional structure, which in turn generates levels of risks imposed on MTE. As a matter of fact, the larger the institution is, the higher risk the implementation of MTE will be, given that other factors are fixed. The reasons for this reside in but not limited to the following points:

- A larger institution needs more investment on MTE, including financial and human resource, etc., which may lead to lower ROI (return on investment) rate for the early stage.
- A larger institution is normally making more effort and taking longer time to implement a new MTE, as the difficulty to convert the users who are used to teaching and learning traditionally may be larger than those of smaller size (lesser users). This factor may cause difficulties for initial decision-making.
- A larger institution is facing much more complex user's resistance scenario when a change occurs. It needs more contribution on analyzing the scope of change management and limitations of business continuity during the change, as a change manager has to consider the tolerance bottom line (Luftman et al. 2004) more carefully than those of smaller size. (*In some cases, if the user's resistance to a change is going out the control that managerial and operational support can no longer carry on the change process, the change manager will report to decision makers who will have to review the change decision itself and make the proper adjustments swiftly to avoid massive chaos, disorders, productivity loss, potential employee turnovers, and any other risks due to the change*.)

The current institution size ranges from "small" to "large" on the vertical axis of the framework and will be analyzed with the horizontal axis, which is presented from "conservative" to "aggressive."

How fast the development is or how big an institution wants to be compared to its current size in a fixed timeframe is always the factor that cannot be ignored when building up an MTE, as it directly affects what and how the MTE should be designed and constructed. In fact, the more aggressive the development is, the riskier the implementation of the MTE will be, given other factors are fixed. The following reasons may help to explain this statement:

- An aggressive development requires more and growing support on MTE, and this brings about the risk that the investment may not be constant or sustainable due to potential subprojects that may occupy/share the resources.
- An aggressive development generates bigger changes and results in issues on user adoption rate. Implementation of the MTE has to be aligned with development and handle these change management issues.

Grounding on the analysis above, it is practical to draw out the framework, with the level of risk for different placements (Fig. 1).

## 2.2 Business Objectives

Other than the above development scope, the business objective also attracts significant attention. It is necessary to understand the MTE-related business objective an institution wants to achieve. Hsu (2013) has pointed out that different

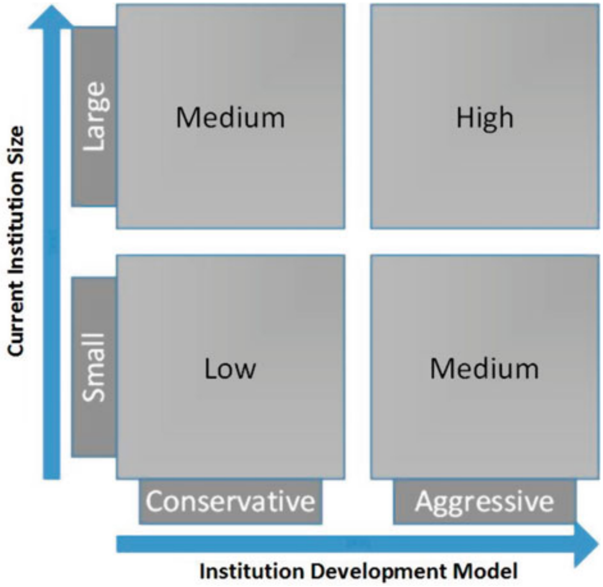


**Fig. 1** Institution's development scope (Brief instructions on the framework by "vertical" and "horizontal": Small and conservative: in this scenario, the institution will face the lowest risk within this framework; Small and aggressive: in this scenario, the institution will face the medium risk within this framework; Large and conservative: in this scenario, the institution will face the highest risk within this framework; Large and aggressive: in this scenario, the institution will face the medium risk within this framework)

business objectives through MTE would lead to different levels of risk to deal with (or the effort needed to overcome the risk). To break this down, the following questions are worth asking to institutions themselves:

1. Is MTE one of the must-have platforms to deliver teaching resources within the development scope? (Importance of MTE)
2. What is the proportion of MTE course content in the entire institution? (Online/offline content ratio)

Establishing the framework is based on answering these questions. In order to answer the first question, it is quite critical for MTE development methodology designers to figure out the below aspects:

- Understand to what extent the institution is going to transfer from the traditional teaching method to MTE or online. Will MTE be a complementary (optional/selective) or strategically critical (compulsory) delivery method?
- How to qualify students who study through MTE?

If the answers indicate that the MTE will be one of the main platforms and the quality of MTE in terms of academic and technical (will discuss later) will be controlled properly, the importance of MTE will be marked as high and vice versa.

As for the second question, there is a list of things to consider as well:

- The higher proportion of MTE course content means the more investment on technical infrastructure (network, servers, storage and e-content preparation, etc.).
- The higher proportion of MTE course also means the more workload of daily operations and ongoing maintenance there will be, not only in technical part but also in academic and managerial part, which links back to the first question.

MTE development methodology designers are suggested to talk to the management level for these details and then place the institution in the framework proposed below (Fig. 2):

## 2.3 Course Content Cost

Cost is always part of the center of concerns. MTE development methodology designers need to be aware of the budget and tangible and intangible cost before practically implementing MTE. This part is taken out as a follow-up uniqueness from the business objectives to discuss the details of cost from different perspectives.

As mentioned above, the online/offline content ratio affects the level of attention and effort inputs, yet this section discusses attributes of the course that are planned to be delivered through MTE, which deals with the implementation and operational cost of the MTE over the time. Designers are suggested to take this into consideration well before planning it by closely cooperating with decision makers for detailed requirements in the very initial stage of the MTE development and then prepare the associated reports to stakeholders for budget approval.

The selected attributes of the MTE course are categorized as:

**Lifecycle length**: the frequency of the course content will be updated as the knowledge updates, depending on the content's nature. The shorter lifecycle length of the content drives up the ongoing cost directly (Kukulska-Hulme 2012). For example, the knowledge updating period of fundamental and traditional sciences (such as maths, physics, and chemistry) is relatively longer than that of applied sciences (such as computer science, engineering, and electronics) (Martin 2013). As a result, the shorter update lifecycle of the MTE-based course content has, the more budget and the tighter capital flow it requires as time goes on.

It should be reasonable to foresee that the technological cost (e.g., content recording and uploading, network consumption for video streaming) generated through updating process may be reduced as technology's maturity levels up, yet the physical/operational cost (such as video editing cost and academic inputs) is expected to remain the same.

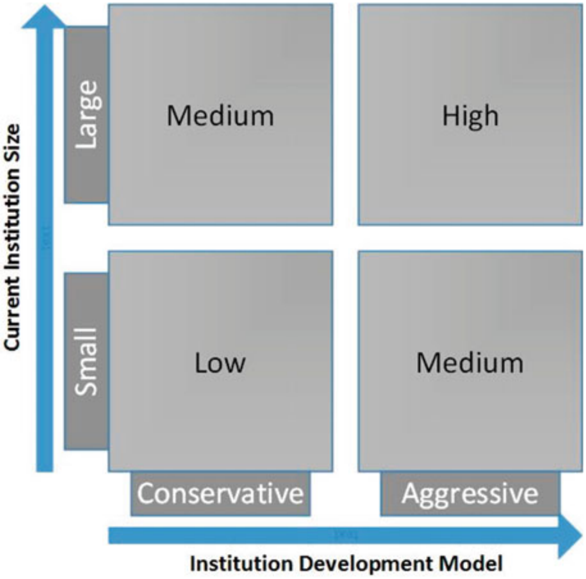


**Fig. 2** Business objectives (Brief instructions on the framework by "vertical" and "horizontal": Low and low: in this scenario, implementation of MTE needs to draw less attention as it has the least effect on institution; Low and high: in this scenario, the institution has not positioned the MTE as a compulsory teaching method yet will digitalize and mobilize its more course content. A few reasons may lead to this situation, for example, institutions may be holding a conservative attitude on MTE and just want to set up the MTE first to see the feedback from students before putting it into strategic level. Therefore, implementation of MTE needs to draw a relatively higher attention and efforts, of which most is on **technological limitations**; High and low: in this scenario, MTE will become a critical method for the education provider in the future's blueprint, while the institution has not decided to digitalize and mobilize the teaching significantly (this is probably because, e.g., the technological limitations are impeding the process of digitalizing and mobilizing the course content); therefore, implementation of MTE needs to draw a relatively higher attention and efforts in terms of **strategic positioning in academic development** as well as **user adoption/resistance**; High and high: in this scenario, the attention the institution will pay on implementation of MTE will be the highest, as it will be as high as the business level, which affects its survival)

**Click-and-play or live streaming**: MTE development methodology designers should understand the cost of different technical course delivery patterns (Carroll 2014; Ostashewski et al. 2011). Academic efforts (such as human resources cost of lecturers) occupy a considerable part of the total cost for course content. If a course is decided to be delivered through prerecordings (click-and-play), which means the academic cost is one off and fixed until this content update lifecycle ends. On the other hand, the academic cost for "live streaming" will be much higher than "click-and-play," as the cost is counted for every session delivered (Kulich et al. 2013).

Moreover, the cost gap between these two methods grows larger when it comes to the technological aspect. For instance, the technological cost for "click-and-play"

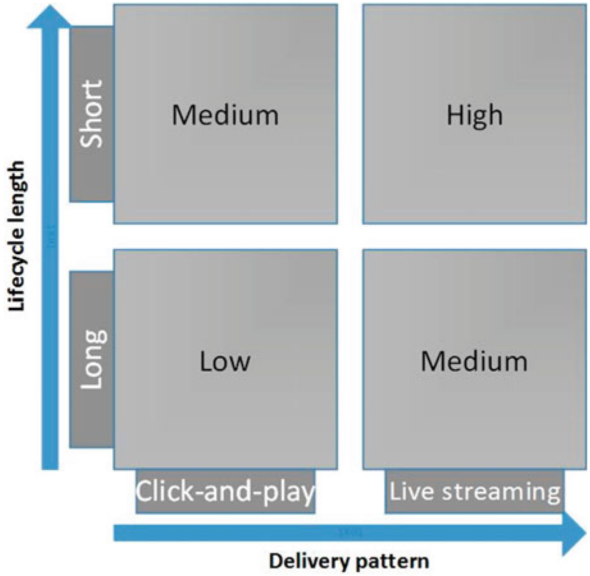


**Fig. 3** Course content cost (Brief instructions on the framework by "vertical" and "horizontal": Long and "click-and-play" oriented: in this scenario, the cost will be relatively low; Long and "live streaming" oriented: in this scenario, institutions will have to invest more on **IT infrastructures** for more stable connections and acceptable quality, while users also need to gain the access to the higher-speed internet; otherwise, there may be a higher MTE drop-off rate from the user side; Short and "click-and-play" oriented: in this scenario, institutions will have to invest more on the **academic** and **operational** part for the content's shorter update lifecycle to keep delivering up-to-date knowledge to users; Short and "live streaming" oriented: in this scenario, institutions will have to invest on both **IT infrastructure** and **academic** and **operational** part, and the total cost will be the highest, as stated on the above analysis)

is paid off mainly by education providers in IT infrastructure (including servers, storages and network, etc.) procurement, maintenance, and upgrade; meanwhile, the cost and the requirements of connection for users are affordable, regardless of the cost on mobile devices. However, in order to maintain a reasonable level of quality for delivered course in "live streaming" pattern, the technological cost will be boosted up dramatically for both education providers and users (Rutz 2012). The courses of "live streaming" are not instantly and real-timely accessible, and this delivery method is more sensitive to the network stability than "click-and-play." This is because there is no other time slot for content delivering when lecturers and students are seated and ready, yet the network is disconnected. Otherwise, the cost of changing time slot due the technical issues may be too much and unaffordable for both parties. Understandably, the courses of "click-and-play" are accessible whenever the users have the access to the Internet with network-enabled mobile devices.

Bringing back to the framework for this uniqueness, the above categories can be used for the two dimensions, as below (Fig. 3):

## 2.4 Teaching Resources Distribution

Another uniqueness that each education provider holds is how, what, and where are the teaching resources distributed. This uniqueness is used to help determine to what extent the institution will and should rely on the MTE.

Tertiary education has been increasingly more accessible to students in different locations. As a result, the past decade has witnessed the expansion and development of campuses in metro and regional areas. Institutions tend to have multiple campuses that are geographically separated locations to fulfill this development needs (Giemza et al. 2012).

> MTE development methodology designers should notice that even if the current situation or the development blueprint of the institution does not have the multi-campus included, it is still worth taking this uniqueness into consideration as proactive action for the future.

In this context, the associated teaching resources are more or less split and distributed in these locations; meanwhile, they are also interconnected and shared through some ways. Therefore, the dimensions that form this uniqueness are:

- The paradigm of geographical locations. A multicampus pattern itself has necessitated the MTE. For instance, given the reputation and education quality, more often than not, regional-based institutions rely relatively more on the remote or distant education than metro-based ones (Handal et al. 2013). This is because such institutions like New England University (2011) are less attractive to students because of their geographically disadvantaged locations. Therefore, on one hand, they are developing in metro areas to attract more students to come, and on the other hand, they are also expecting to broaden student sources through innovative teaching methods, such as remote/online education and MTE.
- How close/deep the interconnection and relationship among these locations and distributions are (Zeichner 2010). In most cases, the teaching resources, such as courseware stored in database or storages, can be easily accessed and shared through a secured network (e.g., the VPN tunnel). However, if the academic staff will have to travel between different locations to deliver the courses because of this shared teaching resource pattern or if the students have to travel from one location to another to attend the lecture or tutorial, these scenarios may drive up the need of MTE (Fig. 4).

## 2.5 Targeted Student

Different education providers have their unique marketing target according to their academic strength (e.g., courses they are offering) and preferences. However, this difference brings out the uniqueness in the user acceptance of MTE due to the situation and background they have (Kim et al. 2013), which is analyzed in this

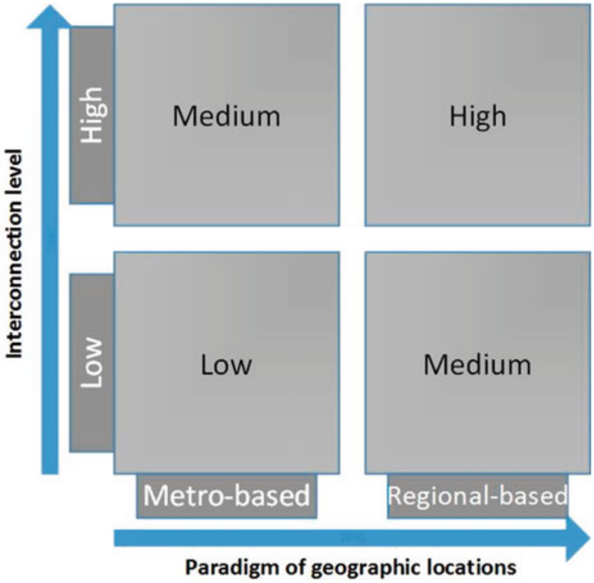


**Fig. 4** Teaching resources distribution (Brief instructions on the framework by "vertical" and "horizontal": Low and metro based: in this scenario, the need of MTE seems to be the least for this stage. MTE can be optional for the institution, and the methodology designer may talk to the management for the real needs and scope of MTE; Low and regional based: in this scenario, the need of MTE is marked as medium for this stage. The regional-based pattern necessitates MTE for its expansion of student enrolment; High and metro based: in this scenario, the need of MTE is marked as medium for this stage. Due to the high level of connection among the multicampuses, MTE seems to provide the solution to fill the gaps that are created by closely shared teaching resources; High and regional based: in this scenario, the need of MTE seems to be high. MTE is likely to help the institution to expand and develop if the implementation is properly designed and managed)

section. In order to place the institution accurately when trying to be precautious to the possible user resistance toward MTE, methodology designers are well advised to be aware of the students' allocation and then report to the management as early as possible.

The industry has been analyzing the statistics regarding the user acceptance and resistance toward an IT product/change over the years. The research shows that the background (e.g., the degrees and majors) and the age group tend to be the most influential factors in this regard. Therefore, this section takes these two as the vertical and horizontal axes separately.

Statistically, students with technology-related background (e.g., computer science) show higher acceptance of MTE, which in turns reduces the associated changes (including training and user resistance); students with non-technology-related background tend to be more reluctant to this change, which renders the MTE's implementation risky to be failed (Khaddage and Knezek 2011):

> It should be noticed that MTE development methodology designers should never equate the background to courses offered in institution, however, given that there is no effective method to complete this survey, and this equation is statistically justifiable, MTE development methodology designers can make the rough judgement until relevant survey and convincible statistics have been released.

On the other hand, research shows that the age group also statistically affects student's acceptance toward MTE. In general, given the background of students, there is a gradual increase on the curve that shows the acceptance rate, and the acceptance rate drops after a peak point (Venkatesh et al. 2003; Wu et al. 2011).

In the formation of the framework, the impact from background on the acceptance rate is displayed through amplifying the gap between the age groups. Therefore, instead of the shaped framework like other uniqueness, the framework for this is presented as area diagram, as below, where the shadowed area indicates the gap (Fig. 5).

## 2.6 Institution's Technology Acceptance Level

Finally it comes to the technological side, which has been discussed over the years since mobile teaching was introduced. To a large extent, the technological limitations, such as the network bandwidth, hardware and software performance, etc., have been the bottlenecks of MTE development so far (Short et al. 2014). These are directly affecting the final cost (mainly on intangible such as adoption rate, user's satisfaction, etc.). However, this section does not intend to repeat these pure technical discussions, as other researchers tend to focus on this aspect.

From an IT perspective, what matters the most is how to manage the IT product/service that is intended to be implemented for users (Cheon et al. 2012; Hur and Bannon 2013; Pollara and Kee Broussard 2011). In order to achieve this, user's acceptance level, which has been discussed earlier, is the key that should be paid attention to. Bringing back to the framework of this uniqueness, this key can be reflected through the following two indexes as a whole:

1. Current technical maturity of the institution: this index shows to what extent the current institution's technological structure is formed. Several questions can be asked to the institution itself for self-diagnosis:
   - Are the current IT infrastructures being less problematic? From a technical perspective, if the whole IT infrastructure is designed well with little issue and ready for add-ons like MTE components, then the implementation of MTE seems to be easier.
   - What is the current average level of user's satisfaction toward IT services? Even though the IT infrastructure is technically well established, users may be resistant to the IT products or services due to personal preference, non-friendly user interfaces, poor IT management or insufficient IT training, etc. This would somehow determine user's level of cooperation when MTE is introduced to them, which in turn affects the effective delivery of MTE.

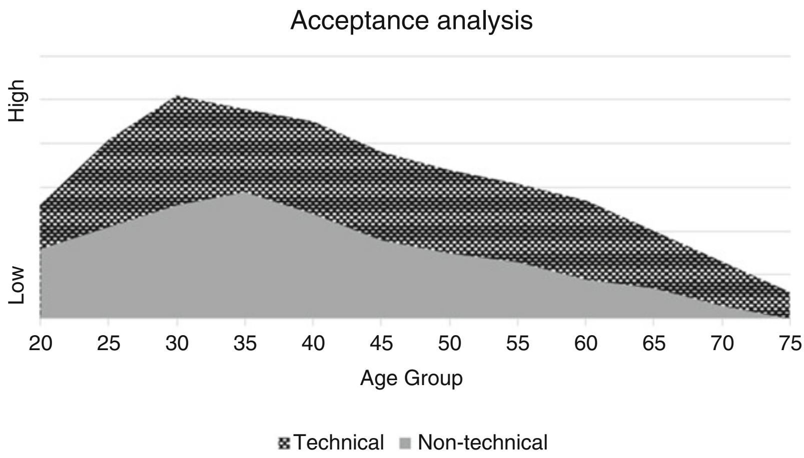


**Fig. 5** Targeted student (Brief instructions on the framework by "vertical" and "horizontal": Given the age group, students with technology-oriented background present higher MTE acceptance rate than those with non-technology-oriented background; Given the background, there is a gradual increase on the curve that shows the MTE acceptance rate, and after the peak point, the acceptance rate drops)

This is an index showing the overall maturity level of institution's readiness of MTE, presenting the predicted acceptance level regarding MTE from both institution and user side.

2. The technical complexity level of the planned IT infrastructure with MTE inclusion. This indicates how complex the technological infrastructure will be after MTE is implemented in the future. When discussing this index, methodology designers should be closely referring to the first uniqueness – institution development scope, as the larger the scope is, the more complex the IT infrastructure tends to be.

   Given the maturity level, the higher technical complexity in the future is expected to boost up a higher level of intangible cost. The institution needs to pay extra attention on the execution of MTE's development.

The framework established on this uniqueness is shown below (Fig. 6):

## 3 Guidance of Framework

The placements of the institution on these frameworks do not automatically reflect or provide MTE development methodology designers the practical consultation on what and how they should be aware of and what should be done accordingly. There should be a mechanism to guide how to extract valuable information from these placements.

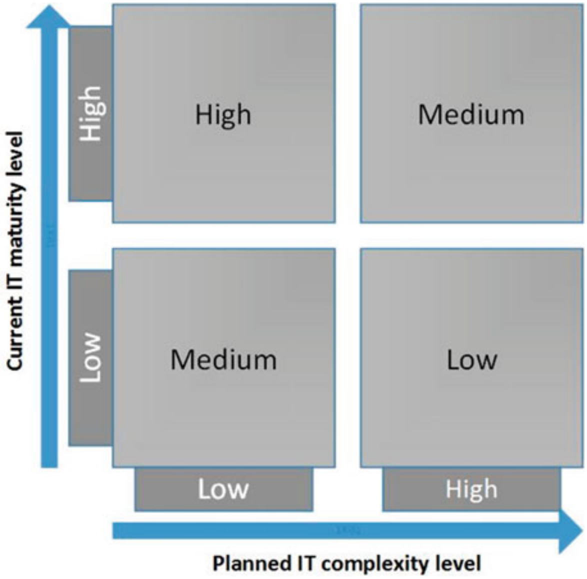


**Fig. 6** Institution's technology acceptance level (Brief instructions on the framework by "vertical" and "horizontal": Given the maturity level, the higher level of technical complexity is, the higher effort it needs to overcome the possible risks and issues after implementation of MTE; Given the planned technical complexity level, there is a gradual increase on the curve that shows the MTE acceptance rate, and after the peak point, the acceptance rate drops)

In fact, quantitative data is hardly accessible through these placements, given that the frameworks are not quantitatively established, and the relevant statistics are not industrially available. The qualitatively marked frameworks established in this paper have determined that simply drawing the conclusion on these frameworks as a whole seems to be unjustifiable. Meanwhile, each framework deals with different uniqueness, and it may not even the importance of the uniqueness due to the individuality of each institution. MTE development methodology designers have to stand one step back to be able to view the relationship between the frameworks and the institution's situation and then make the adjusted judgment.

In this context, a concept of "weight" is introduced to quantify the result of placements. The MTE development methodology designer should use this to guide themselves when making decisions and reports regarding the overall risk level, financial and institutional cost, as well as MTE adoption rate, thereby building up precaution and readiness to possible outcomes after implementation of MTE.

Since each institution has its different strategic and resource allocations on these uniqueness frameworks, it is more reasonable to assign a specific "weight" to the uniqueness to reflect the reality of the institution as well as the flexibility of the framework itself. The "weight" should be given to each framework based on the importance level of the associated uniqueness (e.g., 0 for not relevant, 1 for least important, 10 for most important). When assigning the "weight," MTE development methodology designers should be informed by the institution's current situation and development plan to guarantee the accuracy of "weight."

The "weight" can be used as a reference when measuring and forecasting the potential risk and outcome by applying it to the placement for a specific scorecard and then adding up the scores to receive the total score. By doing so, the purpose of quantifying the result can be achieved. However, to make this concept validated and effective, it is necessary to build up a set of benchmarks (preferably specific score) to show the score range groups representing the suggestions and consultancy. At this stage, due to the lack of supporting samples that need plenty of field studies with authorized data inputs in the further research, this paper presents a potential research topic and provides a possible guidance on its directions. Yet, by the time that the supporting database is established and the validation of this framework system is enhanced, it then will be more practical and beneficial to carry this theoretical methodology toward the further step.

## 4 Findings and Results

Being the first input of the proposed database, this paper applies the concept of “weight” to Nan Tien Institute (NTI) based on its visions on MTE as introduced previously, which aims to exemplify the use of this framework system in reality. The placements on the frameworks and the weights given to the uniqueness are concluded from NTI’s current strategic planning as well as the understanding of its reality.

NTI’s unique settings in the six aspects discussed above can be summarized as:

1. Institution development scope: NTI’s development tends to be aggressive in the next scope period, while the authors want to build up a holistic educational niche that has relatively small size.
   - The placement on the framework is marked as “medium” level of risk (“small” and “aggressive”).
   - The importance level of this uniqueness is scaled as 10 due to its survival criticality.
2. Business objectives: NTI has to allocate most of the limited resources into other business activity expansion and development, and the MTE seems to be in a relatively long-term experimental phase; therefore MTE will not be the major task to achieve within the scope at the moment. Meanwhile, the online/offline content ratio is marked as low.
   - The placement on the framework is marked as “low” level of input effort (“low” and “low”).
   - The importance level of this uniqueness is scaled as 3.
3. Course content cost: NTI tends to keep the update lifecycle of MTE-based course content “long” for multiple reasons, and the content’s form is set to be “click-and-play” to achieve the best flexibility for both academic staff and students.
   - The placement on the framework is marked as “low” level of cost (“long” and “click-and-play”).
   - The importance level of this uniqueness is scaled as 7 because the budget for this has to be controlled within an affordable range.

4. Teaching resources distribution: NTI has campuses in two different locations, a main campus in Unanderra Regional which hosts most of the teaching resources and a branch campus in Sydney Metro. One of its first priorities is to broaden the student source and increase its reputation and attraction. These two campuses have frequent information exchange and sharing with each other from technical and academic bases.
   - The placement on the framework is marked as "high" level of needs toward MTE ("high" and "regional").
   - The importance level of this uniqueness is scaled as 6 due to the rapid expansion on both campus construction and information exchange frequency.
5. Targeted student: Currently, the students in NTI are mainly aged in their 40s or older, and most of them have non-technological background. Thus:
   - The placement on the framework is marked as relatively "high" level of user resistance, and therefore the cost to achieve MTE adoption and to reduce the user resistance is deemed high.
   - The importance level of this uniqueness is scaled as 5, as it is critical to the success of implementation of MTE in the regard of change management.
6. Institution's technology acceptance level: NTI is concerned with this uniqueness, as throughout the institution, the IT development is still leveling up its service quality to a higher satisfactory standard, and before that, the user resistance generated will be the potential risk for MTE implementation and adoption. On the other hand, in response to the development blueprint and scope, the planned technical complexity level is deemed as "low."
   - The placement on the framework is marked as "medium" level of acceptance toward MTE.
   - The importance level of this uniqueness is scaled as 9, as it is critical to the success of implementation of MTE in the regard of change management.

Even though the detailed scorecard that hosts both placements and weight has not been established and validated, there are valuable information that can be extracted from the analysis above to help prioritize the six uniqueness. In the meantime, the indication of placements will also help NTI to be precautious and proactive accordingly when designing the MTE. As a summary, the following table is made, by the scale of weight (Table 1).

The corresponding priority management dealing with the table above has to be executed by following the order. Along with the placement result, a set of suggestions and methodology guidelines can be reasonably concluded as below:

- Designers should be aware of that the MTE's implementation should always be aligned with NTI's development scope, so as the risk level it may face.
- NTI should pay more attention on MTE, as NTI's current situation necessitates the MET to a large extent. It can be an effective solution to NTI's limitations mentioned previously.

**Table 1** Framework summary upon NTI

| | | | | | | |
|---|---|---|---|---|---|---|
| Scale of weight (priority) | 10 | 9 | 7 | 6 | 5 | 3 |
| Uniqueness | 1 | 6 | 3 | 4 | 5 | 2 |
| Placement | "Medium" level of risk | "Medium" level of acceptance toward MTE | "Low" level of cost | "High" level of needs toward MTE | "High" level of user resistance | "Low" level of input effort |

- NTI needs to reinforce its current IT maturity level by fixing its existing issues before moving forward. Otherwise, it would cause chaos and be more costly to fix when new challenges are introduced with MTE before old issues are resolved.
- User resistance will be one of the major concerns when implementing the MTE. Designers should try to mitigate this by effective change management, selecting user-friendly MET IT systems, providing appropriate training.
- NTI has to be patient for a successful delivery of MTE. This patience should be reflected in not necessarily limited to continuous financial investment but also in the top-down management support and the cooperation from both IT department and users.

By doing such analysis, the exemplification of the framework placement and idea of weight upon NTI is completed. As stated above, the result has been clear for NTI, which can be used as a reference when practically implementing the MTE in the short future.

## 5 Future Directions

This chapter is a groundbreaking point that introduces MTE development methodology designers a way to contemplate their way of designing, and the proposed theoretical methodology is fully flexible and varied by different needs/situations, which has the potential to help MTE implementation to be successful.

This chapter, however, has inhabited limitations by its natures of:

Subjectivity: each framework requires a placement of institution that is completed by MTE development methodology designers themselves. Even though the authors have emphasized that the involvement of management and strategy level is necessary to increase the accuracy of positioning, there are no strict rules to illustrate to what extent the involvement should be, and there is no mechanism to guarantee the authentication of the involvement.

Nonquantitative data: it is hard for MTE development methodology designers to place the institution on the framework as expected because most of the required parameters on the frameworks are determined by nonquantitative data, which has made this less completed.

Inadequate supporting data: this paper is a methodology to MTE methodology, and it requires industrial supporting data and involvement, yet missing, to validate it. However, it is believed that the more inputs from the reality, the more accurate the placement and result will be.

Ideally, the authors and concerned researchers will start the follow-up research to refine the framework as soon as the validated data has been collected and come up with quantitative frameworks as well as the scorecards of "weight," thereby officially introducing the scoring system with corresponding solutions and suggestions. By that time, this paper and the follow-up papers would be more valuable to the MTE design methodology.

## 6 Cross-References

► Characteristics of Mobile Teaching and Learning
► Design of Mobile Teaching and Learning in Higher Education: Introduction
► Designing a Mobile Applications Curriculum: Overview
► Development of Mobile Application for Higher Education: Introduction
► Student Feedback in Mobile Teaching and Learning

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# Part III

# Adoption of Mobile Technology in Higher Education

# Adoption of Mobile Technology in Higher Education: Introduction

# 21

Jun Hu

**Abstract**

With the evolution and upgrade of both telecommunication infrastructure and end user's devices, more and more students in higher education possess their own mobile devices connected to Internet with moderate computing power which burst the urge of mobile teaching and learning to allow people study from anywhere at any time. In January 2013, education apps shared 10.55 % of all active apps on Apple App Store, with 40 billion apps downloaded from the Apple App Store in early 2013. Although there are still many debates and barriers for mobile teaching and learning in the current stage such as the efficiency comparison to the traditional face-to-face teaching and the high costs of mobile data access and high costs of smart mobile devices, it is widely acknowledged that mobile devices have changed the style of living and learning especially for new generation. Therefore, the pioneers of adopting mobile teaching and learning around the world shared their experience from their practices and class with all the others to lead the way to better future mobile teaching and learning design and implementation.

The percentage of the world's population covered by a mobile cellular signal increased dramatically since 2000. The number still keeps increasing with a fast growth rate now. The capabilities of mobile devices are greatly enhanced too. With more and more mobile devices used by students, there are great needs of mobile learning from new generation. In January 2013, education apps shared 10.55 % of all active apps on Apple App Store, with 40 billion apps downloaded from the Apple App Store in early 2013. Mobile devices have changed the style of living and learning.

The adoption of mobile technologies in teaching and learning has experience more than a decade from the very old types of mobile devices to smart phones.

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Educators from universities, schools, and educational institutions have designed and adopted many different mobile education models and methods in different countries and different disciplines. This is an iterate life cycle with design, development, test, and improvement. All the current mobile applications have been through these processes and enhanced during the long journey. As a result, the adoption of mobile learning in teaching and learning is now matured than its initial stage and has benefited many students and learners in higher education and other industries.

Mobile teaching and learning (M-learning) has been introduced into higher education for many years. Some of the pioneer educators and designers from very different disciplines and countries have shared their practices and experience in the following chapters. Some of the advantages and disadvantages during these programs are discussed. Some problems and critical issues are also proposed in these chapters, which lead to better solutions for mobile teaching and learning. Their findings from the real practices shed a light on the future design and adoption of different mobile learning programs.

The adoption of high technologies in education also receives many debates, such as whether they are as efficient as the traditional face-to-face (FTF) teaching and how to assess the influences of remote teaching. M-learning has both advantages and disadvantages when compared to traditional FTF learning. Instead of using M-learning as a substitute for traditional teaching, it should be adopted as a complements in current stage. Due to the current limitation and barriers of mobile technology and mobile devices (such as contents on screen, high cost of mobile data transferring, low quality of signal in some places, etc.), mobile learning is far from a replacement to the traditional learning methods. A blended-learning mode (which is combined with FTF learning and online or mobile learning) is a preferred learning mode for both educators and learners. To facilitate teaching, mobile learning should be adopted as same as normal blackboard and chalk. In other words, mobile learning should not be designed to just use the mobile devices or technologies, but be adopted where it is needed to assist teaching and learning.

The advantages of mobile teaching and learning include (but are not limited to): anytime and anywhere (not fully achieved but more convenience than before); flexible access; more efficient use of the small time slices on learning; cost saving; engaging in-class and after-class discussion with teachers and peers; supporting more interactive functions and contents; assisting special needs from students; increasing interests of learning; enhancing personal learning; engaging team collaboration in learning; improving self-regulated learning; life-long learning; and learning with social media.

But there are still some barriers for mobile teaching and learning in the current stage. The lack of Internet access in some places or regions, lack of continuity of mobile data transfer between high buildings and the different qualities of mobile signals in different areas are still the technical barriers to reach real anytime and anywhere mobile learning. Beside the technical issues, the high costs of mobile data access and high costs of smart mobile devices are also problems for adopting mobile learning. Even in Australia, not all students in the university have a mobile device or smart mobile devices. To provide equal access of the teaching materials and contents, the students without mobile phone should be taken into consideration. The professional development of mobile curriculum design, mobile technology skills, and knowledge of mobile teaching and learning of designers, educators, and the managers in universities and institutions are also important for mobile teaching and learning programs. Without the suitable skills and knowledge and the matching goals from educators and institutions, mobile learning programs cannot be launched successfully. Policies and regulations in government and universities/organizations are also important to support mobile learning adoption.

In sum, to achieve successful mobile learning is very important but difficult in a university or an educational institution. The pioneers of mobile teaching and learning in the following chapters shared their experience from their practices and class with all the others to lead the way to better future mobile teaching and learning design and implementation.

Dr. Angela Murphy, Dr. Helen Murphy and Helena Song introduced a cross country mobile learning program in ▶ Chap. 26, "Mobile Learning in Southeast Asia: Opportunities and Challenges." Southeast Asia is a diverse region consisting different countries, cultures, religions, politics, and a multiple languages. Mobile learning is well-documented in the UK, Europe, the USA, and Australia, but not many studies focus on mobile learning in Southeast Asia. This region contains both developed countries such as Singapore and developing countries including East Timor. The differences in economic developments mean different penetrations of telecommunications technologies, including infrastructure to support mobile and internet networks, varies vastly, and the extent to which this technology is used for learning similarly varies. The chapter examined the mobile device market penetration in the various countries of Southeast Asia and the particular demographics of those users. Internet censorship impact on mobile learning in some countries was also examined. The current policies, infrastructures, and mobile learning initiatives of mobile learning in a cross-section of East Timor, Indonesia, Malaysia, the Philippines, Singapore, and Thailand were examined separately. In the end of the chapter, it reviewed the enablers and barriers to mobile learning in Southeast Asia and proposed its future directions. The authors believed that in many areas of Southeast Asia, traditional modes of didactic delivery are still dominant. The findings of this chapter shed light on future international mobile learning design and development for educators.

In ▶ Chap. 30, "Networked Teleoperation Applied in Mobile Teaching: Study," Qiongjie Luo discussed how mobile technology can be implemented to assist learning process from remote locations. Mobile teaching plays an important role in connecting remote learners and facilitating learning process for all students. Mobile technology can not only assist mobile teaching and learning, but also in the fields such as space, underwater exploration, medical surgery, and hazardous environments. The author argued that educations not only focus on the passing on of knowledge but also the interaction between teacher and student. The bilateral teleoperation based mobile teaching will become a revelation to the existing education structure. This chapter focused on the control of bilateral teleoperation systems across the Internet. The designed features included adaptability to time-varying asymmetric delays and stability with good transparency performance for the Lyapunov-Krasovskii functional. The chapter also adopted an experimental validation of the developed theoretical methods. The results showed the designed controller is suitable for practical use. This chapter extended the new mobile technologies into mobile teaching and learning, which shed light on future cross-discipline design with different equipment and devices in mobile learning.

Linda Robson, from the Open University, introduced the challenge of making mobile learning accessible in ▶ Chap. 22, "Accessibility Challenges in Mobile Learning." Although the use of mobile delivery opens up the education experience to a group of learners, it is likely to be problematic for another group. The chapter discussed what accessibility means, why it is important, the types of challenges for designing resources, and how to maximize accessibility for mobile learning programs. Accessibility is defined as the extent to which a service or product is available to as wide a range of individuals as possible in the chapter. Some challenges, including different educational setting, different mobile devices and screens, different cultural background, different environment and timetables, different economic status etc., are discussed in the chapter. The author also encouraged the readers to be aware of the accessible issues that affect their students, not only the students with disabilities. One solution may not suit all learners. As one door opens, another door closes. There needs to be an awareness of the range of challenges and ways in which students learning.

Dr. Zuzana Palkova introduced the use of mobile Web 2.0 tools and applications in online training and tutoring, through the outcomes of the Leonardo da Vinci project MobiVET 2.0. Over 6 billion people have access to a connected mobile device now. Mobile technology is changing the way we live as well as the way we learn. The author believed that interactive learning materials enhance the learning process; are enjoyable; and, using wireless networks, may be used anywhere, at any time, and by anyone. The history of e-learning was also briefly introduced in this chapter. As Web 2.0 had been widely adopted in online teaching and learning, mobile Web 2.0 is also adopted in many mobile teaching and learning applications and programs. Online training and tutoring had been developed very fast in professional development programs in many countries. The MobiVET 2.0 project aimed at filling the online training gap between the self-directed learners and VET trainers by developing mobile e-learning 2.0 knowledge and skills of the trainers. The primary descriptive analysis was conducted to analyze the results from MOBIVET 2.0 students. The author also indicated that it is essential for educators to learn new technologies to design and implement successful mobile learning programs. This chapter shared some useful findings of the use of this technology in real online training programs.

In ▶ Chap. 25, "Mobile Education via Social Media: Case Study on WeChat," Dr. Aimee Zhang introduced the design of social media teaching and learning on WeChat. Social media has been developed very fast in the last decade. Some universities and educational institutions have developed teaching curriculum for social media and adopted social media in teaching and learning. Combined with mobile technologies, social media provides better solution for teaching and learning. The majority of social media teaching and learning studies focused on Twitter, Facebook, and Second Life platforms. This chapter examined a new mobile social media platform – WeChat – which has more than 800 million users all over the world. Not like Facebook, Linked-In, or YouTube (with 8–11 years accumulation of users and development of contents), WeChat only has 3 years history. The number of registered users increased dramatically in three years. The advantages and disadvantages of WeChat public account was compared in this chapter. Instead of using university teaching materials, this study composed teaching materials for public learners and compared the number of readings, reposts, and likes for different contents on three mobile educational social media public accounts: WollongongBaby, WEMOSOFT, and MobileClass. These designs provided learners a new method of self-motivated learning. Different functions of WeChat and WeChat public account are good for different expression of knowledge, sharing of knowledge, group discussion, and feedback collection. It was also combined with off-line activities to engage learners to communicate, contribute, and share their knowledge, skills, and experience. The author believed that content is king for social media teaching and learning. The results were very good from both quantitative data analysis and qualitative reviews. It proposed the future design and development of social media learning on mobile devices.

Debra L. White discussed from the educator's view in ▶ Chap. 23, "Gatekeepers to Millennial Careers: Adoption of Technology in Education by Teachers." Mobile technology brings more access to good and bad resources to the students. It is challenging for the educators to be a gatekeeper for the generation who was born with those technology and mobile devices. In the future, mobile learning will change everyone's learning process as well as the way of people's living.

In ▶ Chap. 24, "Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom," Wendy Kraglund-Gauthier shared her experience and findings in the practice of mobile teaching and learning. The findings also indicated future design of mobile teaching curriculum for mobile teaching and learning.

Danielle Reid and Christopher Pruijsen discussed the use of voice message and short message in primary and secondary education from industry point of view in their ▶ Chap. 27, "Increasing Learning Outcomes in Developing Countries by Engaging Students Out of the Classroom Using SMS and Voice Mobile Technology." They shared the design and adoption of their program in primary and secondary schools with all the other educators. As one of the most common features on all mobile devices and one of the most popular functions in some developing countries, the short message can be adopted in different ways to improve and assist teaching and learning inside and outside classroom.

Dr. Susan Crawford discussed the use of iTouches and iPads in physical education initial teacher education in her ▶ Chap. 31, "Use of Mobile Digital Technology and iPod Touches in Physical Education." It also benefited students from all different majors, subjects, schools, universities, and countries. Mobile technology brought knowledge together and generated new innovations when it was adopted by cross-discipline designers and educators. This chapter proposed the methods of adopting mobile technologies and devices in physical education.

Lucy Haagen introduced another adoption of mobile technology in teaching and learning in China in ▶ Chap. 29, "Mobillizing the Middle Kingdom: Bringing M-Learning to High Schools." This chapter shared the experience of mobile teaching and learning in a Chinese high school, which is different in cultural background, school structures, policies, and expectations. The chapter also shed light on global mobile teaching and learning program design and development in the future.

In all these chapters, educators and teachers from different countries, different cultures, and different disciplines shared their experience and findings in real practices with all the others. The innovative adoption of mobile teaching and learning in different environment and situations shed light on future adoption of mobile technology in teaching and learning, not only in universities, but schools, educational institutions, and for all public learners. The barriers and constraints they found also indicated the directions for future mobile learning improvement. The knowledge shared by these pioneers is invaluable. Their suggestions and advices should be taken into account for future mobile learning program design and development. The institution managers and policy makers should also consider these suggestions when making new policies and regulations for future mobile teaching and learning.

# Accessibility Challenges in Mobile Learning 22

Linda Robson

## Contents



**Abstract**

Mobile Learning opens up a wide variety of opportunities to deliver learning new and exciting ways (▶ Chap. 21, "Adoption of Mobile Technology in Higher Education: Introduction"). Making learning accessible is a challenge for educators regardless of the medium or platform with which they are working. This chapter looks at some of the accessibility challenges which educators face when moving to mobile delivery.

In some situations the use of mobile delivery opens up the education experience to being far more accessible to a wide range of learners than more traditional delivery style. However, it is frequently seen that whilst adopting mobile delivery is beneficial to one group of learners, it is likely to be problematic for another.

This chapter briefly considers what accessibility means and why it is important, before going on to consider the types of challenges which educational developers and teachers should be aware of when designing resources, in order to maximize accessibility.

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It does not attempt to address every single accessibility issue and potential adjustment, but to encourage the reader to consider a range of issues their learners may face and to raise awareness of how particular delivery choices may affect potential learner engagement. There is also an acknowledgement that it may not be possible to cater to all learners using a single delivery solution. Where there is conflict between the needs of different groups, in terms of usability, it may be appropriate to offer multiple ways for students to engage with the learning, instead of attempting to make every activity fully accessible.

## 1 Introduction

Mobile technologies have been adopted by users worldwide at an enormous rate. Consequently, it is not surprising that educators have identified an opportunity to reach new audiences and to deliver educational material in new and enhanced ways. The adoption of mobile technologies within education has opened up many possibilities for engaging learners in a wide range of activities. However, at the same time as opening up new possibilities for engagement, the adoption of mobile technologies in learning also has the potential to exclude some individuals, particularly where developers have not considered a range of accessibility issues which particular learners may face.

Before discussing accessibility challenges in mobile learning, some thought is needed regarding what the term accessibility means and why it matters.

In its widest sense, accessibility could be defined as the extent to which a service or product is available to as wide a range of individuals as possible. This could include consideration of variation in a wide variety of different factors such as educational setting, cultural background, socioeconomic status, etc. More commonly, the term is used with a much narrower focus, to refer to designing products or services in order for them to be used by individuals with a disability.

Although this chapter will focus on supporting students with disabilities, it is important for educational developers to be aware of the other access issues which may affect their students. Presumably, those developers harnessing mobile learning would have considered issues around bandwidth and connection reliability (▶ Chap. 4, "Design Considerations for Mobile Learning"), along with device availability and some consideration of cost, whether that is borne by the individual learner or the educational provider. Developers should also be encouraged to consider the characteristics of their target student group(s) and of any individuals which may be knowingly or inadvertently excluded.

Pike (2010) studied the increasing digital divide for HE students in prison and highlighted the increasing restrictions on accessible study programs for students due to increased uptake of internet-based teaching. Whilst it might be accepted that only a limited number of educational opportunities can be afforded to students in prison, the narrowing of accessible curriculum for this group may impact on the effectiveness of rehabilitation and have a negative impact on society.

Frequently, women are disadvantaged in accessing the technology to be able to access education. In the developed world, children are usually given priority access to internet enabled devices in order to support them in completing their school homework. Prior to mobile devices being widely available, men often got second priority regarding access to computers and the internet, and women would be at the back of the queue. The increase of relatively cheap mobile devices has addressed this inequality to some extent. In many western households, there are enough internet enabled devices available for the whole family to be accessing simultaneously. However, there is evidence that women in minority communities of the developed world, still lag behind the men in their digital literacy (Tolbert et al. 2007). In poor and rural areas of the world, there is still a significant gender-based digital divide (Elnaggar 2008; Al-Rababah and Abu-Shanab 2010), with women having much lower rates of access to the internet and potential learning technologies.

There is also a cultural dimension to accessibility of various educational opportunities, dependent on gender. Some subjects are seen as masculine and others as feminine which makes them more or less attractive to males and females accordingly. For individual learners, they may be attracted to a particular subject but feel excluded due to gender stereotyping of that discipline.

Prison students and women are just two examples of groups of students who could be inadvertently excluded due to the choice of medium for an educational program. Whilst not wanting to stifle innovation, it is important that developers are aware of the consequences of their decisions. Educators should work towards being inclusive whenever possible and be aware of the limitations where it is not possible.

The remainder of this chapter will use the term accessibility defined as;

> designed to promote the inclusion and participation of individuals with disabilities.

So why is accessibility important?

There are a number of answers to this question:

- There is a moral and ethical case for promoting inclusion and participation of all individuals in education and more generally within mainstream society. Individuals who are integrated into society through effective education are able to realize their potential and become an asset.
- In many countries there are legal requirements for products and services to offer a minimum level of accessibility. For example, in the UK, the Disability Discrimination Act 1995 and the Special Educational Needs and Disability Act 2001, in the USA, Section 504 of the 1973 Workforce rehabilitation Act and the Americans with Disabilities Act 1990, and in Australia, the Australian Disability Discrimination Act 1992.
- To promote technical efficiency. Frequently accessible learning design is also more effective learning design for the general population. It is likely to be compatible with a wider range of devices allowing easier interoperability and updating. Interfaces which are designed for users with visual impairment are

usually easier for everyone to interact with. This is a benefit to all students, regardless of whether or not they have disabilities.

- A significant number of students are likely to have disabilities, either declared or undeclared, and possibly unknown even to the student. Roughly 5 % of UK students and 6 % of US students in post compulsory education declare a disability (Seale 2006), and there are likely to be more that do not declare. Around a quarter of students declare the disability state dyslexia, but this is commonly thought to be underreported.
- It is usually much cheaper to incorporate accessibility features into a learning program at the point of conception, than to retrofit features when an individual learner with particular needs joins the program and identifies an issue.

Whilst the utopian dream may be to have everything fully accessible to everyone, there are always funding limitations to consider, and compromises may have to be made. Too much emphasis on accessibility could lead to a danger of defaulting to an accessible specification which then degrades the experience for the majority and potentially stifles innovation. Developers may have to choose between access for one group and access for another. When making these decisions it should be remembered that the focus should be on every individual having an opportunity to achieve the learning objectives. That doesn't necessarily mean that every activity should be fully accessible, and in some instances it may be appropriate to provide alternative learning experiences. Just as providing balanced nutrition can be achieved through a variety of menus suited to different tastes, comprehensive education can be provided through activity options selected to cater to different needs and preferences. When providing alternative learning experiences, care should be taken to ensure that the students with disabilities are still embedded into the sociocultural aspects of the learning program. Ideally, the majority of the program should be accessible to all students with alternative learning activities provided just for discrete elements, so that all the students feel that they are following the same learning journey. It may also be appropriate to offer the alternative learning activity as an option for all students, not just those with disabilities, which allows for variation in preferred learning styles and reduces the risk of those students with disabilities feeling that they have been separated from the rest of the cohort.

Importantly, the need to provide accessible learning materials should not prevent innovation by learning providers. Whilst an attempt should be made to preempt potential issues with learning activities during the development phase, there may be occasions where an accessibility issue is not identified until a particular learner tries to engage. Where this situation occurs, learning providers will find students with additional needs will be much more sympathetic towards the situation if their needs have been anticipated in other learning activities and they feel there has been an effort to include them in the majority of the learning experience.

The remainder of this chapter is divided into three sections in which it will consider a number of features of mobile teaching technologies and highlight the positive and negative aspects of their use, related to accessibility issues.

Accessibility and disability are very complex areas, and technology is evolving rapidly. Consequently, it is not possible to produce a comprehensive list of every issue and solution. Additionally, the individual nature of disability and its impact means that there is no "one size fits all" solution to many of the challenges faced. However, by the conclusion of this chapter, the reader should be aware of a number of key concerns, and have developed a mind-set to be able to identify the types of questions which tutors and academic developers need to be asking.

## 2 Devices and Interfaces

If users are able to bring their own device to the learning environment, they are likely to solve some of their accessibility issues themselves. Familiarity with a particular device, which can be used for a number of different tasks, reduces the need for the student to invest time in learning basic functionality and operation. Individuals with disabilities face the same challenges in all aspects of their life, not just in learning. Therefore, they are likely to own devices which are particularly suited to their needs. Our allowing them to then bring their preferred mobile devices to the learning environment means they will already feel confident in their ability to use the technology. However, developers need to be aware of the range of devices which might be in use and the types of issues their content may cause. Developing for a range of devices increases the cost of development. Conversely, if educators specify a particular device must be used, it reduces compatibility problems. But it may be more challenging to cater to a range of accessibility issues. It may also increase cost to the student, if they have to buy a particular device for a specific study program.

By definition, mobile devices need to be small and light enough to carry around. Consequently, the screen size on mobile devices is necessarily small. At one end of the scale are tiny screens just a couple of inches across, seen on some mobile phones, mp3 players, and smart watches. The screens get larger on smart phones, handheld gaming consoles, and PDAs. At the other end of the scale tablets and iPads have much larger screens but are less mobile, no longer fitting into a pocket due to their increased size and weight (Fig. 1).

The size of the screen on the chosen device has a big impact on its accessibility. A smaller screen means that either the content will be displayed smaller or less can be displayed on each page, or both. Obviously there is a point at which content is displayed too small for any user, not just those with disabilities. But the issue is likely to be more acute for those who are visually impaired, or have reading difficulties such as dyslexia. However, there is no direct correlation between screen size and ease of reading. Schneps et al. (2013) found that the reading comprehension of some dyslexic students increased when using electronic display with short line length. Visually impaired users suffering from tunnel vision may find a smaller screen easier to use as they are able to focus on the entire screen and do not lose anything which other users would be observing in their peripheral vision.

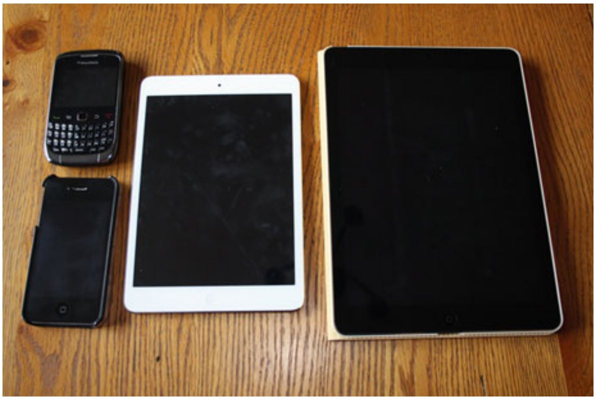

**Fig. 1** A range of mobile devices showing different screen sizes. From *left* to *right*, Blackberry, iPhone, iPad Mini, and iPad 2

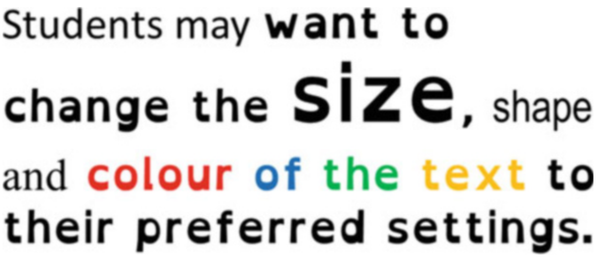


**Fig. 2** Examples of variation in text font, size, and color, including dyslexic friendly font OpenDyslexic (OpenDyslexic 2014)

The optimum screen size for interacting with a particular learning activity will be a personal issue depending on the particular student's needs. Within the general population, we find that some users like to access digital content on a relatively small mobile phone, whilst others prefer the larger screen of a tablet device, despite the inconvenience of reduced portability. This preference may also vary according to the content which is being delivered. The ratio of text to images within a particular learning activity may influence a learner's decision regarding the preferred device to use. This decision will also be affected by the type of engagement the learning activity is looking for. For example, an activity designed to promote students ability to critically analyze a painting, as part of an art history activity, would require much better resolution of the images, and potentially larger screen, than if the same image was used to accompany a historical narrative and provided to give context rather than to be studied in detail.

Moving on from screen size, the text size and shape also have an impact on how effectively the user can interact with the learning activities. The ability to change the font can be particularly useful, and developers may wish to consider offering specific dyslexia friendly fonts, in addition to the standard, frequently used fonts which are available (O'Brien et al. 2005). If using specialist fonts, consideration needs to be given as to how they will render on different devices, if they are compatible with different versions and software packages, and if the user would be required and able to alter local settings appropriately (Fig. 2).

As fonts and text size are altered, it is important that formatting remains sensible for the particular device and content. For example, diagrams or images, and associated text descriptions need to be retained in close proximity. Equally, text embedded within diagrams and images needs to respond suitably to resizing.

In some instances, it may be appropriate for some content, which is not critical to the message being delivered, to be removed to reduce clutter on small screens or when selecting larger fonts, although it could be argued that such content which could be removed is redundant and should not be present anyway.

Similarly, color, brightness and contrast affect the ease or difficulty with which a user can read from a screen. To some extent, users can usually customize displays using the standard device settings or through applying external overlays. An external film or overlay applied to a device's screen can be used to alter the brightness or hue and reduce glare. It can be useful to also offer different color schemes within the learning activities to cater to individuals with a range of visual abilities. Some individuals find it difficult to read light-colored text on a dark background, and vice versa.

As technology evolves, devices may become more or less accessible. For example, the kindle eReader has been popular with dyslexic readers due to the ability to easily manipulate the text size and the contrast. However, the kindle paperwhite and kindle fire are backlit, which is not so accessible for readers who experience visual stress or scotopic sensitivity. Some kindles also have embedded readout software which is useful for those who find interacting with text difficult, due to either visual impairments or dyslexia (Fig. 3).

Many modern devices are controlled through use of a touch screen. For users with mobility problems, a mobile device which they can operate with a touch screen can often be more user friendly than trying to access electronic materials using a PC or laptop. Mobile devices, by definition, can be brought to the user and are generally lightweight so can be easily manipulated.

Where a user has limited manual dexterity, the use of touch screens, particularly if they are small, can be challenging. Both screen sensitivity and spacing of controls on the screen are important considerations to facilitate use by as wide a range of users as possible. The consistency of button position and function is useful for all users, but particularly so if users have difficulty locating controls. Consideration should also be given to the likelihood of accidently selecting the wrong button which can be very frustrating for users.

It is a common misconception that visually impaired users will find the use of touch screen very difficult. In fact, provided there is consistency of control position and function, completely blind users can become very adept at using touch screen devices, when they are combined with audio responses. In some instances it may be useful to apply a tactile indicator to the touch screen to assist individuals in finding the correct locations (Rainger 2005; Arrigo 2010).

Once the basic controls have been mastered, the ability of learners to interact with the learning activities in a touch screen environment depends on the type of activity which is presented to them. Using a touch screen to select items for display or to navigate through a selection of static pages is fairly straightforward. Activities

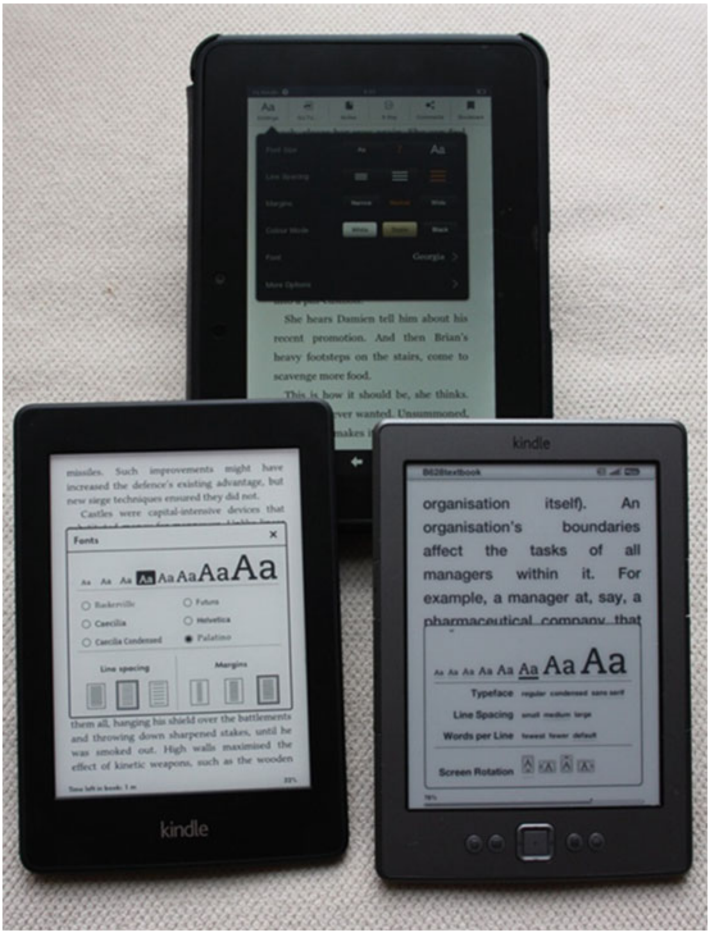


**Fig. 3** Kindle Fire, Kindle Paperwhite and Kindle Wifi showing text preference menus

which involve drag and drop may not be possible for students with visual impairment or manual dexterity problems. Small buttons can be problematic, particularly when arranged close together and consideration should be given to how to arrange different functions on the screen. For example, putting significant space between "save" and "delete" buttons to reduce the possibility of selecting the wrong one.

So far, consideration has been given to interaction with material through a touch screen. Another option is to use voice recognition. Many mobile devices have some form of voice recognition as a standard feature, allowing basic controls. This feature can be harnessed for use with the learning activities that are being delivered. The iPad and iPhone incorporate Siri software which will respond to voice commands. When asked for something that it doesn't have, it will automatically search the internet and give a suitable response. Although not infallible, it usually responds with something sensible. Unlike many voice recognition packages, Siri does not require training to a specific user. This advantage is time saving for most users, but may be a hindrance if an individual has significant difficulties around annunciation of their speech.

If presenting users with learning activities which are to be controlled using voice recognition, consider if the required commands will be obvious to the user, or if some training will be needed. Often there is a generation gap between the educational developers and the target learners and the possibility that the two groups use different vocabulary. Students who are studying in a non-native language may also use different word constructs, as well as having variation in pronunciation.

There can be difficulty for some students in using voice commands. Those with speech impediments or who have difficulty enunciating, due to physical impairment or deafness, for example, may find voice recognition difficult to use. There also needs to be awareness that specialist words may not be known or understood prior to completing the particular learning activity.

In summary, the choice of device and design of the interface has a range of impacts on usability. A small, lightweight device offers the benefits of being very portable but with the challenges of small screen size. Larger devices are less portable but likely to offer increased functionality and allow greater complexity and resolution on the screen.

Students with particular needs will have preferences regarding which devices best suit their needs. Ideally, developers will design learning activities which can be accessed on a range of devices and allow interaction in a variety of ways. Having multimodal interfaces which users can interact with in a variety of ways will allow the greatest number and range of users to access the learning (Arrigo 2010).

## 3 Study Environments and Timetables

Thinking about the study environment, there are two distinct reasons why educators might want to use mobile learning. One is to take the learning resources to the learner, and the other is to bring the learner to the resources (▶ Chap. 24, "Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom").

These two different reasons for utilizing mobile learning technologies have different challenges in relation to accessibility. When learning is being taken to a place of the learner's convenience, this can be both an advantage and a disadvantage. For example, a student who suffers from fatigue or has limited mobility can access the learning without having to travel to a college campus, or even from a hospital bed. However, the ability of the students to access their learning wherever they happen to be increases the likelihood that the environment will not be suitable for effective engagement with the materials. Students need to be able to concentrate on the learning materials, without distractions from other things in their immediate environment. Some may value the classroom environment to help them engage with the learning which is being presented. Going to the physical classroom is a clear signal to others that the individual is engaged in learning and should not be disturbed. A learner who is trying to engage from home may find that they are frequently interrupted by other family members or distracted by other demands.

Students should be encouraged to be aware of the environment in which they choose to study and to take steps to select a place which will be effective for them. The most suitable place will vary from individual to individual, particularly where students have specific learning difficulties or concentration problems. For some individuals, complete silence will be the only way for them to be able to concentrate. Meanwhile, others find that some level of background noise is essential for them to be able to focus effectively and concentrate on what they are doing. Coppin and Hockema (2009) give an interesting account of how an individual with dyslexia and ADHD (Attention deficit hyperactivity disorder) organizes their workspace, using both physical distribution of artifacts within their immediate environment and background noise, to assist them in organizing thoughts and ideas. Other learners may find this type of environment too cluttered and distracting.

Some mobile learning is used in order to take the learning experience to a particular place, situation or artifact of relevance. This allows the student to contextualize the learning beyond what could be achieved in the classroom setting. For example, engaging in learning in a museum, a historic place or an industrial setting. In these situations there may be accessibility issues to do with physical access; is it wheelchair accessible?, What are the noise levels like? Is both the physical space and the learning activity navigable for a student with visual impairment?

If the answer to any of these questions is no, this does not mean that no student should be given the opportunity to engage in this learning, because some are excluded. Educational developers should strive to overcome these barriers if possible. Can a different, more accessible, location be selected for the learning to take place? Or can the chosen location be made more accessible? For example, putting pressure on a museum to ensure that a particular artifact is positioned in a location which is wheelchair accessible will be of benefit not only to the students, but also to the general public who are using wheelchairs or pushchairs. There is also the possibility that a museum may be able to access funding to improve their accessibility if they can show a number of users would benefit. However, where there are difficulties which cannot be overcome, or while waiting the infrastructure to be changed, alternative arrangements need to be made for those who are unable to access. Where there are challenges which cannot be fully addressed, it is important that the student is made aware of any difficulties which they may face. Ideally, information regarding accessibility should be available within the mobile learning environment so the students are aware of what to expect and what support has been put in place for them. In some instances, the use of GPS could be harnessed in order to assist students to navigate to particular places using more accessible routes (Arrigo 2010).

Whether the learning takes place in the student's choice of environment or situated in the context of the learning, consideration needs to be given to the student's ability to engage effectively without distraction in order to achieve the learning outcomes. Students with dyslexia, fatigue, or concentration issues may find it difficult to focus on the learning if there are several other things going on in their immediate environment. They also find it difficult to multitask, particularly activities which require both listening and writing at the same time. With the situated learning it needs to be ensured that the students have enough time to engage with the environment and take notes or assimilate their learning. For some disabled students that may require extra time at the learning site compared with other students.

## 4 Timetabling

Although one of the key advantages of mobile learning is often that students have the freedom to study where and when they please, the issue of timetabling still needs to be considered. Even self-paced study programs will have key milestones which students need to adhere to in order to make progress and gain credit for their studies. Consequently, students have to be able to pace their learning. Whilst there is likely to be significant variation in the ways in which students manage their study time, it is imperative that they are all able to achieve the learning outcomes by the target date set either by themselves or by the institution. Some students will choose a steady trickle approach, whilst others may prefer longer more intensive blocks of study.

Students may need assistance in identifying how to make best use of the time which they have available for study. Whilst mobile learning opens up the possibility of studying in otherwise potentially wasted time periods, for example, waiting at bus stop or 15 minute on a tea break, there is a question to be asked about the quality of the study taking place. While some activities can be effectively fitted into such short bursts of study, many educators will argue that longer study periods are needed in order to fully engage with new concepts and ideas and achieve deep learning. There is a danger that because mobile learning offers the facility to fit study into these small study opportunities, students may not timetable longer study slots. When students have medical conditions which require regular healthcare appointments, mobile study programs may become something which is slotted in around other commitments and not given as high priority as more formally timetabled study might. However, it also offers the flexibility so that students attending medical appointments do not miss any teaching sessions.

One of the features of dyslexia is that individuals find organizing and managing their time challenging (Kirby et al. 2008). Consequently, dyslexic students may need support in managing the more flexible elements of their study programs, to ensure that they get them completed within a set study period.

Students with physical or mental disabilities may have significant fluctuations in their health with a consequential impact on their ability to study over time. They will need support to ensure that they are able to utilize the opportunities they have to study whilst feeling well, and manage the less effective or absent periods to have minimal impact on their overall progress.

Many disabled students receive additional support to assist them in overcoming related difficulties in their studies. Whilst this is very valuable, the extra support often requires the individual to spend additional time on their studies (Robson 2014). For example, students may need to use some of their study time learning to use assistive technology or working with a specialist study support tutor to improve their study skills and develop compensatory coping mechanisms. This additional support needs to be timetabled around the standard study program which can be challenging. Where new technologies are introduced to facilitate mobile learning, there may be a difficulty if the study support tutors are not familiar with, or do not have access to, the mobile devices and content being used.

## 5 Collaborative Tasks

Many mobile learning programs involve students in completing collaborative tasks, or discussing aspects of their learning with their peers. In both instances, students need to communicate with each other and there are a variety of different tools which could be used to facilitate this.

For synchronous communication, students could use instant messaging, voice calls, or video calls. For asynchronous communications forums, voice messages or video messages could be used. For students with disabilities some of these will be more accessible than others, and the device they use for access may also impact on the ease-of-use.

Any textbased form of communication requires a minimum screen size in order to be accessible to the general population as well as those with particular requirements. Individuals who find it difficult to type, particularly on a touchscreen, may find themselves excluded from instant message discussions, as others are able to reply much quicker than they are, and the conversation moves on to fast for them to be able to contribute meaningful comments. The ability to input text using voice recognition software can alleviate this issue. Voice recognition software can also be useful if individuals find text communication difficult due to limitations on their ability to spell. Some dyslexic students may feel very confident in a face-to-face group discussion using oral communication, but using text-based forums can be challenging because they are unable to express themselves so effectively in writing. Equally, there will be other individuals who feel quite shy in a face-to-face discussion and much more comfortable using a text-based online format.

It is important that any text-based communication is also compatible with readout software. This will allow access by visually impaired users, and may also be a preferred way of accessing by other individuals.

Using voice and video communications is difficult for those with auditory and visual impairments. It may also be challenging for some with manual dexterity problems to capture video to the same standard as that of their peers. Whilst the communications themselves may not be being assessed, it is important that the communication technologies chosen do not impede the student's ability and enjoyment of communicating with each other. Frequently, students can be distracted by process when they are learning, particularly if they are attempting to use a process which they find is for some reason challenging or cumbersome.

## 6 Future Directions

This chapter has just scratched the surface of some of the issues of accessibility when utilizing mobile learning. Specific difficulties which may be faced depend on the particular mobile learning environment, learning activities and objectives, and the needs of individual students. When designing learning, mobile or otherwise, educational developers need to be aware that students are likely to bring a multitude of different accessibility challenges. Consideration of common issues should be included early on in the learning design process in order that accessibility features can be designed into the learning experiences.

Whilst educators cannot be expected to cater for every possible combination of additional requirements, they should take reasonable steps to accommodate common difficulties and to make their learning accessible to as many students as possible. In addition to fulfilling any legal or ethical requirement to cater to disabled students, accessible learning design commonly produces a learning experience which is improved for all students. It is also sensible to try and anticipate needs as it is usually far more economical to design accessible learning at the point of course development, than it is to retrofit accessibility features. Finally, there needs to be an awareness of the range of challenges and ways in which students may want to interact with materials. Making activities more accessible for one group may result in it being increasingly challenging for another. Put another way in terms of accessibility, as one door opens, another door closes.

## 7 Cross-References

▶ Adoption of Mobile Technology in Higher Education: Introduction
▶ Characteristics of Mobile Teaching and Learning
▶ Design Considerations for Mobile Learning
▶ Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom

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# Gatekeepers to Millennial Careers: Adoption of Technology in Education by Teachers

23

Debra L. White

## Contents



**Abstract**

As gatekeepers of the students' futures, schools can no longer provide education that lacks the needed digital skills to excel in the twenty-first-century world. Teachers cannot fail to equip students with these skills without compromising the professional futures of their learners. Increasing digital literacy is the clearly stated goal for both International Society for Technology in Education (ISTE) and Common Core State Standards (CCSS). Yet, actual use of digital tools in schools remains inadequate, contributing to the digital divide. Slow-to-adopt districts and classrooms have typically cited IT security and bandwidth concerns, parental objections, lack of technological professional development, and difficulty accommodating access for all students, or "the digital divide." Many of these concerns are addressed through IT departments and communication with parents. However, teachers still need to be given more professional development training in education technology to help them integrate these tools into their educational practices and shift their teaching toward twenty-first-century culture. Teacher adoption of digital tools in lesson planning, implementation, and

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assessment can only happen after they have first learned these skills and practiced with the tools outside the classroom. This kind of professional development will help teachers model critical contemporary skills and become gatekeepers for students crossing the digital divide into millennial careers.

## 1 Introduction

> In times of drastic change, it is the learners who inherit the future. The learned usually find themselves beautifully equipped to live in a world that no longer exists.
>
> —Eric Hoffer

It is true that, in this day and age, change is taking place so rapidly that the world students enter upon graduation does not resemble the world as it was when they began learning. One way to stay abreast of change is through a primary agent of it in modern society: technology. Instruction and technology have walked hand in hand for decades now in ever-increasing degrees. Lou Yipling and his associates (2001) found statistically significant positive learning effects at all levels with computer-assisted instruction in PK (mean E S = +0.55), all the way through adults in training situations (mean ES = +0.22) with scores for elementary, secondary, and college falling between. What was facilitated with computers 12 years ago has expanded greatly, and it is currently expressed in personal devices today. Due to lowered costs of these devices (such as tablets, laptops, and smart phones) and increased use for social media as well as information, the use of personal devices in everyday life is here to stay. This can be good news for schools as well, and harnessing their use in education is yielding higher engagement in learning as a potential cost-saving move across the nation. This is known as BYOD, or bring your own device. By making positive use of this technology, instead of discouraging it like a nuisance, such devices prove their purpose as educational tools in the classroom instead of mere social distraction. Implementing BYOD has special requirements for IT, administrators, instructors, and students alike if it is going to run successfully.

## 2 The Mission of Education

Education is always a mission whether overtly or quietly inherent. There is no knowledge that can be passed from one generation to the next devoid of a worldview or religion. The culture of education is not neutral. Followers of Jesus Christ have a clear calling for education to be infused with His truth and to hold impactful significance for the student's worldview. If an instructor's educational mission field is in the fields of Africa, they would learn African ways of doing things, talk their language, enter into their paradigm, find points shared in common, and so on. If it were in India, the educator would need to relate in these ways in Indian culture. There is no less of a mission in the field of US education and/or online learning.

Mobile learning should include the positive employment of social media. Objections about social media and the Internet in education are not about its educational use.

It is about its social misuse. This should not equate a banning of social media in education; instead it decries (profoundly) how necessary it is to educate students on the right use of it, missing how useful it could be. Picture a world entering the dawn of the Internet and social media where educators said, "Wow! This is really powerful; we should teach ourselves how to harness it and guide our children through it." First, they learned how to secure data and kept this concept updated frequently and taught digital citizenship to all users. Second, they explored the possibilities with students finding out what could be done to research more fluently, publish more with impact, keep content discussions ongoing outside the classroom, help learning become more enjoyable, assess actual learning more regularly, go paperless, increase information for parents, enable data-driven decisions, reach more homebound students, create OERs (open educational resources) to share with the world, share culturally with other classes, adopt causes advocating to a global audience, collaborate with other teachers, help students collaborate more, develop lesson plans with sources all included, and increase student ownership of their learning. After all, the students are creating a digital footprint that could stick with them through college and careers." This world is still possible through technology and mobile learning, and it is happening today.

In mobile learning, bring your own device (BYOD) is a practice where schools must "get onboard or get run over." So many staff and students are already bringing personal devices to school making its accommodation unavoidable and setting up security for it inevitable. When schools choose to harness this, personally owned devices become a valuable tool instead of a disciplinary problem. The BYOD movement is among the top ten trends in education technology (Becker 2013). Common Sense Media (2013) reports the rise of personal ownership of mobile devices and identifies that 75 % of children have access to mobile devices at home. While a growing number of children utilize educational applications on mobile devices, Walling (2012) places on the importance of integrating classroom devices, the Internet, and personal devices to achieve academic excellence through technology in education. Best practices can be identified by lining them up within five categories of recommendations from the National Education Technology Standards (NETS) of the International Society for Technology in Education (ISTE). They are as follows: facilitate and inspire student learning and creativity, design and develop digital age learning experience and assessments, model digital age work and learning, promote and model digital citizenship and responsibility, and engage in professional growth and leadership. When it is realized that security, acceptable use, and professional development are not only achievable, but actually an asset, it becomes easier to sell this concept to your community and funding consortia, and then all stakeholders win.

Technology for technology's sake alone is not a worthy goal, and it can become a distraction or even detraction, from the goals of learning. Therefore, guiding education with technology, whether through assisting the instructor or the student, begins with the stated goals of the educator, the parent, the student, and the curriculum. Where technology enters into the picture is to further the communication between teacher and parents, teacher and students, students and one another, students and outside experts, and students and the course materials and to provide a platform of practice for their newly acquired skills in a style of differentiated instruction. Educational technology, through online computing, apps, and software, offers the greatest opportunity for both collaborative and individualized learning which hallmark current learning theory. Furthermore, “in order to be relevant in our present culture, we must respond to the growing body of knowledge in core subject matter and resources with content expectations that have grown exponentially. Language must now include the grammar of technology and the Internet (November, 2008). These things must be reflected in our mission of education.

There are six standards for effective practice:

1. Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.
2. Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
3. Students apply digital tools to gather, evaluate, and use information.
4. Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
5. Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
6. Students demonstrate a sound understanding of technology concepts, systems, and operations (International Society for Technology in Education 2008).

## 3 Security

### 3.1 Administration and Policy

The ability of schools to meet the growing demand of integrating technology in the classroom is growing. By identifying the barriers and readiness of schools to implement the use of personal mobile devices into existing curriculum, schools face both challenges and innovative means to integrate a variety of mobile devices to enhance the learning experiences of digital natives of the twenty-first century. Exploring the results of successful implementations and failed BYOD programs helps prepare education technologists and teachers to brace themselves for a technology movement, which affects budgetary decisions for digital equipment, bandwidth allocations, firewalls, computer security, and classroom management.

Administrators must come in ahead of adopting BYOD policies with full institutional commitment. Mobile phones, social media, blogs, Wikipedia, and so on are not inherently troublesome; only their misuse is. Blocking these things does not make the schools more secure, but it does limit the educational capacity of technology for teachers and students who are trained on how to use them. Therefore, it should be a priority in education to teach proper navigation of these tools that are already ingrained in our students' lives. This is more effective than any filtering device that can be hacked through. "Educating is always more powerful than blocking" (McLeod 2012). Professional development, community awareness, security, and funding all fall under the leadership of school administration. Teachers, parents, IT staff, and consortia will only be positively involved if they are lead to be. Developing a school BYOD policy "may include how to manage (a) authorized use, (b) prohibited use, (c) systems management, (d) policy violations, (e) policy review, and (f) limitations of liability" (Emery 2012), but it also requires a great deal of encouragement and PR.

## 3.2 IT Concerns

BYOD is not possible without the hard work of involved IT staff. Wi-Fi and Web 2.0 tools are device neutral, which reduces the complexity of integrating a variety of devices into one location. A floor plan of all buildings, including the location of all cement and brick walls, is necessary to facilitate optimal bandwidth in all areas of access. It is consistently recommended to allow for far more bandwidth than initial needs assessments show because BYOD frequently yields many more devices coming in than anticipated (Xirrus 2012), plus its use gains momentum as more and more creativity gains progress. Quarantined network for students' devices, up-to-date antivirus scanning programs, protecting data in the cloud, and tiered access separating school system data for IT, administration, teachers, students, and guests all guard against lost or altered data, as well as a host of other potential problems. Once the school is ready to adopt BYOD, listen to the plans of involved teaching staff and allow time to choose and develop standards, hardware, software, instruction, and networking so it can be established into the infrastructure (Ullman 2012). Just like over estimating bandwidth, leaving plenty of room for adjustment and growth is a must or the initial hard work will be outdated too soon. Many districts base as much of this as they can in cloud technology for more seamless expansion and growth.

## 3.3 Digital Citizenship

Students are eager to get onboard with BYOD, not only for social media but for social learning, ease of research, and collaboration. They are more than willing to gain the privilege by first learning and committing to good acceptable use policy and Internet safety. This is their role in security. Common Sense Media offers a curriculum to middle school-aged minors for gaining savvy in the digital world where knowledge increases safety. Their topics are as follows: Digital Life 101 (6–8), Strategic Searching (6–8), Scams and Schemes (6–8), Cyberbullying: Be Upstanding (6–8), and A Creator's Rights (6–8) (www.commonsensemedia.org), covering everything from stranger danger to copyright law which goes far in satisfying Common Core technology goals and CIPA (Children's Internet Protection Act) requirements.

High school students can earn a DDL, or digital driver's license, by passing sections of curriculum on digital etiquette and security, access, healthy communication, laws, rights and responsibilities, etc. (Swan and Park 2012–2013).

## 4 Educator Opportunities

### 4.1 Professional Development

Educational technologists are a bridge for the technology generation gap that resides between great, tenured teachers who did not have technology in their education and this generation of learners and a positive mentor for online students of all ages. It is important to continue learning to gain enough skill to lead them and help others continue to lead them and relate to students in their own online world. There are many effective ways for PD in technology to infiltrate school as educators and students begin to increase the use of technology in classrooms. Some schools have younger, more tech savvy teachers already using it who are encouraged to pass it on through their department, while others are simply providing tablets to ten teachers at a time and asking them to discover what can be done with it. ISTE reported that one district in Arizona is organizing a splashy show-and-tell conference for educational technologists and software designers to set up displays to inspire their local teachers and then break out into small groups for practice sessions. Why not propose CE credits for downloading or attending sessions from tech conferences and presenting it locally? Hiring educational technology specialists is always a worthy investment that can produce measurable results. Contact state professional organizations for education technology for information on their annual conference and subscribe to their newsletters for the teacher's lounge. Always remember, though, to invest in only those things that serve the educational goals instead of having education serve technology.

Technology offers a very flexible method of professional development through the use of communication suites like Adobe Connect. Teacher instruction, staff development, and leadership can be exercised in real time and asynchronistically, in small groups or as an entire staff, and attendance registries can assist in crediting continuing education. This increases opportunity for staff development by not requiring physical attendance on campus, especially for the support and management of online instructors.

### 4.2 Increased Interaction

This is a vast mission field without any global boundary that can reach parts of every nation in the world accessible through the Internet. It affords nearly endless opportunities for interaction and helps to decide if it is positive or negative in nature. If this mission field is only cluttered with the accoutrements of the world, then it will serve to make the lost more lost. If the distractions are refined, harness the learning power of instantly ready information, and distill it to the students in an engaging manner, the online environment for this mission is captured . Students across the world are in the online environment all the time without their distinctly Christian influence for a significant part of their social and academic life. This is a mission field that spans the globe, and it envelopes our own children as well. It should not be abandoned to the non-Christian world.

The strongest advice for teachers integrating technology into the classroom is to adopt a proactive teaching pedagogy that includes solid learning outcomes. Education can be more engaging through technology with its endless applications creating opportunity. Opportunity to vary teaching and learning style, to relate to students in their digital world, publishing opportunities, research opportunities, collaborative opportunities, and much more is possible. Teachers are blending and flipping their classrooms because it allows for *more interaction,* not less. This is through teacher to student, student to student, teacher to class, student to class, class to outside sources, and student to learning objects and course materials. They are drawing in less talkative students through text and class wikis, mainstreaming special needs of students through alternative communication modes, and using virtual field trips and lab projects for active class participation during lectures. When portions of instruction are prepared digitally through video, it can be assigned for homework outside of class time buying valuable time for projects and collaboration during class (this is what is commonly known as “flipping” the classroom because the lecture is at home, and the application or practice is done together in class) (Bergmann and Sams 2008). Virtual field trips, videos, and labs are all examples of learning objects which become more readily available for knowledge building and can be used again and again or shared between teachers (Cohen and Nycz 2006).

### 4.3 “There’s an App for That!”

All of these things, and more, are possible with the many websites and apps available online now. (Check out http://www.appsinclass.com/apps.html.) Publishing opportunities (audio, video, and written) and exploring the ICDL children’s digital library, student response systems, and Google Earth maps all are waiting to serve learning goals. Collaborative storage tools like Dropbox allow sharing between teachers, and Google Docs is perfect for student teamwork on projects. Social media is for conversations with experts and authors, flashcards skill builders, listening center activities, and formative assessment apps abound. Check out just a few school favorites from A–Z: Adobe, Alice, Audacity, audioBoom, Blackboard, Blogger, CamStudio, Camtasia, Discovery streaming, Dreamweaver, Dropbox, Edmodo, Engage LMS, Evernote, Flashcards Deluxe, GarageBand, Glogster, Google Apps for Education and the Teacher Dashboard, iMovie, iWork, Jing, Microsoft Office Suite, Moodle, MS OneNote, Poll Everywhere response system, Prezi, Quizlet, QR barcodes, Remind101, Sketchpad, SMART Boards, SMART Pens, Spaaze, TurningPoint, Twitter, Visual Basic, VoiceThread, Voki, WorldCat, YouTube, and Zangle.

Edmodo has been nicknamed the "Facebook" of education. It provides a closed environment for the class created within it to communicate, collaborate, and follow links for assigned work. It helps parents, students, and teachers stay coordinated and provides a real time opportunity to communicate in between classes that are on campus. Edmodo is a great central hub to plug in other tools for your students and parents to use. Jing is a screen capture program that allows instructors to tutor through a video that shows their computer screen while voicing over instructions on how to complete an assignment or use a piece of software. Avatars are not only fun for presenting coursework but also provide a degree of anonymity in online work for underaged students, so it is a good practice to teach for when students launch out into other online endeavors. StudySync provides web-based educational content about literature across subject matters. It assigns peer to peer reviewing of written responses to literature and other assessment tools that can be customized or used as provided. LogMeIn Rescue is a free remote access program that will allow permission to access another person's computer if they are struggling with technology and need assistance with using the virtual classroom. Fluency21 is a lesson plan generator. This site fosters more intentional planning to flexibly accommodate students anywhere within the digital divide to more actively engage twenty-first-century learning skills and includes a debriefing session for each lesson for future improvement. It also makes an open educational resource contribution to the global learning community at large. OERs, or open educational resources, are making an enormous impact in education by being available freely to all who can access the Internet.

## 4.4 Classroom Management

As instructors begin to rethink their presentations in class and incorporate new things, behavior management naturally comes to mind. Will BYOD be a "blessing or a bane?" Is it disruptive or does it truly make learning and use of time in class more efficacious? What does technology offer in contribution to behavior management? First of all, real-life application has shown that when engagement in class goes up, behavior issues decrease (Higgins 2011). Next, recognize that Rome was not built in a day and just slowly add in elements of instruction as they are learnt. This will avoid the loss of time and attention to awkward integration when the teacher is overwhelmed. Lastly, do not abdicate teaching to technology; it is only a tool and the teacher must still be actively in charge. Train classes in acceptable use and accountability, capitalizing on their desire to have these "cool tools."

Some teachers have captured the usefulness of the QR code to set the tone for each class immediately upon entering the room. A QR code is the black and white SKU code that can be scanned with phones and connect to the Internet message or link(s) it contains. At school the captured information that students scan might be "Watch this 5 min video and begin a five-sentence paragraph response." Or, "Swap homework with your partner and correct each other's answers; be prepared to show an example on the white board, one fact others may have also gotten wrong." In this way, students entering the room know to come in ready to be engaged in the class right away. When the teacher is ready to speak or to get everyone involved in group learning, they then begin with, "Okay, place all devices on the upper right corner of your desk. . .." Make it a class policy that devices are allowed as long as they remain in sight at all times and are turned on for educational use only. As they leave the room, text out any reminders for the next class through Remind101.

Data input is another great reason to use technology as a teacher. Students can use devices for response systems during class discussion and have formative feedback immediately as they learn. This can also tabulate classroom behavior in the elementary to show earning (or losing) reward points as they go. One such reward program, ClassDojo, also has links to report great (or negative) behavior to parents right away. Keeping your data app available during class allows input to be calculated into grades in real time rather than the instructor having to calculate them later.

Yet another advantage of BYOD is the increased ownership of learning as students search out information to apply to the lesson and accept responsibility for acceptable use policy. This is a good reflection of the educational trend of teachers becoming more like facilitators of learning rather than providers of information. The same sense of ownership is reflected in the inherent responsibility for taking care of the device. It has been shown that much greater care is taken if it is their own, than if it is a school-owned device. Encourage ownership of the AUP at school, as well, by having the students help set school-wide rules on the use of student-owned devices. Be sure to begin by establishing high classroom expectations for use and then let the learning roll.

## 4.5 Assessment

New concepts in assessment are growing out of educational technology, some that are mobile-learning friendly as well, that have potential to become new best practices. Online assessment is coming to schools by this year, 2015! As many educators consider the woes of assessments, their ability to effectively evaluate learning and teaching to the test, the development of online assessment has forged on. Mitch Fowler, in his article "Online Assessment: From Instant Access to Meaningful Decision Making" (2013), advocates for computer-adaptive assessment and immediate access to results for next-step decision making for teachers and professional development choices for administrators. Knowing sooner what weaknesses are being expressed in current classroom and campus dynamics allows for quicker intervention. In theory, this goes beyond teaching to the test and allows assessment to retake its proper role in guiding instruction. It will be interesting to track the impact of this technology to see if it, in fact, accomplishes this ideal or merely drives the current trend of the tail wagging the dog even faster than ever before. Many are hoping it achieves the desired improvement.

Assessment ultimately occurs in the way that Internet use builds a digital footprint. Educators should help students cultivate a positive one. What about passing on this practice to secondary students? Elementary? Fontichiaro and

Elkordy (2013) teach all about data-loaded badges that students of all ages can earn and keep in online backpacks that highlight interests, skills, and accomplishments in students' lives not consistently represented on the traditional report card. A new online open-source framework called Open Badges Infrastructure coordinates the creation of badges and their ability to showcase in a positive way for students. It provides reinforcement for anywhere/anytime learning outside of school, and it is a great way to teach portfolio creation and positive cultivation of an online reputation.

Michael and Amanda Szapkiw (2010), in their website for graduate classes on instructional design, state that authentic assessment includes live performance, demonstrations, projects, and portfolios, and they challenge teachers to find more. One final test of educational worth is employability. Google hiring practices provide an interesting case in point. J.R. Sowash, in his blog, The Electric Educator, posted the recent *NY Times* article on Google interviews and concluded, "Teaching (and learning) facts will not prepare students for success. Teaching them how to interpret, analyze, and evaluate and apply information will. Google is looking for critical and creative thinkers, not Jeopardy champions." Reeves et al. (2002) call for several authentic online practices that place strong priority on "real-world relevance" and activities that "are seamlessly integrated with assessment." This is called formative assessment which is a much better indicator for employers than the artificial assessment of static pencil tests with singular right answers. Take note of the following excerpts from that *NY Times* article Sowash shared: In Head-Hunting, Big Data May Not Be Such a Big Deal by Adam Bryant (2013). It was an interview with Laszlo Bock, senior vice president of people operations at Google, and he has a lot of valid points for educators to consider about tech integration and assessment!

> I think this will be a constraint to how big the data can get because it will always require an element of human insight.
>
> I don't think you'll ever replace human judgment and human inspiration and creativity.
>
> G.P.A.'s are worthless as a criteria for hiring, and test scores are worthless — no correlation at all except for brand-new college grads, where there's a slight correlation. Google famously used to ask everyone for a transcript and G.P.A.'s and test scores, but we don't anymore, unless you're just a few years out of school. We found that they don't predict anything.
>
> . . . academic environments are artificial environments. People who succeed there are sort of finely trained, they're conditioned to succeed in that environment. One of my own frustrations when I was in college and grad school is that you knew the professor was looking for a specific answer. You could figure that out, but it's much more interesting to solve problems where there isn't an obvious answer. You want people who like figuring out stuff where there is no obvious answer.

## 5 Future Directions

There are many worthwhile reasons to integrate mobile learning into the education of students. Furthermore, the ability to implement it continues to improve year by year. Administrators and IT can work together on realistic security and infrastructure options. All stakeholders can work together to develop effective AUP and classroom management strategies. Then the positive effects of increased engagement and interaction in learning combined with reduced behavioral problems can yield desired educational achievement. It is not only possible to implement BYOD; it is to everyone's advantage to encourage and exercise positive digital citizenship with this generation of learners.

According to the National School Board Association, these skills are among several that have been identified as crucial to future success:

- Capacity for continued learning
- Cooperation and team building
- Precise communication in a variety of modes
- Problem solving with creativity and ingenuity
- Generation and organization of A LOT of technologically produced information
- Craftsmanship of products and ideas

In an educational community teachers are investing ideas and concepts into students and planting seeds that will last for years beyond any current school year. It is something that must be done intentionally and with integrity because of the potential to reach far into the lives of learners. Teachers are stewards of truth, knowledge, confidence, and direction. These skills are essential to communicating knowledge and skills. Collaborative, blended learning environments foster the development of them better than classes lacking the social media and technology infused in them. They open the gateways to millennial careers.

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# Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom

# 24

Wendy L. Kraglund-Gauthier

## Contents



**Abstract**

Mobile teaching and learning (M-learning) has been a trending topic in recent years due in part to the increased proliferation of mobile devices in classrooms. Mobile technology can yield both opportunities and threats to the way an educational institution attracts and retains students and runs its business in terms of technological infrastructure, financial impacts, instructor and student training, human resource management, and course deployment. It provides avenues for flexible, personal learning for different groups in the same classroom and enables individual discovery. Real-time exchange rates, interactive management activities, synchronous communication, and global collaboration can also be brought into the classrooms anytime and anywhere. Yet the lack of Internet access in some rural and remote regions, lack of continuity of wireless data transfer between buildings, and the different qualities of mobile signals in different areas are still technical barriers to reach real anytime and anywhere mobile learning. The high costs of mobile data access and different mobile rates in different states and countries also increase the difficulties of adopting efficient mobile learning. Mobile technologies present risks and ethical dilemmas,

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including, but not limited to privacy, data storage and access, copyright, and equitable access. Mitigating risks and capitalizing on opportunities is possible, and when the implications for teaching and learning in and outside the classroom with mobile technologies are considered and addressed, a rich pedagogical experience can emerge.

## 1 Introduction

In recent years, technology has dramatically changed the way institutions conduct the business of education. A scan of the literature reveals the research field and professional writing outlets are replete with studies and reports involving 21st-century learners and their skills and ways of learning in elementary and high school contexts. The education field is awash with examples of student learning activities that incorporate technology.

With the goal of improving students' educative experiences, teaching practices have been researched and theorized extensively, especially in higher education classrooms of the latter half of the 20th century (Chickering and Gamson 1999). There is an array of educational philosophies underpinning teaching practice, especially within the context of working with adult learners. There are far fewer parallel studies examining 21st-century instructors in those same contexts. Absent are writing and research that weave the business and process of student learning in higher education that involves technology with the required pedagogical approaches needed in classrooms enhanced with mobile technologies. A noted exception was Herrington and Herrington's observation that "the disruptive nature of the integration of new technologies in education often results in practitioners relying upon tried and proven pedagogical approaches, leading to 'one step forward for technology and two steps back for pedagogy'" (as cited in Cochrane 2013, p. 247).

In response, this chapter identifies key concepts of mobile technologies as a disruptive force in higher education. But rather than a technical blueprint for implementation — a challenge because of the rapid evolution of technology itself and the myriad of applicable contexts — this chapter explores the philosophical frameworks that impact instructors' approaches to teaching in higher education contexts. The goal is for readers to conceptualize and perhaps reconceptualize the pedagogical approaches that instructors use with their learners. When pedagogical processes are at the forefront of course design and when instructors engage in reflective practice with the goal of improving teaching, learning that integrates mobile technologies can be student centered, engaging, and empowering for all.

### 1.1 The Impact of Disruptive Technologies

In the mid-1990s, a time when computers and computing technologies were just establishing a place within educational contexts, Bower and Christensen (1995) realized the potential of emerging, user-friendly computing technologies to both disrupt and to yield opportunities. They identified an intersection between what consumers required from technology to improve performance and its overall trajectory as a performance-enhancing option in time. For Bower and Christensen (1995), "sustaining technologies tend to maintain a rate of improvement; that is, they give customers something more or better in the attributes they already value." Disruptive technologies, on the other hand, have a flatter trajectory on the dimension of time because of their differences and the high switching costs for users. Included in these costs is the perception that the disruptive technology is no more effective than what is currently in use and familiar to users.

Mobile technologies, in particular, are sustaining and disrupting teaching, learning, and operations. Some argue institutionalized, traditional didactical structures of knowledge transmission have translated into a narrow concept of effective teaching, defined in terms of the cultural artifacts that embody its presence and function and that vary within the social context (Crawford 1996). These artifacts traditionally include lecture halls, desks, podiums, paper, and the physicality of an instructor and students (Friesen 2010). Furthermore, "actions and expectations around new teaching models alienated some staff, particularly those who saw themselves as guardians of the old ways" (Higgins and Northover 2011, p. 131).

In traditional classrooms, "the receptivity and perceived legitimacy of new educational delivery modes is strongly related to the extent to which these instructional technologies reinforce or retain the central elements of the institutionalized and identity-enhancing classroom setting" (Jaffee 1998, p. 28). As Bailey (2002) proposed:

> For a large percentage of current teachers, the adoption of many educational technologies is a two part process involving 1) the reexamining of fundamental educational philosophy and pedagogy on the one hand, and 2) learning how to thoughtfully employ student-empowering applications of technology on the other.

This is still the case in our current educational contexts some 10 years later. For example, the scant research on mobile technologies and learning have focused on students' access to content rather than an engagement *with* the content or the cogeneration *of* content (Cochrane 2013).

## 2 Mobile Technologies in Higher Education

Mobile teaching and learning (M-learning) has been a hot keyword in education in recent years because of the dramatically increasing penetration rate of mobile devices globally. Mobile devices have experienced very rapid changes from 2000 to 2014, with a reported 1.1 billion people using smart phones and tablets to access mobile Internet technologies (Manyika et al. 2013). While mobile devices are currently used primarily for voice and text message communication, they are also used to send pictures, listen to music, record video, watch television, play games, surf the Internet, check email, manage schedules, browse and create documents, and more. According to Manyika et al. (2013):

> App downloads grew 150 percent in 2012, and ... So-called near-field [transactions] (which use unpowered radio frequency chips to easily exchange data between devices) grew 400 percent in 2012 and are expected to increase 20-fold by 2016. Time spent playing video games, emailing, and text messaging on mobile phones grew 200 percent in the past four years. In the United States, an estimated 30 percent of all Web browsing and 40 percent of social media usage are now done on mobile devices. (p. 32)

Because of technology and Moore's Law, students can carry hundreds of electronic books on one electronic device and access academic resources virtually instantaneously. Students and instructors alike can access virtual classroom space with personal mobile devices and a volume of data is available at one's fingertips.

## 2.1 Opportunities and Threats with Mobile Technologies

Mobile technologies, by their very nature, present both opportunities and threats for administrators and instructors to consider and mitigate, including, but not limited to privacy, equitable access to technology, Internet access, and appropriate use. The pervasiveness of mobile technologies in higher education's classrooms and educational spaces both on and off campus presents an opportunity for instructors to harness the power of these devices for learning.

By recognizing the typical 21st-century student is connected to a network of peers and information, instructional strategies and learning activities both in and outside the classroom can become relevant, engaging, and responsive. Using mobile devices such as clickers and web-based polling are opportunities to engage students in real time by providing responses to questions and to course content. Based on these responses, the instructor can modify teaching in real time. For example, if the majority of students respond with the correct answer to a problem in balancing a chemical equation, the instructor can move on to the next idea. In a large class, the shy student who is reluctant to ask questions or volunteer comments out loud can contribute to the discussion electronically. In a Political Science class, the Internet can be used to stream live images of political uprisings as a conversation starter.

Publishers and software engineers are also recognizing how connected students are to their mobile devices. Many course textbooks are available for purchase as a PDF or e-text version, often at a substantially lower price. At Algonquin College, located in Ontario, Canada, for example, a campus-wide strategy to access only electronic textbooks from publishers or open access sites is expected to translate to student savings of over $2 million dollars by 2016 (K. MacDonald, personal communication, November 26, 2014). In addition, software companies now create mobile versions of software that address smaller screen sizes and bandwidth constraints. From a hardware perspective, if more students bring their own devices to campus (BYOD), the demand for access to institutionally owned computers in student labs decreases. Overall, these opportunities translate to the potential of improving the student experience on campus, and customer satisfaction is crucial for financial success.

The proliferation of mobile devices on and off higher education's campuses does not come without threats. The lack of continuity of wireless data transfers between buildings and the different qualities of mobile signals in different areas are technical barriers to reach true anytime and anywhere mobile learning. On campuses with a high BYOD rate, investments in student computer labs are wasted. The unpredictability of the number of individuals wanting to access the intranet can cause system slowdowns and crashes. Beside this, the high costs of mobile data access and different mobile rates in different provinces and countries are also increasing the difficulties of adopting efficient mobile learning (Bridges and Traxler 2005). Institutions are at the mercy of data companies setting prices based on supply and demand.

Ethical issues concerning mobile devices are abundant and many of these issues translate to learning via a mobile device. With mobile learning comes the issue of students located in countries other than in North America who wish to participate in classes within the continent. An ethical issue here is the different legal procedures and laws in general. In testing situations, mobile devices, especially wearable technologies can be brought in the exam without being noticed. On a more personal level, with the ever-present mobile phone in campus dorms and other social spaces, the potential for privacy invasion is significant, as is cyberbullying. If an objectionable event goes viral, it is difficult to reverse a negative image of the institution as a whole.

As with many new technologies, the biggest concern for users and also the most significant ethical dilemma is the security of sensitive information. Institutions of higher education collect a great deal of personal information about their students via their mobile technologies. Using an unsecure Wi-Fi threatens to expose this sensitive information to anyone who may have the capability to gain access to the technology used to store and analyze information. With data becoming more mobile, the threat of security breaches increases (Kraglund-Gauthier and Young 2014). The privacy laws in the United States, for example, are different than the ones in Canada and the institutions providing the course via mobile learning could be accessing information of students that is legal for them to do in Canada, but not legal in other locations across the globe. Students participating in a class from another country may not be aware of the ability and right of their institution of choice to access and use their personal data for any purposes they wish to use it for (Bridges and Traxler 2005). With challenges such as these creating wariness and mistrust, it is little wonder that mobile technologies have yet to be firmly established as legitimate and powerful tools of teaching and learning. Higher education stakeholders need to anticipate these threats and put into place privacy policies and rules regarding data storage and appropriate use.

## 2.2 Key Considerations for the Integration of Mobile Technologies

Specific departments within the institution have different functions and different technology needs; therefore, a variety of software programs and hardware must be purchased. Technology is a significant expense, and decisions for implementation must be proactively made that align with the institution's overall academic and operational goals. The needs of instructors in one department need to be considered in relation to the needs of other departments, and key decision-makers will need to balance the distribution of *desired* technology with *essential* technology. These programs and technologies must also be chosen based on how long they will serve the institution's needs and in consideration of hardware refresh rates and necessary software upgrades. Decision-makers must ensure that any investment made will be sustainable and that the selected technology is not anticipated to become obsolete too soon. As well, the potential impact of the technology must be assessed from various perspectives.

Mobile technology provides avenues for flexible, personal learning for different groups in the same classroom and enables individual discovery (Kukulska-Hulme and Traxler 2005). Additionally, mobile and data services offer potential for new methods of teaching and learning; for example, the emerging field of wearable technology has the potential to take learning anywhere. Real-time exchange rates, interactive management activities, synchronous communication, and global collaboration can also be brought into the classrooms at any time and from anywhere. With mobile technologies, students have access to a wealth of knowledge via their connections to campus libraries and to businesses that have a web presence.

Mobile technology and applications cannot be successful in isolation. An engaging instructor and effective curriculum design with inspiring content are vital for a successful mobile learning program. When "problems are often seen as an indicator of incompetence and failure" (Osterman and Kottkamp 1993, p. 21), specific competencies in creating and displaying content requires a comprehensive understanding of different types of hardware and software as well as new developed technologies the telecommunication industry. Well-designed course content can include not just readings and discussions but also incorporate the interactive communicative functions on mobile devices (Oblinger and Oblinger 2005). Functioning effectively in the media-rich classrooms of the 21st century requires a skillful and appropriate application of technology that is linked strongly to the curriculum.

When designing an effective learning activity that incorporates mobile technologies, instructors must consider the different characteristics of mobile devices and of mobile learners themselves. Individuals' past experiences, prior knowledge, and personal views and opinions tend to impact on the types of activities required for learning (Vygotsky 1978) and "their interpretations of the purposes or goals of an activity" (Crawford 1996, p. 44). Students use mobile phone in smaller time slots, such as waiting for friends or on a bus. A well-designed activity should make use of these smaller time slots. The smaller screen size and limited input options are key considerations. Mobile access has its limitation on the size of content. Videos can be valuable resources for learning but may be cumbersome and inefficient on mobile devices, and it may be difficult to read subtitles. Yet, similar to traditional learning environments, interactive functions and social communication are also effective ways to engage students and increase long-term memory. Discussion between students and communication with instructors helps students to understand the materials and to apply their knowledge in real cases. Constructive feedback from students also helps improve instruction.

## 3 Pedagogical Paradigms Impacting Teaching and Learning

Although difficult to define because of the individualized nature of teaching and learning, the term *pedagogy* is often used in reference to the instruction of children and encompasses the art and science of teaching. Adding to this, Loughran (2006) argued that *pedagogical practice* includes more than the transmission of information, but also includes the "relationship between teaching and learning and how together they lead to growth in knowledge and understanding through meaningful practice" (p. 2). In contrast, a more inclusive definition not bounded by age incorporates the term *pedagogic setting* to "denote any identifiable group ... for whom teaching and learning are an explicit and overarching goal" (Leach and Moon 2008, p. 10).

In this chapter, pedagogy carries a broad, inclusive meaning that encompasses teaching and learning in higher education, one borrowed from the Center of Instructional Development and Educational Research (CIDER 2009). According to CIDER, "pedagogy represents the creation of environments designed for learning." In refining the concept of pedagogy even more specifically in terms of student-centered activities that incorporate mobile technologies, "Scholarly learner-centered pedagogy represents the conscious creation of environments designed to foster learning through a focus on learner autonomy, social engagement, and cognitive processing, based on principles of teaching and learning developed through theoretical and empirical research" (CIDER 2009). Such structured and analytical ways of thinking about beliefs and practice adds foundational intentionality to teaching (Dewey 1959).

### 3.1 Philosophical Underpinnings of Teaching

A developed educational philosophy of practice serves as "a tool to promote teachers' ongoing personal development" (Beatty et al. 2009, p. 100) and informs the process by which instructors approach the inclusion of mobile technologies into their design of student learning activities.

A behaviorist philosophy of education serves to characterize instructors who concentrate on teaching skills that enable learners to function within society and who tend to focus on behavioral modification through positive and negative reinforcement (Elias and Merriam 1984; Merriam 2001). The behaviorist instructor is often authoritative and directive, and their teaching tends to be sequential in nature, with students having little to no involvement in determining learning outcomes or delivery methods (Elias and Merriam 1984). One can find behaviorists leading traditional elementary and secondary classrooms and delivering lectures in higher education classrooms and in skills labs.

A progressive instructor acts as a guide to learning and is someone who creates opportunities for individuals to gain practical knowledge and skills that can be transferred to and from real-life experiences (Zinn 1999). Progressive instructors design learning experiences that enable students to reflect on experiences, evaluate the experiences, and, thus, gain a heightened awareness of the learning derived from those experiences (Lindeman 1926/1961). By making a connection between the material at hand and past material and experience, a student can bring a critical awareness to the new knowledge and experience.

When individuals are participants in their learning, they are less passive and are better prepared to play an active role in society (Dewey 1959). In educational settings designed by humanistic instructors, discussion is encouraged, student input and self-direction are welcomed, and personal insight is sought. The instructor's intent is to create opportunities for learners to delve into their own constructs of teaching and learning, perhaps challenging systemic and societal norms. Mutual trust and respect — a sense of community, as it were — is required.

Constructivist instructors assert that students build and interpret reality based on how they perceive their experiences. In this learning paradigm, instructors consciously create opportunities for learners to engage actively with the course materials and with each other. Direct lecture is minimized and the instructor functions as a facilitator, guiding students through interactive activities that build on their prior knowledge and understanding (Bangert 2004). In an early review of the effectiveness and efficiency of networked Internet communications technology in education commissioned by the Canadian Council of Ministers of Education and Industry Canada, "effectiveness of the technology seemed correlated with the extent of interactivity that the technology afforded the learners" (Ungerleider and Burns 2003, p. 30).

By understanding philosophical underpinnings of teaching, an instructor can frame thinking and pedagogical intent. In doing so, instructors have the awareness and potential to make learning more meaningful for their students. Yet, in the drive to address the learning needs of 21st-century learners by incorporating mobile technologies, it is important to "not lose sight of what matters in terms of quality pedagogy and learning experiences" (Kirkpatrick 2011, p. 24).

## 3.2 Effective Instruction in Higher Education

After collaborating with key scholars in the fields of higher education policy, administration, and economics, Chickering and Gamson (1999) released the document *Seven Principles for Good Practice in Higher Education* in 1987. They contended that the effective teaching of face-to-face post-secondary courses can be linked to the instructor who:

- Encourages student-faculty contact
- Encourages cooperation among students
- Encourages active learning
- Gives prompt feedback

- Emphasizes time on task
- Communicates high expectations
- Respects diverse talents and ways of learning (p. 76)

From a pedagogical standpoint almost two decades later, including these seven points into the design, delivery, and assessment of course outcomes is a prudent decision — one that has transferability to learning environments that include the application of mobile technologies.

Leach and Moon (2008) went so far as to attest that “Good teachers are intellectually curious about pedagogy” (p. 1). In consideration of the challenge in defining instructor effectiveness, Danielson’s (2007) four broad domains of teaching responsibility are appropriate considerations within the context of mobile technologies in higher education because of the delineation of components: (a) planning and preparation, (b) the classroom environment, (c) instruction, and (d) professional responsibilities. Instructor effectiveness in terms of Domain 1: Planning and Preparation is derived from knowledge about six components, including among others, knowledge of content and pedagogy, resources, and instruction. Components of the “classroom environment” that may reveal teaching excellence include how the created environment enables interactions between facilitators and students that are respectful and understanding and are premised on a culture for learning. Other components of this domain involve classroom management of time, groups, tasks, and resources. Danielson’s third domain is “instruction,” which is comprised of five subcategories involving the ways in which instructors communicate with students about learning expectations and course content, engage students, use different assessment strategies, and be flexible and responsive to changing needs and situations. Regardless of definition, these dimensions are not mutually exclusive, but rather are interlocking elements that, when combined, comprise a holistic concept of an effective instructor (Danielson 2007; Strong et al. 2011) who incorporates mobile technologies effectively in ways that support student learning.

### 3.3 Reflective Thinking and Practice

One common thread throughout much of the literature about teaching is the importance of taking the time to examine the beliefs unpinning personal teaching practice, thus revealing personal philosophies of teaching and learning (Darkenwald and Merriam 1982). Schön (1983) differentiated between technological knowledge and “professional artistry” (p. vii) and urged instructors to use reflective practice to inform and develop their philosophies of teaching. Theorists have also acknowledged there is more than one framework from which to construct these personal philosophies (see, e.g., Brookfield 1990; Merriam and Caffarella 1999; Zinn 1999). Others, including Biggs (2002) and Flannery and Wislock (1991), have argued that a firm understanding of personal philosophies of teaching may enable instructors to make informed decisions on teaching methods and evaluations of student learning and reflections on practice.

"Reflective thinking is the process of making informed and logical decisions on educational matters, then assessing the consequences of those decisions" (Taggart and Wilson 2005, p. 1). Reflective thinking is also a hierarchical construct, moving from the technical, to the contextual, to the dialectical, with each level building atop the other. The foundation of Taggart and Wilson's (2005) reflective thinking pyramid is technical in nature, built from past experiences and the instructor's ability to set learning objectives and to design activities in which learners are able to meet outcomes while using mobile technologies. It is at the technical level that instructors need to begin to identify teaching practices that help students achieve course objectives. A key component of this level is the honest assessment of the instructor's own skills and knowledge of not only the mobile technology, but also learner-centered pedagogical processes. The instructor can advance to the contextual level by considering "underlying assumptions and predispositions of classroom practice as well as strategies used" (Taggart and Wilson 2005, p. 4). At the dialectical level of reflective thinking, the instructor considers the moral and ethical issues shaping instructional planning and practice. A dialectical level of thinking requires reflective practice, inviting peer review, and sets the stage for instructors to collaborate, to share strategies, and, thus, to improve practice.

Reflective practice in teaching can be depicted concretely in terms of an ongoing cycle of thought and action (Mentor et al. 2011; Schön 1983, 1987). According to Mentor et al. (2011), this cycle begins with reflection and, from this, moves into planning and enacting changes. Then, the reflective instructor takes results from the process and analyzes them in terms of desired outcomes. The cycle begins again with reflection on the evaluation of the results. Through this conscious cycle, the reflective instructor engages in a conversation with practice itself, and:

> In this reflective conversation, the practitioner's efforts to solve the reframed problem yields new discoveries which call for new reflection-in-action. The process spirals through stages of appreciation, action, and re-appreciation. The unique and uncertain situation comes to be understood through the attempt to change it, and changed though the attempt to understand it. (Schön 1983, p. 132)

Mentor et al. (2011) began with reflection; yet, some educators intentionally — and some, unintentionally — begin with incorporating mobile technologies, an action that is preceded by little reflection or inquiry into process, with evaluation and change then following a conscious reflection on that action.

Linking back to Taggart and Wilson's (2005) reflective thinking pyramid, "Self-reflection to interpret and inform practice and establish congruency between theory and practice would be indicative of functioning at a contextual level" (p. 4). Regardless of where that cycle begins, the process is a way in which instructors can develop an awareness of self and others in terms of teaching performance, its outcomes, and potential opportunities for further professional learning (Osterman and Kottkamp 1993). A growing self-awareness may lead to the recognition that teaching practices need to change because of changing circumstances — of content, of students, of delivery methods, or of institutional and societal pressures.

Societal pressures can influence thoughts and actions (Osterman and Kottkamp 1993). In the traditional structures of higher education, the Socratic method of knowledge transmission is deeply rooted in common practice. Ironically, Osterman and Kottkamp questioned why instructors who seek to improve their performance are challenged to identify the specific thoughts and actions which prevent teaching success. This is particularly troublesome in light of the recommendation that in order to improve practice and to move from the contextual level to the dialectical level of reflection, instructors need make time for collegial discussions and seek feedback from peers (Taggart and Wilson 2005). An examination of actual practice brings meaning to an instructor's underlying philosophy of teaching. If "teaching can be defined as a constant stream of professional decisions made before, during, and after interaction with the student; decisions that, when implemented, increase the probability of learning" (Hunter 2004, p. 3), it follows, therefore, that instructors' personal philosophies of teaching and learning are influenced by interacting factors, including their:

> Unique history of experience and awareness, the more generally recognized characteristics of the era, the culture, the ethos of the school environment, the role definitions of *teachers* and *students* [emphasis in original], the ways in which activity... is defined, and the interactions between people in the immediate social context. (Crawford 1996, p. 45)

By employing a rigorous strategy of reflective thinking to their course planning activities, instructors can identify how the current social contexts of 21st-century teaching and learning that incorporate mobile technologies impact course design and delivery. When faced with potential changes to habitual thoughts and actions, it can be argued that only through reflection can instructors identify that to which they are resistant and why. This is certainly the case with learning to teach with mobile technologies.

## 4 Future Directions

As higher education's classrooms fill with 21st-century learners who are accustomed to learning with mobile devices, it is imperative that all stakeholders work to resolve the tension emerging from the mismatch of technological tools and platforms, instructional pedagogy, and the teaching and learning context of instructors and students. "Change is ubiquitous and relentless, forcing itself on us at every turn" (Fullan 1993, p. vii). It is imperative that stakeholders in higher education acknowledge and address the need for a focus on the art and craft of teaching — regardless of tools used — rather than a concentration on the technical mediums of content delivery and learning activities. Instructors with a vested interest in improving student learning "have to ride each new wave of technological innovation in an attempt to divert it from its more natural course of techno-hype, and drive it towards the quality agenda" (Laurillard 2005, p. 71). The issue is separating the hype from the demonstrable "best" practices.

Instructors need to shift their own thinking about pedagogical processes to address the dynamic and shifting nature of teaching and learning in a classroom milieu infused with students' personal mobile devices. In order to thrive in the 21st century, all levels within institutions of higher education need to accept and leverage mobile technologies to transform the way instructors engage with their students and how they provide innovative educational experiences and deliver content. Results from previous research (Kraglund-Gauthier 2014) indicated that the more experience participants have with technology, the more confidence they have in their own abilities to use that technology. Yet gaining more experience carries with it a commitment of time — a finite commodity for any instructor; furthermore, developing content matter knowledge tends to be prioritized over developing content delivery methods.

Instructors who focus on constructivist pedagogical activities can efficiently maximize on students' engagement and motivation, and, in turn, their students will feel a sense of connection with instructors and classmates (Lalonde 2011). How instructors engage their students is due, in part, to the creation of spaces that are conducive to exploration and experimentation with mobile technologies that move beyond mobile technologies as "purely social tools for informal use into powerful tools for enabling student-generated content and collaboration within student-generated learning contexts" (Cochrane 2013, p. 255). It is through active reflection and engagement that an instructor can identify and attain high standards of teaching and develop expert knowledge that leads to self-efficacy and self-actualization for themselves and their students (Bandura 1993; Taggart and Wilson 2005). "The stronger the perceived self-efficacy, the higher the goal challenges people set for themselves and the firmer is their commitment to them" (Bandura 1993, p. 118). With self-efficacy and commitment established, the integration of mobile technologies is sustained.

Clearly, it is incumbent on the instructor to think critically about the process of learning and the quality of desired learning outputs when making decisions on what mobile technologies to incorporate into a course's learning activities. "The adoption of an innovative technology brings into question the fundamental pedagogical beliefs, the technology is marginalized or rejected until it can either be incorporated into the educator's existent *pedagogical* model, or until the model itself evolves" (Bailey 2002). Pedagogical processes, reflective thinking, and the frameworks of Bloom's (1984) *Taxonomy of Educational Objectives* and Taggart and Wilson's (2005) reflective thinking pyramid serve as guiding principles for designing learning activities, not only for students, but also for instructors' own acquisition of knowledge and applicable skills in teaching with mobile technologies. Reflection on practice has the potential to inform the types of goals instructors set for themselves when learning to incorporate mobile technologies and can reveal changes in perspective in the values, beliefs, and actions that form one's pedagogical identity and shape practices.

Mastering the techniques of teaching with mobile technologies may not be an intuitive, simple process; furthermore, instructors "need to see learning to teach as an ongoing process with more challenging than easy answers" (Weimer 2010, p. 157) and to accept mobile technology's disruption of existing instructor-centered power relations. As in any professional industry, the higher education instructor's skill in wielding the tools of the trade is one that improves over time with practice, developed and sustained through research and theory.

## 5 Cross-References


- ▶ Adoption of Mobile Technology in Higher Education: Introduction
- ▶ Accessibility Challenges in Mobile Learning
- ▶ Characteristics of Mobile Teaching and Learning
- ▶ Design of Mobile Teaching and Learning in Higher Education: Introduction
- ▶ Development of Mobile Application for Higher Education: Introduction
- ▶ Gatekeepers to Millennial Careers: Adoption of Technology in Education by Teachers
- ▶ Mobile Learning and Engagement: Designing Effective Mobile Lessons
- ▶ Mobile Learning: Critical Pedagogy to Education for All
- ▶ Mobile Technologies for Teaching and Learning
- ▶ Transformation of Traditional Face-to-Face Teaching to Mobile Teaching and Learning: Pedagogical Perspectives


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# Mobile Education via Social Media: Case Study on WeChat

# 25

Yu (Aimee) Zhang

## Contents



**Abstract**

Social media has been developed very fast in recent years. Almost every generation has their preferred social media platforms. They communicate with others on social media, share photos and information through social media, search information through social media, and plan their future on social media. It had been adopted by young people and students very fast. It also attracted the attentions from educators. Some universities and schools have developed teaching curriculum for social media and adopted social media in teaching and learning. However, some academics have argued that the results of using social media in teaching and learning may be affected by some contents and games from the Internet. Some students cannot separate the good learning contents from the bad or fake ones that they may be used by criminals. Other researchers also argued that social media account is private and the use of social media for teaching and learning may force the students to open their privacy to their teachers, which is a problem. Social media, as a tool for teaching and learning, is the same as chalks and pencils. It could have positive or negative influence on

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learning. When used properly, it can enhance learning performance dramatically. Combined with mobile technologies, social media provides better solution for teaching and learning. Mobile technology has its own advantages (e.g., anytime and anywhere) and disadvantages (e.g., small screen and calculation capability). Majority of social media teaching and learning studies focused on Twitter, Facebook, and Second Life platforms. This study examined a new mobile social media platform (original from China) – WeChat, which has more than 800 million users all over the world. Instead of using university teaching materials, this study composed teaching materials for public learners and compared the number of readings, reposts, and likes for different contents on mobile educational social media public accounts.

## 1 Introduction

The history of social media development has been more than 10 years. The previous definition of social media on Web 2.0 technology is already out of date (Kilpeläinen et al. 2011; Powers et al. 2012; Poellhuber and Anderson 2011). New social media on mobile devices has been growing fast since 2010 and expanded the definition of social media (Castro 2012; Mao 2014). Social media was adopted by new generation quickly now. They search information online, chat with their friends, share photos and information every day, make new friends from their friends' circles, watch movies, listen to music, and plan their schedules via social media or mobile phones (Castro 2012; Wallace 2014; Powers et al. 2012). Educators also studied the use of social media as a platform for education purpose (Casey 2013; Dabbagh and Kitsantas 2012; Heatley and Lattimer 2013; Kilpeläinen et al. 2011). Some of them shared teaching video on YouTube (Heatley and Lattimer 2013; Jenkins and Dillon 2013; Ferris and Wilder 2013; Koutropoulos et al. 2013). Some use game platforms to engage students to class discussion, tutorials, and consultations (Bredl and Bösche 2013; Oblinger and Oblinger 2005; SEO 2013). Some developed their own communication tools for education (Yuh-Shyan et al. 2004). Although there are still arguments on whether educator should be involved in the students' social networks, schools and universities are using more social media as promotion channels, educational platforms and community services now (Vogel et al. 2009). Social media is believed to play a more and more important role in future teaching and learning as well as people's daily life (Castro 2012). Social media is also merged into mobile devices quickly because of the mobility and convenience characteristics of mobile devices (Alley 2009; Mao 2014). Almost all popular social media have their mobile App version now. They are still lag behind their Web-based big brother on functions and page contents (▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). But the usage of mobile version catches up very fast and the providers are enhancing their mobile version continuously. WeChat is a new mobile social media from Tencent in China (Mao 2014). It developed very fast and chased most social media platforms within 3 years in terms of number of active subscribers. The total registered users had passed

800 million in 2014. With the new technologies been introduced into mobile social media and mobile education, it will bring more learners to the wireless environment and virtual worlds (► Chap. 53, "Advanced Image Retrieval Technology in Future Mobile Teaching and Learning"; Mao 2014).

## 2 Development of Learning Through Social Media

Social media is not new to educators now. It has been developed very fast in recent years. Educators and educational organizations have designed and developed many practicing curriculums and courses on social media (Baage 2013; Britt 2013; Buffington 2013; Casey 2013; Haipinge 2013; Heatley and Lattimer 2013; Jenkins and Dillon 2013). Some of them are multination or multidiscipline projects (Alley 2009; McCombs 2010). However, the real effects or performances of these projects are influenced by the vision of the organizations, the design of curriculum, the chosen social media platform, and the readiness of teachers and students for that social media (Wallace 2014).

Designers or teachers usually carefully select one or several social media that is suitable for the teaching disciplines, materials, and skills, such as Facebook (Ferris and Wilder 2013; Haipinge 2013; Kilburn 2013; Poore 2013; Rennie and Morrison 2013), Wimba (Baage 2013), Twitter (SEO 2013; Tyree 2013), Wikipedia (Britt 2013; Ferris and Wilder 2013; Kemp 2013; Poore 2013; SEO 2013), Pinterest (Buffington 2013), YouTube (Ferris and Wilder 2013; Heatley and Lattimer 2013; Jenkins and Dillon 2013; Koutropoulos et al. 2013; SEO 2013), Google + (Heatley and Lattimer 2013), Google search or cloud computing (Heatley and Lattimer 2013; Mills 2013; Ostrom 2004), broadcasting (Castro 2012; Evans 2008), and the new mobile social media WeChat (Mao 2014). Not all social media suits all learners. The readiness of teachers and learners on social media usage and technical skills of using it is important (Poellhuber and Anderson 2011; Cheon et al. 2012; Cumming et al. 2013). If the vision of the organization that has mandated the use of social media or mobile learning is not coherent with the readiness from teachers or students, it usually brings unexpected results (Wallace 2014). Some researchers argued that the over-participation or addiction of students to social networking will lead to a negative impact on their academic performance (Kirschner and Karpinski 2010). But other researchers argued that the performances from learning should be measured through different dimensions that adopting social media in learning increased students' satisfactions on learning process (Al-rahmi et al. 2014).

Most educators believe that using social media in teaching and learning will facilitate learning, increase creativity in learning, and encourage share across time and space (Castro 2012; Howard-Jones 2002; Mao 2014). Some have proved that social media can help special students with disability or from a different cultural background (Baage 2013; Cumming et al. 2013; Koutropoulos et al. 2013; Castro 2012). Personalized learning or learning on demand becomes possible on social media and mobile devices (Dabbagh and Kitsantas 2012; Hsu et al. 2013; Sharples

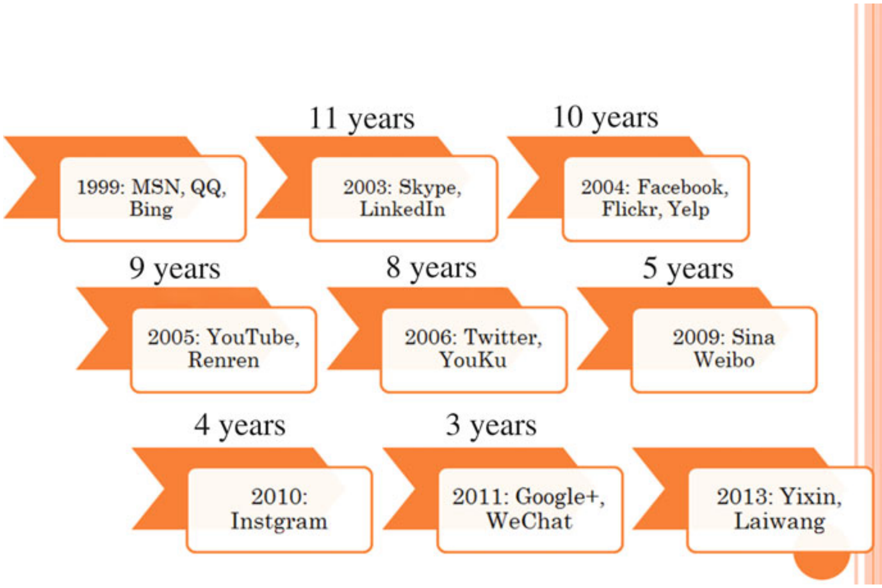


**Fig. 1** Timeline of social media markets (Source: From this study by author)

2000; Tsay et al. 2010). Heatley and Lattimer (2013) argued that social media is the most cost-effective way to expand learning and break the limitation of a fixed classroom.

Figure 1 shows the timeline for social media markets. Some old social media is not popular anymore or already quit the market. Some popular ones, such as LinkedIn, Facebook, and Skype, have been developed for more than 10 years. However, the new social media from China, Sina Weibo and WeChat, have only 5 and 3 years of history but more than 600 million and 800 million registered users in 2014. The difference between Weibo and WeChat is that the previous one started with online users, while the latter one started with mobile users only.

The users use Weibo and WeChat for different purposes. Figure 2 listed the differences between the usage of Weibo and WeChat. Most official departments and famous businesses/persons have their Weibo accounts. People share photos and information on Weibo. The repost rate is higher on Weibo. However, most users use WeChat for chat and connection. Mao (2014) studied the key factors of undergraduate students' WeChat usage and found the influence of friends is the major factor for them. Almost all students use WeChat every day and 18.8 % of them use WeChat for more than 2 h per day.

In a sum, social media has changed the way of teaching and learning. Students are no longer a message receiver that learns from teachers or books. Sometimes, they could possess more knowledge and skills than the teacher, equipped with online searching engines (such as Google), video guide (such as YouTube), and others' experience (from professional groups). Therefore, teaching with social media should be different to traditional teaching. Students are more involved in communication

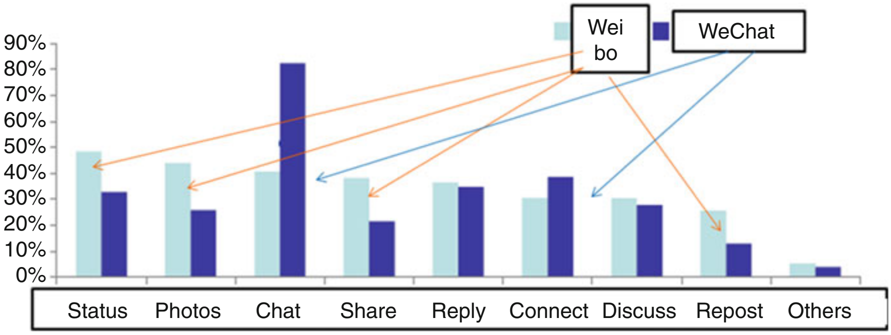


**Fig. 2** Differences on Weibo and WeChat (Source: From this study by author)

with teachers, their peers, or maybe professional people online. They can contribute to not only the class participation or discussion but also the curriculum design and course development. The role of teacher is changed to facilitator to encourage students' searching and sharing during class. But it is important for teachers to identify the usefulness of the knowledge online and quality of information from social media. Teachers can also encourage critical thinking and creative thinking during this process to lead the students on the right track. Social media, if combined with mobile technology, can be more powerful and attractive to learners.

## 3 Combined with Mobile Technology

Traditional social media starts from online platforms based on browsers on computers. They are designed for computer and Internet connections with more contents in the same screens and bigger size of photos or figures.

### 3.1 Transforming Period

Most social media have their own mobile applications for users now. They are available for users from application stores (Apple Store, Google Play, and others) for free. However, some are not suitable for mobile usage (such as big sized pictures or large videos). As a result, the majority of users are still using computers to access them.

### 3.2 Mobile Social Media: WeChat

WeChat is a social media born with mobile technology and users. The initial design of WeChat is only for free Chat and connection on mobile phone. The users' interface and all materials on WeChat are designed in strict limited sizes. WeChat

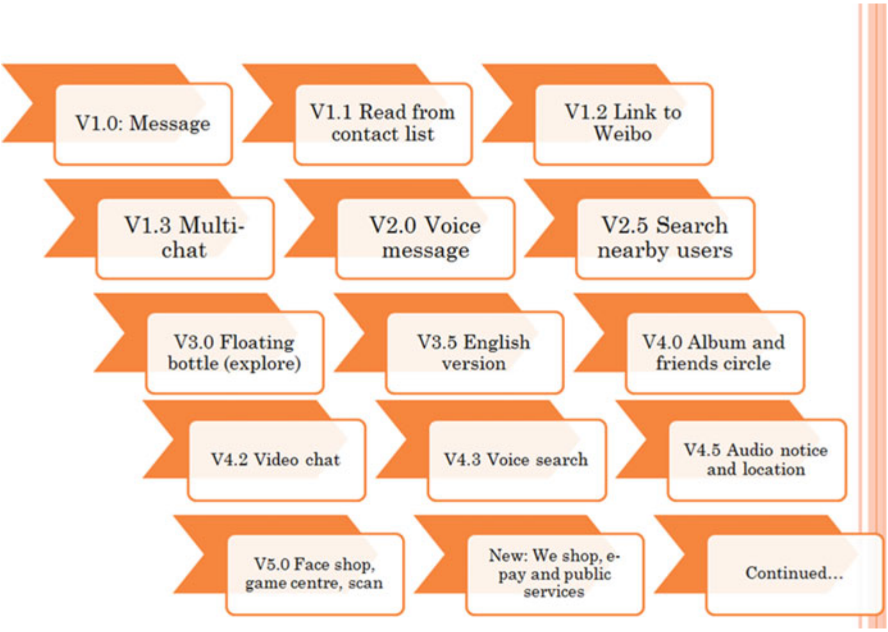


**Fig. 3** Micro-innovation of WeChat versions from 2011 to 2014 (Source: From this study by author)

adopted fast micro-innovation life cycle to develop and try different new functions for its users. WeChat provides free group chat, voice and video messages, photo and text messages, "shake," "look around," "drift bottle," and even "Facebook connect" functions, which are very attractive to young people (Mao 2014). Figure 3 shows its micro-innovations from version 1.0 in 2011 till 2014.

The multiple free functions brought fast growth of registered users since January 2010. WeChat has 800 million users within 3 years, and the users are still growing fast in 2014. As indicated by Castro (2012), "If learning exists at multiple Scales, from cellular to cultural, then so does teaching." As the fast-developing social media platform, many educators already focused on the use of WeChat in teaching, but most of them are in China (Mao 2014).

The users' growth is shown in Fig. 4. The trust levels between users are very high on WeChat. Most of them are family members or close friends. WeChat also provides very good analysis tools for users' analysis.

A WeChat public account is a special account which provides one to multiple methods for users to send group information, such as educational information. It also provides good users' analysis tools and communication methods to engage users. Many authority departments or industry users already adopted WeChat public account to engage customers and users. This study will discuss the possibility of using WeChat public account in education.

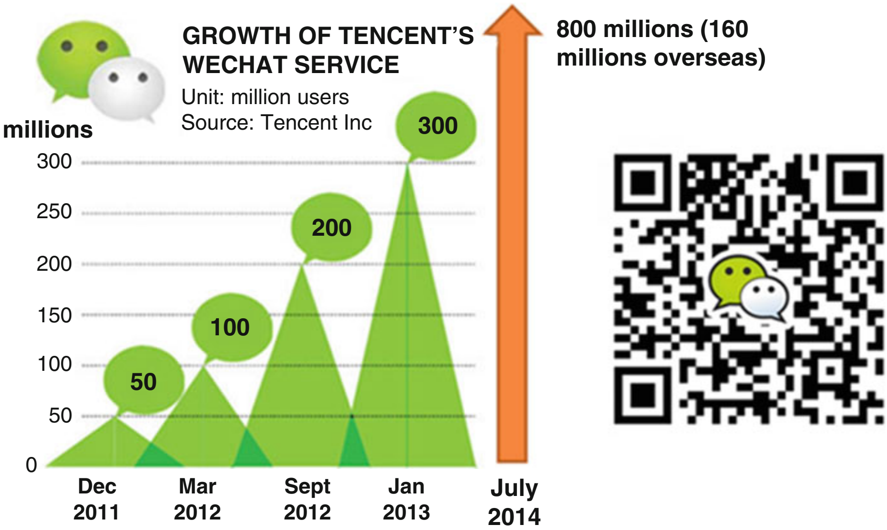


**Fig. 4** The growth of WeChat users by million (Source: From this study by author)

**Table 1** Advantages and disadvantages of WeChat public account

| Advantages | Disadvantages |
|---|---|
| It is one to multiple push information on mobile phone with notice (like short message) | The reach is usually limited by close circles (hard to be forwarded by others and reach out) |
| The trust level between sender and receivers is usually higher (one forward leads to approximately 10 reads) | The editing system is not good enough (still has bugs) and is changed all the time |
| The edited contents can be saved, modified, and sent anytime and forwarded by others | Public account is not English friendly |
| There are good analysis tools to analyze the users' posts and messages easily | There are some bugs in the editing system |

Source: From this study by author

WeChat public account has its own advantages and disadvantages as an educational channel compared to other social media and Weibo. The advantages and disadvantages of WeChat public account are discussed in Table 1.

## 4 Mobile Class on WeChat

Thanks for the opportunity that this study starts looking into mobile education from a community and business perspective instead of formal higher education perspective. Learners can be engaged and motivated from the real needs in their daily life.


**Fig. 5** Three mobile educational public accounts on WeChat (Source: From this study by author)

The curriculum can also be designed to suit different group of learners. To examine the mobile education through new mobile social media – WeChat – three new public accounts were designed and developed on WeChat ("MobileClass" or "口袋课堂") by WEMOSOFT. All of them are registered in May 2013.

As listed in Fig. 5, the first public account, WEMOSOFT, provides investment information and educational class to users (targeting on globe investors and visitors); the second one, Mobile Class, provides economic/food receipt/happiness mobile classes to users (target on well-educated learners); and the third one, WollongongBaby, provides early childhood education activities and information (target on local community and parents with young kids).

Each of them is targeting different user groups in different locations and education or age ranges. WEMOSOFT kept slow updating speed with one update per month or per week. It had 123 followers till 30 November 2014. Mobile Class was updated once per working day and it had 45 followers till 30 November 2014. WollongongBaby kept a once-a-day update since the opening of this account and had 135 followers till 30 November 2014. This public account is designed to be linked to a local community chatting group. Qualitative case study was adopted for this study. Each class (content) was reviewed with its report, user's message, and keyword searching.

## 4.1 Content Development

The three WeChat public accounts were designed and developed with educational information for research. Take the Mobile Class as an example. A total of 80 classes were created for this public account (including 59 economic classes, 14 food receipts, and 7 happiness classes) before 2 December 2014. Figure 6 shows the list of the total 80 classes (contents) for the Mobile Class public accounts. Each of the contents is composed of a title, front-page image, short abstraction, main

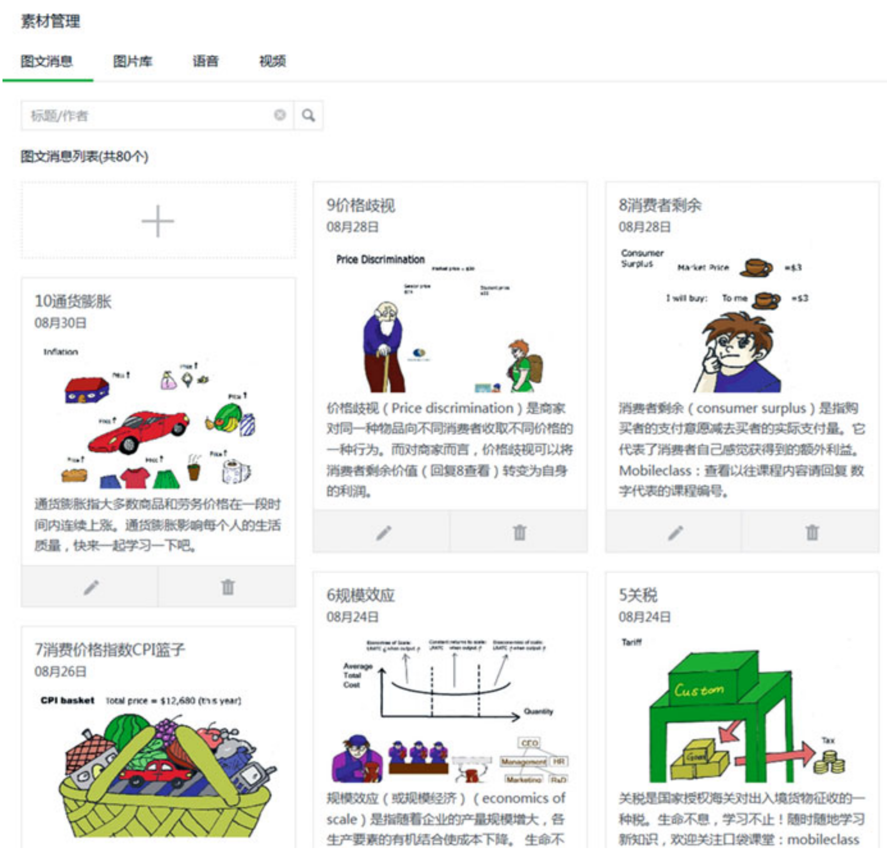


**Fig. 6** Contents for mobile class public account (Source: From this study by author)

context with text and pictures (or animations) for economic teaching, and learning materials. All of them are in Chinese (expect some name in English). Most of them are related to some real-life case studies or historical stories linked to the economic conceptions. They are designed to help Chinese students in their economic subjects and better understand on how to use economic knowledge in real life. There are also some food receipt classes and happiness classes in this public account to give a break for learners from sole economic contents.

The resources (animations and cartoons) for economic classes are from Tutors in Pockets (▶ Chap. 19, "Tutors in Pockets for Economics"; Zhang 2012), which are designed and developed for mobile devices and economic teaching and learning purpose. Each of these animations or cartoons is less than 1 MB in size, which is suitable for mobile screens and mobile data transfer (▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). But all of the contents are translated into Chinese and expanded. Some case studies in the Chinese markets or Chinese history are added to engage the Chinese learners.


**Fig. 7** Example of content in mobile class public account (Source: From this study by author)

Figure 7 shows an example of how these contents are edited in the WeChat public account system. There are some limitations in the editing system by WeChat. Some functions are not working well for English systems or software, and the "Control + V" function is useful in the main context development. The size of pictures in the main context is also strictly limited to enhance the users' experience on WeChat. There are many technical skills in using the WeChat public account editing system. Normal teachers or educators may find it difficult to use it for curriculum or teaching materials design and development. Some of the managers of WeChat public account have to seek advice from professional technical supports.

As shown in Fig. 7, a class (content) is composed by title, author, a front page picture (required), abstract, and main content. Although the front page picture size is not strictly limited, the smaller the picture, the less time learners open the content. This influenced the learners' reading rate of each class. Animations play important roles in the economic classes on WeChat. The contents with animations have higher open rate than contents without animations. The title and abstract also have influence on the reading rate of each class. In general, an attractive title or

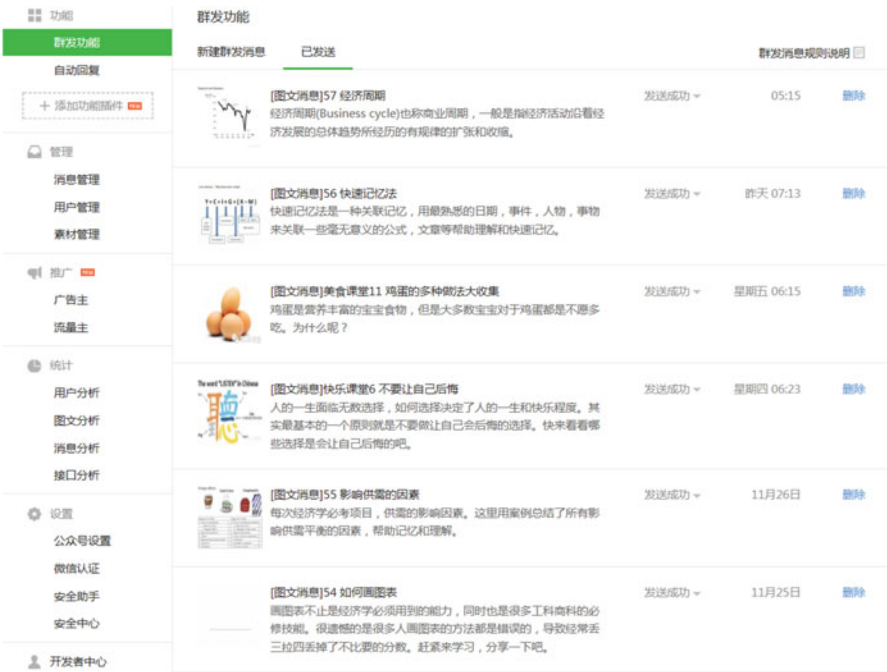


**Fig. 8** Sent message (class) from mobile class on WeChat (Source: From this study by author)

introduction linked to real-life examples leads to higher reading rate. WeChat limited all the pictures in the main body by 300 kb (before November 2014) to enhance reader's experience on their mobile devices. All audio files must be less than 1 min in time length and less than 5 MB in size (before June 2014). All video files must be less than 20 MB in size (before June 2014). All these limitations are designed for mobile users and greatly received users' experience for learning.

After the contents are designed and developed for WeChat Mobile Class. They can be sent in group message to all followers. Figure 8 shows the sent message by date. The message can be a text-only message (can be sent to all users by the manager's mobile phone), one picture message (can be sent to all users by the manager's mobile phone), an audio message (can be sent to all users by the manager's mobile phone), a video message (can be sent to all users by the manager's mobile phone), or a designed picture and text message (a designed class). We only adopted designed class in group message in this study as it is the best for teaching and learning purpose. But the other convenient messages from mobile devices are good for business promotion purpose or emergency information use.

All the sent message and their reach and reading can be viewed in the analysis reports provided by WeChat. This is also a powerful tool provided by WeChat, which is like the functions of Google Analytic tools. With a good use of these tools, designers and teachers can change their class contents and improve learner's experience in learning easily. They are introduced in the following functions.

## 4.2 Analysis on Reports to Improve Teaching

The users' reports and interactions can be viewed in the analysis pages provided by WeChat. As a result, the WollongongBaby account had more followers and active users because of the supporting chatting group. Parents contributed to the curriculum design, information sharing, and suggestions every day. Mobile Class engaged more professional followers and they provided some suggestions on how to improve the contents. WEMOSOFT public account had different performances on different contents due to the design of each material. WeChat provides content (class) analysis, users' analysis, and message analysis. Each of them will be introduced below.

As shown in Fig. 9, the contents are compared in the Mobile Class WeChat public account. The economic class 56 reached 41 people (who are followers of the public account). It was opened by 20 people and one person saved or forwarded it to others. The food receipt class (target on female users with kids or family members living together) and happiness class (target on elder users or working groups with mental health issues) usually have more reads and forwards compared to economic class due to its readers' age ranges and career backgrounds.

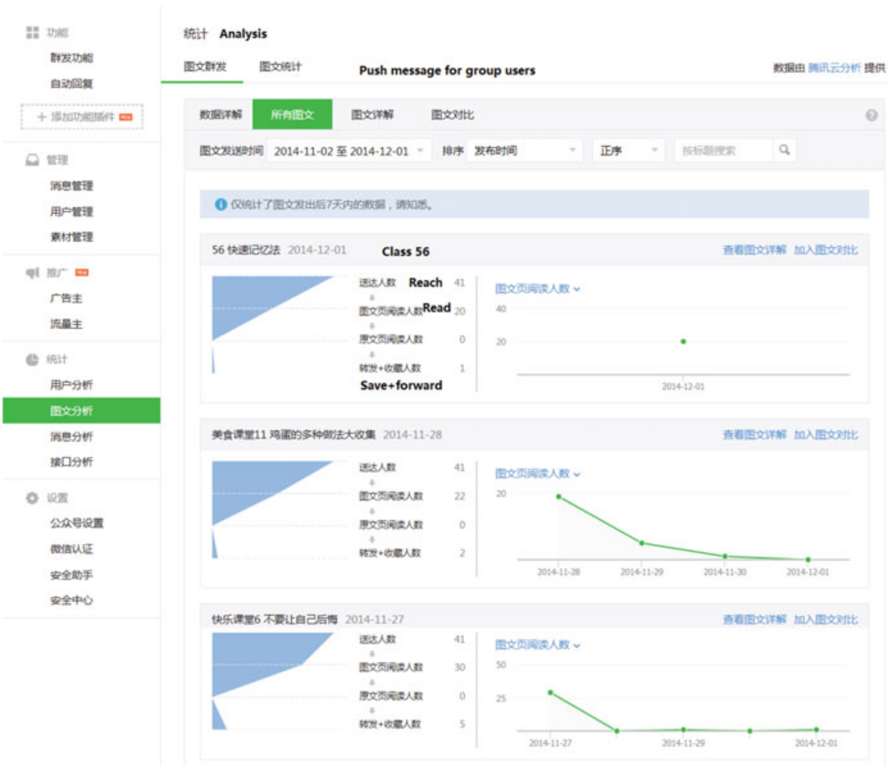


**Fig. 9** Mobile class content analysis report from WeChat (Source: From this study by author)

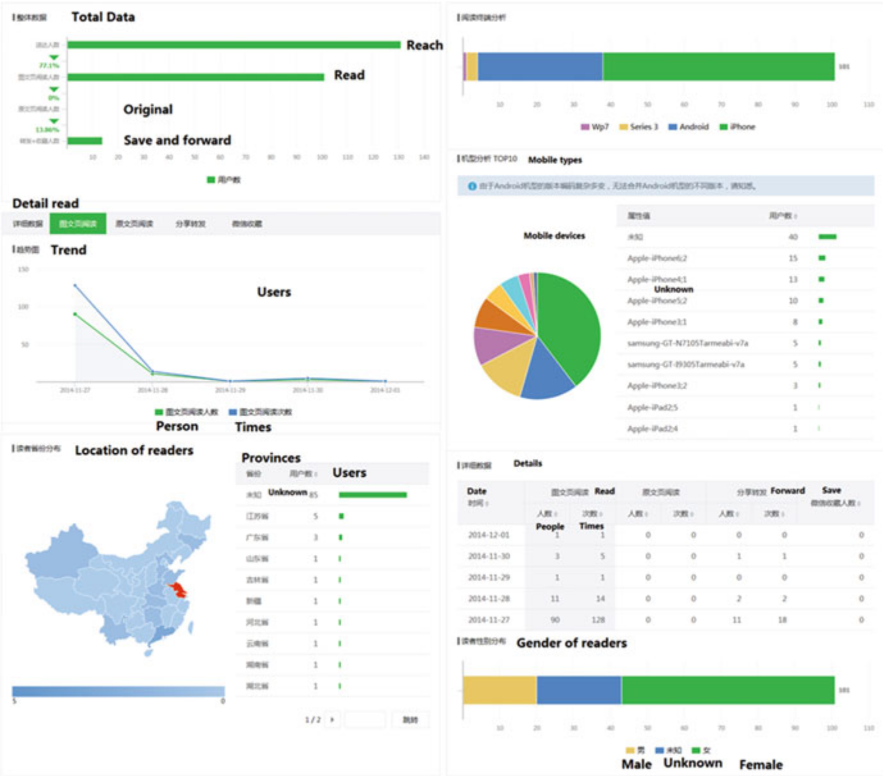


**Fig. 10** Details of learners for one class (Source: From this study by author)

For each class or content, WeChat also provides detail reports on its readers' changes, trends, genders, locations, and mobile devices with their detail types. Figure 10 shows the detail learners' report for one class/content in the listed mobile class. These data provided a good view on whether the content attracts more female learners or male learners, iPhone users or Android users, and users in mainland China (or some provinces in mainland China) or overseas users (marked as unknown in Fig. 10 report). The trend of the number of readers (who opened the content) and number of people who saved or forwarded it to others is also important. Some contents may be forwarded and reviewed several times after a certain period (e.g., the graphing data skill for students who will attend an examination that needs drawing a figure). Some contents have high readings and forwards in a certain day (e.g., the special event or activity on the day the content is sent).

All of these reports gave some good suggestions on how to improve future contents for class or time to send the class/content to learners. WeChat also provide group function to group users in special attributes. Different class for different groups of users can be sent to special groups to increase the learners' experience of learning. The functions are still under developing, and the future functions are expected to be enhanced to provide better experience for both designers and users.

Another useful function for curriculum design on WeChat is the automatic reply functions. They are introduced in the following section.

## 4.3 Automatic Reply for Curriculum Design

The automatic reply functions are very good source of interactive functions to engage learners. With a well-designed logic, it can work like a dictionary, a robot to reply questions, or even a mobile game that leads learners to think and find the answers by themselves. As shown in Fig. 11, the automatic reply (from the Early Childhood Education public account) when a user is added to this public account is a welcome message that will be sent to any new follower. To engage users, a group chat address can be added to engage the users who want to learn from other peers and share their knowledge and experience with others.

Figure 12 shows the automatic reply to users who are searching/sending information without using the keywords (which are already set up in this public account) from the Early Childhood Education public account. The designer can introduce the keywords to users to lead them to the correct information that they are searching. The teacher can also encourage learners to send questions or information back to this public account and review and reply questions in the message management.

The automatic reply with keywords is a useful function for curriculum design. A good combination of keywords can make the learners feel like chatting with a real person (just like artificial intelligence robot on instant communication tools) or doing a game and searching for an answer. It can also be set by sorted names and numbers to facilitate the user's searching for related contents or classes. English keywords, Chinese keywords, or numbers are accepted as keywords. But duplicated keywords can only be searched by the latest one.


**Fig. 11** Welcome automatic replies (Source: From this study by author)

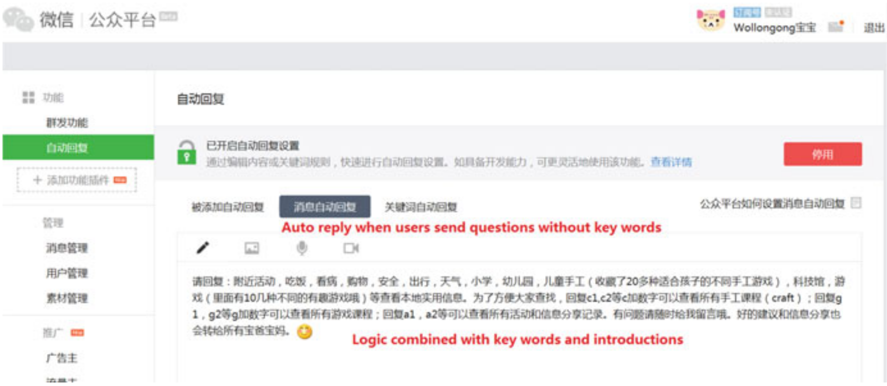


**Fig. 12** Non-keyword automatic replies (Source: From this study by author)

Figure 13 shows the automatic replies from the Mobile Class public account with different class names and numbers for searching.

### 4.4 Message Management for Communications

Message management provides a good communication and interactive interface with users or learners. But only the messages that the users sent to the public account within 5 days are available in the list. And if the manager of the public account did not reply the message (not including the automatic replies), the message cannot be replied manually. This is a disadvantage of WeChat public account. And the expected reply period in Australia and China is also different due to their cultural backgrounds.

As shown in Fig. 14, the message management shows sender's name, message body, and date and time of the message. The manager can save or reply the message manually. The keyword message is hidden from this message list, but the manager can open all messages by ticking the box of the hidden message function. The replied messages (either automatically or manually) are marked as "already replied" in red after the date and time of each message so the manager can focus on the messages that have not been replied.

Like the content or users, the message analysis page also provides detail of reads, changes, trends, and numbers of messages per person.

Figures 15 and 16 show the message analysis page for message report. They provide a good report on learner's interactive with the public account and their interests of the class that had been sent. Another important report in the message analysis function is the keywords report. As shown in Fig. 17, the keywords report gives a good ranking on hot keywords searched by learners. The teacher can easily see where the major questions or concerns are.

From this study, WeChat provides a very powerful platform for mobile teaching and learning, which includes design of curriculum, development of teaching


**Fig. 13** Keyword replies (Source: From this study by author)

materials, interaction with students, and communication or chat between users, and more than 800 potential learners are already on this platform. It provides very good analysis tools for designers and teachers in enhancing their teaching curriculum, doing innovation on their class, and conducting personal education to special groups of learners.

## 4.5 Combined with Off-Line Activities

The messages from users showed that the celebrating events or activities, humor content or title in class, beautiful photos or pictures (such as food), and personal information (linked to real-life example or real person) lead to more reads and forwards. A group activity is designed on the WollongongBaby public account in collaboration with the Wollongong City Council for the annual festival in Wollongong – Viva La Gong. The WollongongBaby group led the biggest group of people and prams in the parade in Viva La Gong. A total of 70 people registered for this activity on the WollongongBaby group and more than 50 showed in the parade. Figure 18 shows the group parade on 8 November 2014 in Viva La Gong, Wollongong, NSW, Australia.

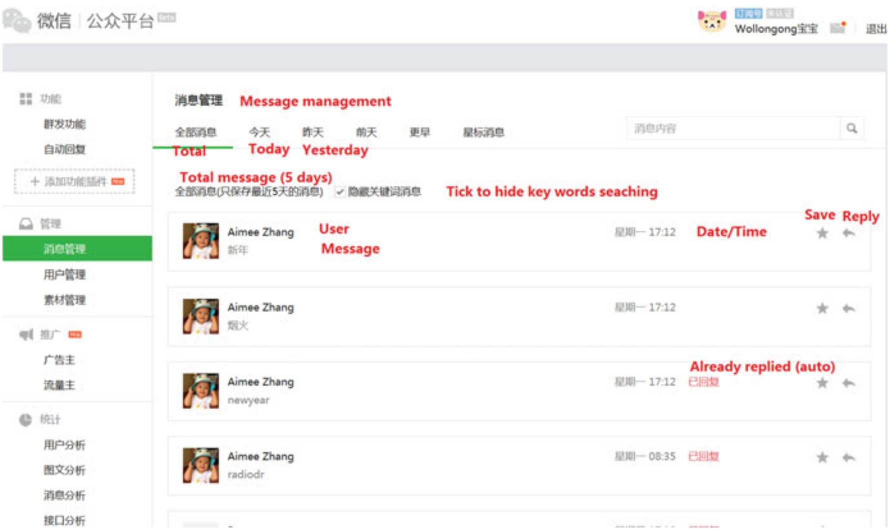


**Fig. 14** Message management (Source: From this study by author)

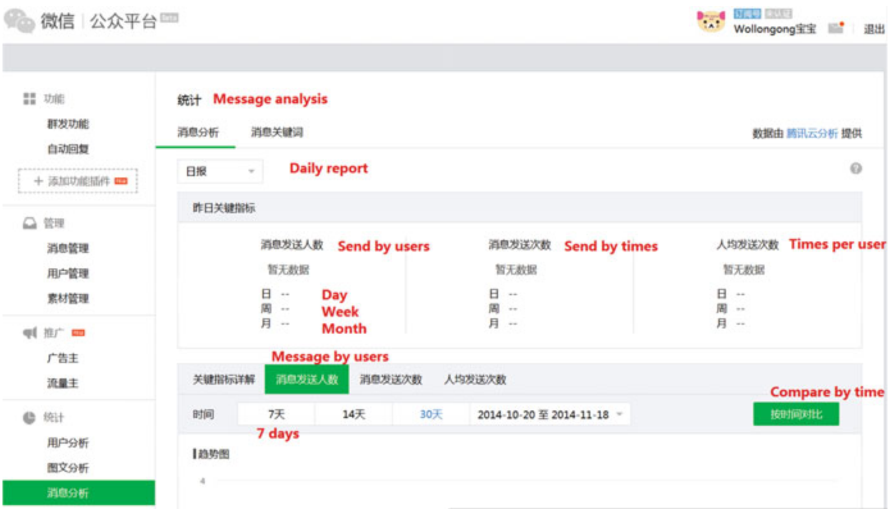


**Fig. 15** Message analysis page (Source: From this study by author)

As shown in Fig. 18, all the decorated posters (on the sides of prams) are printed and distributed to parents before the parade. An educational class was designed and made to teach people how to decorate themselves and the prams with these printed posters. All parents have showed great interests and did a great job to make it real.

Ms. Tian Lu, a mother from the baby group, also made a dancing dragon based on the educational craft class on the WollongongBaby public account. The dragon

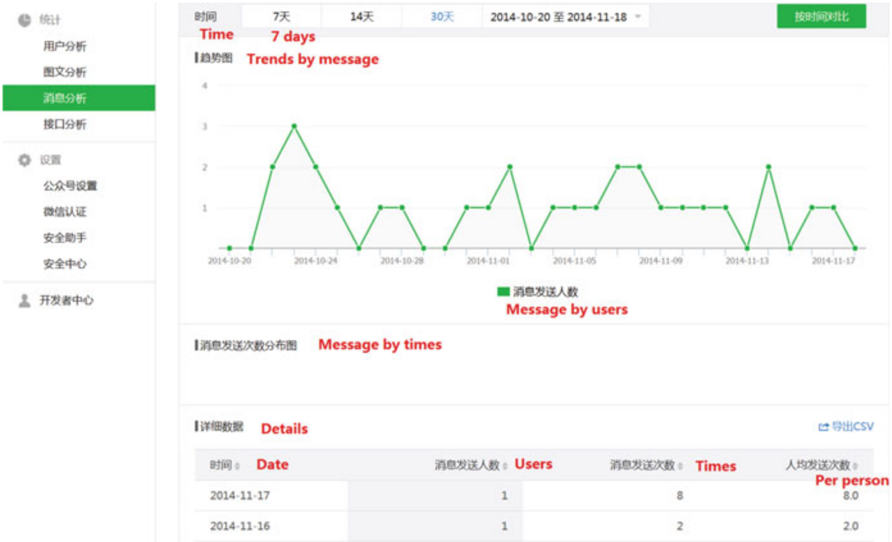


**Fig. 16** Message analysis page 2 (Source: From this study by author)

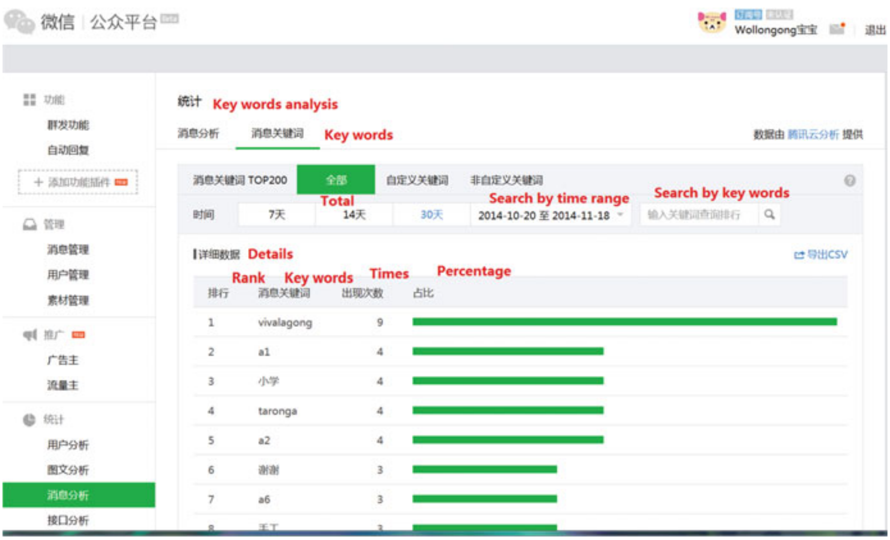


**Fig. 17** Keywords analysis (Source: From this study by author)

was held by two 5-year-old kids (Daniel and Jacky) during the whole parade and attracted many people in the parade. Figure 19 shows the dancing dragon craft from Tian (mother of a 4-year-old boy in the baby group). Parents even made traditional Chinese forehead prints and nontoxic painting colors all by themselves to support the group. A local business owner (a mother in the group) also supported the girl's

**Fig. 18** Viva La Gong Wollongong Baby group parade (Source: From this study by author)

**Fig. 19** Viva La Gong dragon craft held by two boys (Source: From this study by author)

traditional cloth. All of these efforts from learners and participants made Viva La Gong parade a great success for the WollongongBaby group. It also led to the top response and comments in the WollongongBaby WeChat class. Viva La Gong had been on the top of searching for keyword in the WollongongBaby public account. Comments and likes increased dramatically after the event. Parents also shared photos, videos, and their comments in group chatting and personal timelines on WeChat before and after the activity.

## 5 Future Directions

Social media has been developed and introduced into teaching and learning for many years. But the new mobile social media is a challenge for all previous social media. As a new social media born with mobile, WeChat developed very fast in terms of its registered users and functions (800 million users within 3 years). This study established three different WeChat pubic accounts for research and teaching purpose and collected qualitative results from all the analysis report, users' feedback, and message report.

From this study, mobile class with social media is better to be linked with group chat and off-line activities. Group task generated best learning and communication on WeChat platform. The contents with educational information, humors, and celebrations attracted more interactions. WeChat provides very good analysis tools and users' base for mobile education. The trust levels between users are high.

Different functions of WeChat and WeChat public account are good for different expression of knowledge, sharing of knowledge, group discussion, and feedback collection. WeChat can support subgroup of users for a public account. The manager can create different subgroups and put users into each group, such as group by gender, group by location, group by educational level, group by interests, or group by age. Educators can design, develop, and send different materials to different group of learners to achieve personalized learning. This function is also useful for businesses if they want to target different groups of users. New technology and new social media provide many new innovative functions for teaching and learning. To make a good use of different tools, educators should keep studying the new skills and platforms as well as get involved in the learners' preferred social media. Social media education is not a one-go class. It requires continuous promotion, enhancement, maintenance, and communication. Content is king for social media. So does for educational public accounts.

The future use of WeChat for educational purpose can focus on curriculum design on logic combination, multimedia content development, subgroups to engage different groups of learners, and connection with off-line activities and group chat. It is identified as the future trend for learning and business.

## 6 Cross-References

▶ Advanced Image Retrieval Technology in Future Mobile Teaching and Learning
▶ Characteristics of Mobile Teaching and Learning
▶ Tutors in Pockets for Economics

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# Mobile Learning in Southeast Asia: Opportunities and Challenges

# 26

Helen Farley and Helena Song

## Contents



**Abstract**

Mobile learning has been adopted to a varying extent across the countries of Southeast Asia. Though mobile learning initiatives in the UK, Europe, the USA, and Australia are well-documented, much less is known about mobile learning initiatives in Southeast Asia. This region is culturally and economically diverse, containing both developed countries such as Singapore and developing countries including East Timor. This range of economic development means that the penetration of telecommunications technologies, including infrastructure to support mobile and internet networks, varies vastly, and the extent to which

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this technology is used for learning similarly varies. This chapter begins with an examination of the mobile device market penetration in the various countries of Southeast Asia and the particular demographics of those users. Internet censorship potentially will impact on mobile learning initiatives in some countries and this is examined briefly. The status of mobile learning in a cross-section of Southeast Asian countries will be examined, with a particular focus on government policies, critical infrastructure, and notable mobile learning initiatives. The chapter concludes with a review of the enablers and barriers to mobile learning in Southeast Asia and a look at future directions.

## 1 Introduction

Southeast Asia is a diverse region consisting of both developed countries and developing countries. It is not only economically diverse but also culturally diverse, shaped by extremes of climate, a diversity of religions, politics at both ends of the spectrum, and a multitude of languages. Southeast Asia incorporates the archipelagos of the Philippines, Malaysia, and Indonesia with East Timor, Singapore, Cambodia, Laos, Myanmar, Thailand, and Vietnam. Given this diversity, it is unsurprising that the levels of infrastructure available for information and communication technologies also varies between countries, even between neighboring countries.

This chapter will first look at how access to internet and to mobile internet varies across the countries of Southeast Asia. Necessarily mobile learning requires access to mobile devices, so rates of ownership, affordability, and access across a number of countries in the region are detailed. Internet censorship is a significant factor, potentially impacting on mobile learning initiatives. How internet censorship varies between various Southeast Asian countries is briefly examined along with what is specifically censored in each case. The following part of the chapter focuses on a cross-section of Southeast Asian countries, looking at their own particular context and examining significant mobile learning initiatives that have been deployed. The chapter concludes with an examination of the barriers and enablers to mobile learning in Southeast Asia and a consideration of the future direction of mobile learning in the region.

## 2 Access to Internet and Mobile Internet in Southeast Asia

On May 16, 2011, the United Nations declared that access to the internet was a human right. That statement has implications for governments in terms of the provision of infrastructure, hardware, social access, and so on (La Rue 2011). In Southeast Asia, there are three distinct levels of broadband internet penetration (Deibert et al. 2012). In the first grouping are Brunei, Malaysia, and Singapore which have high levels of mobile, broadband, and computer penetration. The second group is made up of the middle-income countries, Indonesia, the

Philippines, Thailand, and Vietnam. These countries have high levels of mobile penetration, but quite low levels of broadband internet and computer penetration. The third grouping includes Cambodia, Laos, and Myanmar, which have low levels of mobile, broadband internet, and computer penetration (Jeroschewski et al. 2013). Even though many do not have access to reliable broadband internet, the demand for internet and associated services is rapidly increasing (Jeroschewski et al. 2013). Counterintuitively, the number of internet users is growing more quickly than the number of internet subscriptions. Public access points, including internet cafes, account for this difference. For example, in Indonesia, around 7,500 "Warnets" short for "Warung Internets" supply affordable internet access to people in Java. Similarly, in the Philippines and Thailand, internet or cyber cafes provide affordable internet access to those who could not afford a connection in their home (Jeroschewski et al. 2013). Even with these constraints, the region has made remarkable progress in the last 10 years (So 2012).

Broadband internet penetration is restricted in most countries within Southeast Asia due to the poor infrastructure. This is mostly attributable to a lack of private investment coupled with the severely limited capacity of the people to pay for services (Jeroschewski et al. 2013). Singapore and Malaysia are the significant exceptions to this technological deficit. New investors have focused their resources on providing infrastructure for mobiles rather than for broadband internet (Jeroschewski et al. 2013). In addition, a lack of access to electricity in Myanmar, Cambodia, and Laos necessarily limits the uptake of computer technologies. This is especially true in rural regions in these countries where the demand is not high and the disposable income of the residents is lower (Jeroschewski et al. 2013).

In many developing countries, and those of Southeast Asia are no exception, mobile technologies have been adopted at greater rates, as compared to personal computers, also because tablets and smartphones are more affordable and easier to use (Zambrano et al. 2012). Even with the emphasis on supporting infrastructure for mobiles, there are three factors that hinder the penetration of mobile broadband. The first is lack of knowledge of potential users about the availability of mobile internet and the services it can facilitate (Jeroschewski et al. 2013). The second factor relates to affordability. The cost of buying a phone, a sim card, and any upfront fees associated with holding a mobile account can account for a large proportion of a person's income (Jeroschewski et al. 2013). The third significant barrier is the lack of availability of internet-enabled phones, particularly smartphones in some areas. In most areas, feature phones are still the main kind of phone available (Jeroschewski et al. 2013). In some areas this is rapidly changing and one in four people own a smartphone as they become more affordable (Jeroschewski et al. 2013). Southeast Asia benefits from its relative proximity to China where many unbranded, affordable smartphones are being manufactured (Jeroschewski et al. 2013) with some being used for mobile learning (see ▶ Chap. 29, "Mobillizing the Middle Kingdom: Bringing M-Learning to High Schools"). Even so, in many countries in Southeast Asia, there is potentially a very large digital divide which often restricts access to education (Bandalaria 2005).

## 3 Internet Control and Censorship

Governments across Southeast Asia have to balance the increasing sophistication and availability of emerging ICTs on the one hand with social stability, cultural values, and security on the other (Deibert et al. 2012). In this region, there are some of the world's most liberal societies and some of the world's most restricted, all in close proximity (Deibert et al. 2012). Along with the growing dominance of mobile technologies in the marketplace, there is a corresponding increase in governments' abilities to monitor and control access to the internet and all that can be retrieved with it. This monitoring generally manifests in the form of centralized filtering mechanisms, regulators to monitor content, and prosecutors to address transgressions (Deibert et al. 2012).

Myanmar and Vietnam are among the most restrictive regimes with a particular focus on the restriction of independent media, material that could be considered to be politically sensitive, pertaining to human rights or political reform (Deibert et al. 2012). A report by the Berkman Centre of the Internet and Society (2006) revealed that Vietnam has sophisticated and effective filtering systems that resemble those of China. It is important for educators to understand the extent to which internet censorship may impact on mobile learning in Vietnam. Social networks, for example, are often used in mobile learning scenarios to encourage collaboration and sharing of information. In Vietnam, however, local authorities partially or wholly block access to sites such as Facebook (Subramanian 2012). Only a third (33 %) of consumers in Vietnam over the age of 15 have a social media profile on a platform called Zing Me and 28 % have an active Facebook profile (Nielsen 2011). Though a previous investigation of internet censorship showed no active censoring of information in Indonesia, more recent investigations suggest that pornography, select political and blasphemous content, and internet-tool-related content are censored. In Thailand, content related to politically sensitive events is filtered. In 2009, 44,000 websites were actively blocked by the nation's government (Deibert et al. 2012). By way of contrast, Singapore only censors a relatively small number of sites, generally of a pornographic nature (Deibert et al. 2012). There is no evidence of filtering in Malaysia or the Philippines (Deibert et al. 2012).

## 4 Ownership of Mobile Devices in South East Asia Countries

Data suggests, that in some regions, mobile devices are being purchased instead of computers. In countries such as Cambodia and Laos, people won't have access to a PC, but they will have access to a mobile phone (So 2012). This popularity of mobile devices is reflected in rates of mobile subscriptions as compared to the population. Commonly across Southeast Asian countries, there are more mobile phone subscriptions than people. The level of mobile phone subscriptions in Singapore is 153 %, in Vietnam is 149 %, in Malaysia is 141 %, in Cambodia is 132 %, in Thailand is 120 %, in Indonesia is 115 %, in Brunei is 114 %, and in the

Philippines is 107 %. Even in a relatively economically disadvantaged country such as Laos, there are still roughly as many subscriptions as people (102 %) (Greene 2013).

Smartphones have more affordances to be leveraged for mobile learning, though levels of smartphone ownership as compared to feature phones remains relatively low across most of Southeast Asia. Of mobile phone users, the percentage of those who own smartphones are 15 % in the Philippines, 23 % in Indonesia, 49 % in Thailand, 80 % in Malaysia, and 87 % in Singapore (Greene 2013). These figures are based on data collected by Nielsen Holdings who tend to concentrate their research on urban areas (Greene 2013). Those figures are generally lower for the countries overall. Data collected by Pew Research indicates that in Malaysia, 89 % own a mobile and 31 % own a smartphone; in Indonesia, 78 % own a mobile and 11 % own a smartphone; and in the Philippines, 71 % own a mobile and 17 % own a smartphone. Predictably, smartphone ownership tends to be higher in countries with higher per capita income (Pew Research Global Attitudes Project 2014).

In addition, smartphones tend to be owned by people under 30 (Hussin et al. 2012). In Malaysia, 49 % of 18–29 year olds own a smartphone, 30 % of 30–49 year olds, 11 % of 50+ year olds (Pew Research Global Attitudes Project 2014). In the Philippines, 24 % of 18–29 year olds own a smartphone, 18 % of 30–49 year olds, and 9 % of 50+ year olds. In Indonesia, 18 % of 18–29 year olds own a smartphone, 9 % of 30–49 year olds, and 3 % of 50+ year olds. This creates some opportunity for mobile learning with higher levels of smartphone ownership among the demographic that are most likely to engage in formal learning.

Tablets are a low cost, flexible alternative to laptop and desktop computers, suitable for learning due to their ability to leverage mobile apps and their portability. They are suited to collaboration and are able to capture data (Johnson et al. 2012). Tablet ownership and penetration among mobile users in a cross section of Southeast Asian countries is rapidly increasing: there are 47 % in Singapore, 42 % in Malaysia, 16 % in Thailand, 5 % in Indonesia and 5 % in the Philippines. These figures are as a percentage of mobile phone users in urban areas (Greene 2013). Though these figures are increasing, the overall penetration rates remain too low to leverage ownership for mobile learning. This would indicate that mobile learning initiatives designed for use in most Southeast Asian countries should be designed with smartphones in mind, and to ensure high levels of adoption, with feature phones in mind.

In order to maximize the benefits of BYOD policies in educational institutions, any mobile learning intervention should leverage the affordances of mobile devices and users' familiarity with those devices. It is therefore useful to consider how people in this region are using their mobile phones. The most popular use of mobile phones, after making phone calls, is texting (Pew Research Global Attitudes Project 2014). This is probably due to the very low cost of texting as compared to calling. In Malaysia, 89 % own a mobile phone and 89 % (of mobile phone owners) text, 51 % take pictures or video, and 27 % access social media. In Indonesia, 78 % own a mobile phone, 96 % of those people text, 46 % take pictures or video, and 23 % access social media. In the Philippines, 71 % own a mobile phone, and of those

99 % text, 54 % take pictures or video, and 17 % access social media (Pew Research Global Attitudes Project 2014). These figures should be kept in mind when designing mobile learning interventions. If the educator is going to ask students to use their phones in a way that is unfamiliar to them, sufficient training must be supplied in order to ensure the efficacy of the intervention.

## 5 E-Learning and Mobile Learning in Southeast Asia

Due to the poor access to broadband internet, and in some cases even electricity, there has been a marked lack of success with e-learning in many parts of Southeast Asia. Recent data suggests that prices for mobile phones and internet access have dropped substantially, opening the door for mobile learning initiatives in these poorer countries (So 2012). Even though mobile devices and subscriptions may still provide a significant cost for many people, mobile technologies are more affordable than both broadband internet and desktop or laptop computers. In addition, mobile learning provides study options to learners who are geographically remote from physical campuses and allowing them to fit study around their work or carer commitments (Chun and Tsui 2010). This flexibility is being demanded by learners, who want to learn wherever and whenever they want (Johnson et al. 2012). Mobile learning allows for both formal and informal learning (see ► Chap. 46, "Moving Towards the Effective Evaluation of Mobile Learning Initiatives in Higher Education Institutions"). In using their own devices, students are beginning to learn how to use their networks for more than just texting, allowing them to learn to "just in time" in response to emerging questions or problems. It also supports "discovered" learning where students discover the relevance of information for themselves, apt for their particular learning context (Johnson et al. 2012). There is also a move away from traditional didactic methods towards challenge-based and active learning, leveraging the affordances of mobile technologies to allow learning in real-world situations (Johnson et al. 2012).

Mobile learning affords flexibility in open and distance learning institutions (Hussin et al. 2012), allowing those in rural areas greater access to education (Clothey 2010; So 2012; Jambulingam and Sorooshian 2013). Students are more and more wanting to use their own mobile technologies for learning. Mobile phones and tablets are viewed as an extension of an individual's personality and learning style. Learners are familiar with using the devices in their personal lives and educators can leverage that familiarity to allow students to use these devices for learning (Valk et al. 2010; Johnson et al. 2012). For example, in 2010 researchers in Malaysia surveyed university students with some 84 % of them wanting to participate in mobile learning activities. However, most did not want to incur data usage charges as part of that participation. Interestingly, less than half (46 %) thought that their institution was ready for such a step (Hussin et al. 2012). In the Philippines, learners' familiarity with their own mobile devices was one of the reasons the University of the Philippines Open University decided to use mobile learning.

No expensive training was required as people were already familiar with how to use their own devices (Bandalaria 2005).

As a consequence, institutions are increasingly adopting BYOD (Bring Your Own Device) policies. Students can use their own devices for learning and well as in their personal lives (Johnson et al. 2012). By adopting these policies, institutions can spend less money on mobile learning overall. Though they do have to provide infrastructure to support a variety of devices, it is still less expensive than also buying the technology (Johnson et al. 2012). There is no longer any expectation for universities to provide technology directly to students. Since older students are likely to possess their own mobile devices, universities can take advantage of existing devices to encourage mobile learning activities, without having to purchase mobile devices for students (So 2012).

Even though rates of mobile ownership are high in many parts of Asia (Chun and Tsui 2010), a survey of mobile learning articles in five prominent educational technology journals revealed that only one Southeast Asian country appeared in the list of the top 22 contributing countries – that country was Singapore (Hwang and Tsai 2011). Though there could be a number of reasons for this, including English not being the first language of educators, it is potentially indicative of the small numbers of mobile learning initiatives occurring in this region.

## 6 Technology Trends Impacting on Mobile Learning in Southeast Asia

There are a number of global technology trend that are also impacting on mobile learning in Southeast Asia. The impact of these trends are most evident in the more developed countries such as Singapore or Malaysia. These trends include cloud computing, social networking, and mobile applications or “apps”.

In 2012, cloud computing was heralded by technology in education forecasters, the New Media Consortium (NMC), to be adopted within a year or two within K-12 in schools in Singapore. Though Singapore is a wealthy country with good access to both technology and ubiquitous connectivity, cloud computing is expected to make an impact in education on most countries across Southeast Asia. It allows for a shared pool of learning courses, digital assets, and resources to be accessed by educators and students. The cloud can be accessed via computers or laptops but also by a range of mobile devices (Teal et al. 2014). The learner is able to plug into this cloud anywhere and at any time using a mobile device (Teal et al. 2014). The cloud is especially useful in mobile learning as it removes the necessity for storing resources on the phone or tablet which have a necessarily restricted storage capacity.

Social networking is increasingly being used by educators to promote interactivity in classrooms and to enhance collaborative opportunities. Interestingly, people in Southeast Asia are some of the world’s most frequent users of popular social networking sites such as Facebook and Twitter. In 2010, Indonesia, the

Philippines, and Singapore were among the top ten Twitter users in the world. Similarly, the Philippines and Indonesia are among the top ten markets of unique Facebook users, ranking third and fourth respectively. Though these social networking sites are popular, they are not always accessed by mobile devices. Once people are online, they are very often using social media. In the Philippines, once online, 86 % of people are using social media. In Indonesia, this number is 84 % and in Malaysia, 76 % (Jeroschewski et al. 2013). With these numbers, it allows the features of social networking such as discussion boards, the ability to broadcast announcements to select groups, share photos and videos, and so on to be leveraged for mobile learning. Anecdotal evidence would suggest that groups of students frequently form Facebook groups to offer mutual support and discussion opportunities in specific courses and programs. The use of web 2.0 tools to collaborate is becoming increasingly popular in Asia (Tsai and Hwang 2013), including Southeast Asia.

In 2012, mobile apps or "applications" were predicted to be adopted in 1–2 years in Singapore. Mobile apps are low cost software extensions to smart phones that challenge the dominance of large, integrated software suites such as Microsoft Office (Johnson et al. 2012). Apps frequently have social functions that can allow sharing of content and discussion between users. Augmented reality apps can allow for exploration of historical sites with just-in-time information. Apps can also allow for creation of content, leveraging the features of the smartphone such as camera and sound recording features (Johnson et al. 2012). The literature indicates that discipline-specific mobile apps will become more popular. For example, there are large numbers of apps for foreign language students including dictionaries and flash cards. For almost every discipline, there are a number of apps available for both Android and iOS devices (Oz 2013).

Electronic publishing is making a significant impact on education across the world, often through large publishing companies such as Pearson or Wiley. Publishing in this manner allows for infinite reproduction at low cost while incorporating rich media and publishing to a number of platforms, including mobile (Johnson et al. 2012). The distribution of electronic publications becomes particularly easy through distribution channels such as iTunesU. In 2012, it was said by the NMC to be adopted within 2–3 years in Singapore (Johnson et al. 2012). Enhanced electronic textbooks that can be accessed on mobile devices, particularly tablets, are being used instead of hard-copy textbooks in some countries. These electronic textbooks boast more interactivity and a range of multimedia (Johnson et al. 2012).

Gamification is the incorporation of gaming or gaming elements into educational experiences. Games have been proven effective for learning skills and beneficial in cognitive development (Johnson et al. 2012), and are increasingly featuring in the literature pertaining to global education. Consequently, gamification has been used increasingly in education in Asia for the past 10 years (Tsai and Hwang 2013). Games used for learning across a variety of disciplines are generally goal-oriented, have strong social components, and simulate some real-world experience (Johnson et al. 2012). The NMC predicted in 2012 that gamification would be adopted in 2–3 years in K-12 education in Singapore (Johnson et al. 2012).

As indicated earlier, the most common use of mobile phones, after making phone calls, is texting. There are numerous examples of mobile learning initiatives that have relied on text (Chun and Tsui 2010). Mobile learning initiatives that use texting are very useful as all phones as both smartphones and feature phones can be used for texting. Examples of this kind of learning would include SMS quizzes, where students would receive immediate feedback on their scores. Only in exceptional cases would students need to communicate directly with lecturers or teachers (Mohamad and Woollard 2010). The benefits of immediate feedback are well-documented (e.g., see Peck et al. (2013)), encouraging students to become independent learners (Mohamad and Woollard 2010). Though this is hardly a new trend, texting being widely available for many years, it remains significant, particularly in the developing countries of Southeast Asia.

## 7 Mobile Learning in Particular Southeast Asian Countries

As previously indicated, the countries of Southeast Asia are economically, culturally, and politically diverse. The best way to explore this diversity and its impact on mobile learning is to investigate the status of mobile learning in a cross-section of countries, including government policy and particular mobile learning initiatives.

### 7.1 East Timor

It is very difficult to find information about mobile phone use and about mobile learning initiatives in East Timor. It is likely that this is in part with the amount of resources expended by East Timor to gain independence from Indonesia which finally occurred in 2002 (Marques et al. 2013). Now that independence has been achieved, the government can focus its efforts on reconstructing the country, particularly its struggling education system (Marques et al. 2013). One of the implications of independence from Indonesia was the resulting lack of teachers. Most teachers were Indonesian and subsequently returned to Indonesia after independence (Marques et al. 2013). It has been a struggle for the government and NGOs to make headway in a country where enrolment in school is just 70 % of school age children and literacy rates remain very low (Marques et al. 2013).

Only in recent times has the one-company monopoly over the supply of mobile phones been broken. Mobile phone ownership is now rapidly increasing (Cochrane 2012), though lags far behind other Southeast Asian countries. Though UNESCO has recommended that ICTs and in particular mobile technologies be employed (Capelo et al. 2014), there is little evidence that this has happened. A project whereby SMS messages were sent to new or expectant mothers to give them information about their particular stage of pregnancy or infant development appropriate to them has been trialed. If successful it will be rolled out more extensively (Cochrane 2012). This was the only mobile initiative that the authors could discover.

## 7.2 Indonesia

There have been significant improvements to Indonesia's education system over the past 40 years. The government has worked to decentralize education and thus improve access in rural areas and significant work has been done to improve teacher education (Suharti 2013). Indonesia's population is spread across 13,000 islands, making the provision of education challenging (Bahar 2009). Consequently, much education is delivered at a distance (Soekartawi and Librero 2002). Originally, teacher education was the focus of distance education as most teachers, especially those in rural areas, had low levels of competency (Soekartawi and Librero 2002).

High mobile phone penetration in Indonesia makes it an ideal place for mobile learning (Alamsyah and Ramantoko 2012). One of the issues with mobile learning in Indonesia is that reliability and quality of connection is frequently compromised due to too many concurrent users on the networks (Alamsyah and Ramantoko 2012). One way to overcome this would be to have students come to campus and access the university's internet via Wi-Fi (Alamsyah and Ramantoko 2012). Though this will enable connectivity, it negates many of the positives associated with mobile learning such as access from geographically remote locations and the potential for contextual learning.

In Indonesia, teachers' participation in training is limited due to training location, time, cost, and opportunity (Yusri and Goodwin 2013). Despite various ICT training programs being conducted for teachers' professional development, the ICT skill level of teachers in Indonesia is still quite low as shown by the National Examination of Teachers' Competency which was conducted online in 2011 and 2012. Many failed simply because of their low basic ICT skill level. They did not know how to use a mouse and keyboard, how to open the examination applications, and how to answer the online examination (Yusri and Goodwin 2013). If teachers have low levels of competency in ICTs, it is nearly impossible for them to design and deliver mobile learning initiatives effectively. Much work remains to be done in this area.

## 7.3 Malaysia

High levels of ownership of mobile devices indicate that Malaysia may be ripe for mobile learning (Mohamad and Woollard 2010). Malaysians are also among the most prolific users of their smartphones, spending nearly 6½ h per week using them (NST-Business Times 2013). A number of mobile learning initiatives has been developed in Malaysia already, both in schools and in higher education settings (Mohamad and Woollard 2010). Other affirmative developments include the formation of the Mobile Learning Association of Malaysia (MLAM), which was officially registered on 21 January 2011; as well as the first International Conference on Mobile Learning, Application and Services (mobilcase2012) that was held in September 2012 (Song et al. 2013). In 2014, a Mobile Learning Symposium was held at the Multimedia University in Cyberjaya which attracted educators and postgraduate students from across Malaysia (Farley 2014).

The National Higher Education Plan (PSPTN) developed by the Ministry of Higher Education is a document that indicates the direction of national higher education in Malaysia. Its purpose is to realize the country's aspirations to become a developed, prosperous, and competitive nation. The implementation of the National Higher Education Plan is to be deployed in set phases and the Ministry of Higher Education has developed 21 Critical Agenda Projects to help achieve this. Mobile learning has been identified as one of the Critical Agenda Projects of the Ministry of Higher Education. The potential of mobile learning initiatives often remain unrealized in Malaysia due to a lack of access, bandwidth, and high cost to students (Embi et al. 2013).

There are a number of groups in the Malaysian higher education sector who are actively implementing and researching mobile learning initiatives in Malaysia (Song et al. 2013). But even though mobile learning research has been steadily increasing in Malaysia, the deployment of mobile learning in higher education courses and programs has not been widespread (Embi and Nordin 2013).

## 7.4 The Philippines

It is difficult to implement distance education strategies in the Philippines due to the fact it is an archipelago of 7,107 islands which makes providing infrastructure difficult (Bandalaria 2005; Marques et al. 2013). Even so, there have been a number of successful mobile learning initiatives deployed in the last several years. By 2010, almost all of the courses and programs offered by the University of the Philippines Open University (UPOU) used some degree of mobile learning (Bandalaria 2005). The university has a mandate to provide high quality education to people no matter where they are and no matter what their circumstances. The university made a strategic decision to go fully online and in doing so inadvertently excluded large parts of the population from participating. The use of mobile learning helped to alleviate this disconnect to a certain extent (Bandalaria 2005).

There are relatively high levels of mobile penetration in the Philippines and the population are enthusiastic texters, mostly because it is far less costly to text than to call (Bandalaria 2005). As people are using their mobile phones as part of their everyday lives, no expensive training was required in order to teach people how to use their mobile phones for learning (Bandalaria 2005; Clothey 2010). In addition, the learning became almost synchronous as educators could take a few moments to answer a student's query whenever a text arrived. The educator could be traveling on public transport or waiting for an appointment (Bandalaria 2005). The UPOU used mobile phones for learning in a number of ways: to deliver short bites of course content to learners via their phones (in the early days, via feature phones); tutorial support or student consultation with educators; administrative support for learners; notification of results; and dissemination of information about other programs (Bandalaria 2005).

The Text-2-Teach project in the Philippines is an example of a successful large-scale project that used mobile technologies to deliver educational content to a diversity of schools. Since its launch in 2004, the Text-2-Teach project has provided schools with mobile learning resources in English, mathematics, and science (Natividad 2007). Students could readily download audio and video resources using their mobile phones. Teachers could also send SMS requests for educational resources to be delivered via satellite to a school television. The project was scaled up, reaching approximately 4,000 students in over 500 schools in the Philippines in 2011 (Ayala Foundation 2011). Similar projects have emerged elsewhere in the developing world where access to internet and computer technologies is limited (see ▶ Chap. 27, "Increasing Learning Outcomes in Developing Countries by Engaging Students Out of the Classroom Using SMS and Voice Mobile Technology").

## 7.5 Singapore

As one of the wealthiest countries in Southeast Asia, Singapore has systemic nationwide planning in ICT. The project FutureSchools@Singapore, launched in 2007, is the government's initiative to build a new model for education by exploring innovative pedagogical approaches to the integration of ICT into school curricula (Koh and Lee 2008). Schools identified as "future schools" were awarded funding to transform their learning environments by deploying activities using ICT into the school's curricula. The Singapore Ministry of Education expected to spread the pedagogical innovations developed in "future schools" to other nonparticipating schools in Singapore (Tsinakos 2013).

While the use of mobile technology was not specifically mandated in the plan for FutureSchools@Singapore, some participating schools have already started exploring the potential of mobile learning through pilot projects. By way of example, Crescent Girls' School, one of the original "future schools," is making extensive use of tablets in the curriculum. All enrolled students have tablets preloaded with interactive digital textbooks. Nan Chiau Primary School, featured as a "future school" in 2011, has been trialing the deployment of mobile technologies into the curricula through various mobile learning initiatives since 2005 (So 2012).

## 7.6 Thailand

Students in Thai universities are ready and willing to trial mobile learning, yet mobile learning initiatives in these higher education institutions are relatively rare (Jairak et al. 2009). Research has shown that the price of mobile subscriptions, handset price, poor network coverage, and low disposable incomes of both educators and students hinder the uptake of mobile learning (Jiranantanagorn et al. 2012).

There have been some mobile learning initiatives in Thai higher education institutions, however. A mobile learning initiative was deployed at King Mongkut's Institute of Technology in North Bangkok. In this project, questions were displayed on a screen and the answers were texted using SMS (Librero et al. 2007). In this study, students were using feature phones with small screens and did express concern at trying to learn with such a small screen size (Valk et al. 2010). As smartphones gain more market share, this concern is likely to be less of a problem. Even so, 90 % of the participating students owned their own mobile phones (Motlik 2008).

## 8 Future Trends

A noteworthy feature of mobile learning in Asia, and more particularly, Southeast Asia, is the movement toward designing learning environments that are future focused. These spaces are typically enriched by technology whereby some or the entirety of the learning experience takes place virtually. As would be expected, this move is more evident in wealthier countries with strong ICT infrastructure including Malaysia and Singapore. In these countries, the government's focus is on designing technology-enhanced environments that satisfy the needs of contemporary, tech-savvy learners. Mobile learning, while not specifically discussed at a policy level, is subsumed under broader ICT plans to build future learning environments (So 2012), and is likely to result in more, wide scale mobile learning initiatives.

There are a number of special considerations that need to be kept in mind when designing mobile learning initiatives in Southeast Asia. The experience of participants with mobile learning or even with mobile phones may be highly variable; the access to and affordability of devices may be problematic; or internet searching, research, and access to social media may be impacted by internet censorship (Murphy et al. 2014).

Pedagogical theories need to be re-examined and modified by educators, taking into account the devices used and their affordances. Linking theories to technology will enable educators to better leverage those affordances, allowing them to make best use of the technological context (Embi et al. 2013; Tsai and Hwang 2013). However, the pedagogy must remain the primary concern above the technology (Bandalaria 2005). Deploying mobile learning becomes a balance of leveraging the affordances of mobile devices while not disenfranchising those learners who are unable to afford the latest models.

When designing mobile learning initiatives in developing countries, the rules and roles of the social relationships in the mobile learning space must be made explicit. Also, when designing mobile learning initiatives across cultural boundaries, special care must be taken to accommodate the cultural differences between designer and learner (Teal et al. 2014). Regional factors must be considered when designing for the learning behaviors of students. Each country has its own unique economic, political, and cultural context which may impact on how students can learn (Tsai and Hwang 2013). Instead of just using mobile devices for generic learning activities, as far as possible cultural learning and recognition must be incorporated into activities. For example, use mobile learning for cultural or social studies programs (Tsai and Hwang 2013).

Cost remains a barrier and must be taken into account when designing and delivering mobile learning programs. There can be significant costs associated with buying a mobile device and then buying internet access or phone subscriptions (Bandalaria 2005). This is obviously going to be a more significant issue in those countries when the per capita income is lower (Tsinakos 2013). However, some consider mobile learning to alleviate the costs associated with some modes of study, face-to-face for example. Mobile learning enables learners to study remotely without the need to travel to a physical campus (Valk et al. 2010).

Vigorous research is needed to establish the benefits of mobile learning in Southeast Asia. Large-scale initiatives need to be instigated so that good, reliable quantitative data can be collected to inform both future research and the future deployment of mobile learning (Tsai and Hwang 2013). There is an urgent need to measure the effectiveness and the efficiency of mobile learning systems (Bandalaria 2005). Additionally, good quality research can influence policy initiatives around technology-enhanced learning and inform the planning and resourcing of mobile learning initiatives (Hwang and Tsai 2011).

## 9 Future Directions

In 2012, UNESCO released a report which, among other things, looked at the enablers and barriers to mobile learning in Asia generally. The report named the following enablers: initiatives at the government and ministry levels; research in higher education institutions; and accessibility, connectivity, and affordability of mobile devices (So 2012). The governments of both Malaysia and Singapore have policy related to the deployment of ICTs in education which also includes mobile learning; it is unsurprising then, that a number of effective mobile learning initiatives have been deployed in those countries. Effective research is also being conducted in those countries. A number of academic groups are specifically researching mobile learning in Malaysia (Song et al. 2013); there are a significant numbers of academic papers being authored by Singaporean academics (Hwang and Tsai 2011).

The same report also identified a number of barriers to the adoption of mobile learning. Some of these are fairly unsurprising including the cost of mobile devices and subscriptions. Others indicate a lack of available information about the affordances of mobile devices and the benefits of mobile learning, as well as general concerns around mobile phone use. These barriers include concerns about the misuse of mobile phones; teachers' and parents' mindsets and attitudes; health-related issues (especially fear of radiation); lack of teacher training and support; and lack of high-quality educational content (So 2012). Lack of teacher support is often identified as a barrier to mobile learning and, for example, is the reason given for the low number of mobile learning initiatives in Indonesia (Yusri and Goodwin 2013).

It follows then that critical success factors include: a high market penetration of mobile phones; adequate technological infrastructure (wireless network and mobile applications); and specific professional development on mobile learning for teachers (So 2012). Educators need to address the blending of formal and informal learning. In many areas of Southeast Asia, traditional modes of didactic delivery are still dominant (Johnson et al. 2012).

## 10 Cross-References

▶ Increasing Learning Outcomes in Developing Countries by Engaging Students Out of the Classroom Using SMS and Voice Mobile Technology
▶ Mobillizing the Middle Kingdom: Bringing M-Learning to High Schools
▶ Moving Towards the Effective Evaluation of Mobile Learning Initiatives in Higher Education Institutions

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# Increasing Learning Outcomes in Developing Countries by Engaging Students Out of the Classroom Using SMS and Voice Mobile Technology

27

Danielle Reid and Christopher Pruijsen

## Contents



**Abstract**

Engaging students in developing countries through the out-of-classroom use of mobile technologies can increase learning outcomes, positively impacting the economy and the learners in the long term. Teaching and learning capacity in developing countries can be hindered due to limited access to resources.

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Resource limitations, such as access to electricity, educational materials, technical devices, improper teacher training, and low literacy rates, can limit learning and cause grade retention and student dropout. High repetition and dropout rates further limit resources and lead to overcrowded classrooms making this a never-ending vicious cycle. Basic, GSM-only-enabled mobile devices present an opportunity for engaging students, narrowing the gap in opportunity between the rich and the poor, urban and rural, and bridging literacy barriers by using interactive audio and text content. Full pedagogy of reading, writing, listening, and speaking can offer students a comprehensive learning aid. High mobile penetration and the low barrier to entry, ease of use, and cost effectiveness of mobile devices and technologies in developing countries make them an attractive opportunity for delivering education content. Content can be rapidly created and distributed at contextually relevant times to maximize engagement while actively involving both educators and students in the learning process. A number of mobile educational technologies have been successfully implemented, which demonstrate the benefit of mobile learning to increase student engagement and learning outcomes.

## 1 Introduction

Increasing learning outcomes positively impacts individual students as well as improves long-term economic returns in developing countries (Hanushek and Wößmann 2007). Students engaged in their education benefit from maximized learning outcomes (Reyes et al. 2012) and has been found to increase student grades (Klem and Connell 2004). However, engaging students both in and out of the classroom can be challenging, especially for students in low-income urban and rural areas, where conflicting demands between family and school exist (Cosden et al. 2001). Similarly, a lack of both teaching and learning resources leaves teachers short of time and students at a lower capacity to learn to their full potential. Lack of student engagement can lead to increased repetition rates, higher dropout rates, and the overcrowding of classrooms. This reinforces negative impacts on resources and leads to a self-fulfilling “vicious” cycle, which causes long-term negative effects on teachers, students, parents, and the economy.

High GSM mobile phone penetration in developing countries can be an effective medium to deliver educational audio and text content via interactive SMS and voice and to engage students out of the classroom. Mobile technology has been driving improvements in developing countries in trade, finance, information exchange, and education, which lead to economic benefits and increase gross domestic product (GDP) (Botha et al. 2010).

Interactive SMS and voice technologies delivered via mobile devices can offer students full pedagogy including reading, writing, listening, and speaking to deliver out-of-classroom learning and reinforcement content.

Teachers can embrace mobile technologies to automate the homework process, saving them time preparing, distributing, and grading homework while also enabling them to gain insights from the student result data, directly allowing them to support individual students and refine teaching methods through quantified data. The insights gained from student data can give educators and governments a comprehensive understanding of contemporary education across demographics and geography, to better allocate resources to aid educational development leading to long-term economic improvements. Teacher involvement in developing educational content both in and out of the classroom ensures a high standard of quality by directly relating content to specific, local, and contextually relevant learning topics. The potential of mobile devices and technologies to improve learning outcomes in developing countries will be discussed alongside current educational challenges facing developing countries, including student retention, repetition rates, overcrowded classrooms, lack of teacher training, and limited resources, and alongside contemporary examples of the successful implementation of mobile learning technologies.

## 2 Homework and Out-of-Classroom Learning Positively Impact Student Engagement

Student engagement is fundamental in increasing learning outcomes (Reyes et al. 2012). Higher levels of student engagement increase grades and school attendance compared to situations with lower engagement (Klem and Connell 2004). In-classroom engagement is dependent on prior preparation outside school (Reyes et al. 2012), which is where homework completion can directly increase engagement. Homework process and completion has been found to have a positive relationship on school results, demonstrated by increased class grades and standardized test scores (Cooper et al. 2006), as well as on student achievement (Trautwein 2007). Bempechat (2004) explains the critical impact homework has on the long-term development of students' motivation to achieve, as well as provide them with the time and experience to develop coping mechanisms and strategies to deal with critical feedback, mistakes, and setbacks. Homework also has the potential of involving both school and family, therefore positively impacting students' lives both in the classroom and at home (Felix et al. 2008). Lack of participation both in and out of the classroom, however, can negatively impact the learning process, where teachers become increasingly frustrated by their students' perceived lack of interest in learning, leading to decreased student motivation (Buijs and Admiraal 2013). Homework not only engages students, it reinforces educational concepts, as well as effectively bridges school and home, uniting teachers, parents, and students (Carr 2013). Van Voorhis (2011) found that homework effectively increased student achievement report scores by between 8 % and 31 %. Further, by actively teaching students to set homework goals, implement learning strategies and motivation techniques, and monitor and evaluate homework outcomes, homework effectiveness and engagement are increased (Bembenutty 2011; Carr 2013).

While the case for homework as a tool for increasing learning outcomes and student engagement is strong, teachers often face constraints which can hinder the creation, distribution, marking, and understanding of homework outcomes.

## 3 Teachers Face Constraints, Which Limit Their Ability to Effectively Engage Their Students

Teachers in developing countries are often faced with limited resources, overcrowded classrooms, restrictions on time, lack of training, and an inadequate repertoire of pedagogies, which places constraints on their ability to effectively engage their students. Classrooms are crowded, straining resources and causing difficulties in retaining students (Traxler and Leach 2006). The average size of primary school classes is 83.46 pupils per teacher in the Central African Republic (2012), 53.75 pupils per teacher in Ethiopia (2012), 51.12 pupils per teacher in Uganda (2011), and 37 pupils per teacher in Lesotho (2010) (UNESCO Institute for Statistics (UIS) 2014). In Kenya, the UNESCO Institute for Statistics (UIS 2014) reports that 30.8 % of classrooms do not have a teacher. Teacher shortage is such an issue in developing countries that UNESCO's EFA Global Monitoring Report (2011) estimated that Africa alone requires over 50 % of the 1.9 million teachers needed globally to reach the Education for All (EFA) goals by 2015. Further, if teacher attrition is considered, sub-Saharan Africa will need to recruit an estimated 350,000 new primary school teachers per year until 2015.

In addition to teacher shortages, teaching time is often compromised in Africa. Just 47 % of each school day is spent teaching in Kenya and 44.81 % in Uganda. This equates to roughly 197 min per day in 2013 (UNESCO Institute for Statistics (UIS) 2014). The lack of time spent teaching demonstrates several fundamental issues facing both effective teaching and learning processes and possibly represents undermotivated or overextended teachers, who are lacking necessary resources to teach effectively. South African teachers spend 18–36 % of their available teaching time simply inputting already graded marks, as well as a substantial amount of time on paperwork and preparation of homework (Kanjee et al. 2010). In developing countries such as Uganda (2012), just 19.5 % of teachers have a minimum amount of subject knowledge; and in Kenya just 65.7 % of teachers pass at 70 % threshold in math, language, and pedagogy exams, further highlighting a need for proper teacher aid and training, as well as additional teachers in developing countries (UNESCO Institute for Statistics (UIS) 2014). Due to these limitations as well as lack of awareness, teachers in developing countries can also lack proper education including homework creation, distribution, and grading, particularly when it comes to the use of mobile devices and technologies to deliver educational content (Isaacs and Hollow 2012). Bennett-Conroy (2012) suggests taking a teacher-driven approach to homework creation, which does not require additional reference materials and could include phone calls to deliver educational content and interactive assignments. The benefit of mobile devices as a facilitator to distribute material can be powerful if contextual empathy is considered. Lack of resources and additional educational challenges also extend to students in developing countries.

## 4 Limited Resources in Developing Countries Reduce Student Engagement

Students in developing countries face learning constraints limiting their ability to perform in and out of the classroom. Students lack access to resources such as textbooks, computers, and other data-driven devices due to cost, lack of electricity, and expensive data. These restrictions affect learning outcomes such as the literacy rate, creating further implications on comprehension levels and halting learning. Students begin to fall behind, potentially dropping out or repeating school grades. Limited resources such as textbooks prevail with primary school students in sub-Saharan Africa who are forced to share one mathematics textbook between 2.63 (2012) students, while in Uganda on average 3.11 students share a mathematics textbook (2011); and worse still in Cameroon, 13.92 students share a mathematics textbook in 2012 (UNESCO Institute for statistics (UIS) 2014). Limited access to curriculum material extends out of the classroom, where textbooks are too expensive, out of date, or inaccessible, which further limits potential engagement and the ability to complete homework effectively, especially in the case that additional reference materials are required. Access to electricity can be scarce in rural African regions. In Uganda, 90 % of primary schools do not have access to electricity (2011), while 81.15 % of primary schools in Ethiopia lack electricity. Access to electricity increases in lower secondary schools; however 9.71 % of Ethiopian secondary schools lack electricity (2012) (UNESCO Institute for statistics (UIS) 2014). Parent attitudes in rural areas can further reproduce learning deficits, where Felix et al. (2008) found that parents from poorer socioeconomic groups were unable to support the education of their children and were disinterested in the homework and overall learning process of their children.

Lack of electricity and resources can negatively influence literacy rates, further reinforcing learning limitations, affecting future employment potential and long-term economic prosperity. In 2012, just 49.09 % of Ethiopians and 59.32 % of sub-Saharan Africans over 15 years of age were literate (UNESCO Institute for statistics (UIS) 2014), putting them at a disparity even where resources such as textbooks are accessible. Effective learning despite literacy barriers can be achieved by using audio content, delivered via devices and resources available to students, teachers, and parents in developing countries. Sub-Saharan Africa has experienced a dramatic rise over the past decade in access and use of mobile telephony, with ten times as many mobile phones compared to landlines, making up 83 % of the population (ABI Research 2013). However while mobile telephony access is high, only 16.8 % of Africans (International Telecommunications Report (ITU) 2009) are using the Internet and just 1.98 % of Ethiopians in 2013 were online. Mobile devices can therefore be considered an attractive medium for delivering educational content. Mobile devices have been shown to positively impact the African economy by reducing communication costs and improving agricultural and labor market efficiency (Aker and Mbiti 2010). Audio content delivered via mobile devices can reduce student repetition, if student comprehension levels increase, helping students keep up at school.

## 5 Student Repetition Clogs Educational Systems

Lack of resources inevitably limits learning outcomes causing some students to repeat grades or drop out of school completely. Repetition does not improve educational outcomes (McGrath 2006), rather, it places additional burdens on the economy, overcrowding classrooms and reducing available resources and access to education, and negatively affects student mental health and teacher perceptions. McCollum et al. (1999) found that 25 % of repeaters received worse grades in their repeated year, while 50 % did not do better. In addition, repetition causes learning deterioration due to the long-term perceived failure from both student and teacher, as well as causing social disruption, which can lead to negative behavioral issues (McGrath 2006).

The economic burden of repetition influences both individuals and the wider economy, due to cost increases for both public and private schools, which rises with the duration of schooling (André 2009). It was found that if the resources spent on the cost of repetition in Burundi were invested in enrolling new students, GDP could have risen by 1.3 % per annum (UNESCO 2012). Additional costs, associated with rising student dropouts due to repetition, add to the economical burden of reduced learning outcomes. Where students do not repeat, their economic power and earning potential would increase; non-repeaters generate an annual increase in earnings of up to 10 %; if globally there were no repeaters, this would have the potential to lift global GDP by 0.37 % (UNESCO 2012).

Students from rural areas and lower socioeconomic backgrounds face reduced parental involvement and education, each further increasing repetition rates (McGrath 2006). In 2010, one third of the global total of primary student repetitions occurred in sub-Saharan Africa alone (11.4 million students), which heavily strains school systems, which are already facing rapid population growth (UNESCO 2012). In the same report, UNESCO (2012) reports that 42 % of sub-Saharan students do not complete school, with 16.67 % leaving school before grade 2. Primary school repeaters in Swaziland make up 15.34 % of students, while an additional 11.18 % of students who make it to secondary education repeat a year at secondary school (UNESCO 2011). In Lesotho, just one in three grade 1 primary students continues to complete lower secondary education. In sub-Saharan Africa, over two in five students who begin school will not reach the final grade of primary school (UNESCO 2012). Repetition rates have a dramatic impact on the likelihood for students to drop out of school altogether.

## 6 Students Who Repeat Are More Likely to Dropout

Repetition rates increase dropout rates, with student repeaters 20–50 % more likely to drop out of secondary school compared to students who were retained despite showing similar achievement and behavioral outcomes (McGrath 2006). Repeating one school year was found by Rumberger (1987) to be the greatest prediction of student dropout. Of the 32.2 million repeating primary students in 2010, 31.2 million dropped out, further highlighting the severe negative impact of student repetition (UNESCO 2012). Anderson et al. (2002) report that students who have been retained are 2–11 times more likely to drop out of high school education, compared to their non-retained peers. Chad records the highest dropout rate in Africa, with 72 % of students dropping out, while Uganda and Angola follow closely behind, with 68 % of students dropping out of basic education (UNESCO 2012). In Lesotho, 36.1 % of students drop out of primary education, with a further 36.5 % dropping out at secondary level. Similarly, in 2011 just 85.16 % of students in Lesotho successfully transitioned from primary school to lower secondary school. In Uganda, the survival rate of students to the final grade of primary school is just 24.84 %. In 2010, only nine percent of students in Uganda starting primary school went on to complete lower secondary education. Just as high repetition rates decrease economic prosperity, dropping out of education was found to reduce future incomes and lead to less successful occupational outcomes and opportunities (McGrath 2006). Student dropout creates negative global impact with individual earnings representing cognitive skills, income distribution, and, collectively, economic growth (Hanushek and Wößmann 2007). Measures should be taken to engage students in developing countries so that repetition rates are reduced, leading to lower student dropouts and long-term economic growth and prosperity. When engaging students, particular attention should be placed on environmental and cultural context.

## 7 The Power of Universally Accessible Computing Devices to Increase Learning Outcomes: The Mobile Phone

By using mobile devices, students can empower themselves and increase their learning outcomes. Basic GSM-only mobile phones dominate the majority of the African market with 63 % market share, out of 83 % of the continent's population who own a mobile phone. The ownership of 2.5G-feature phone access technology represents 27 % of mobile device owners, while just roughly 10 % have an Internet-enabled smartphone (ABI Research 2013). This presents Africa as being one of the lowest markets of smartphone penetration in the world (BizTech Africa 2011). This number continues to rise, with annual subscriber growth in Africa growing at the fastest rate in the world. It can be argued that mobile devices have been the most powerful device for change in Africa, having been used across health, education, agriculture, employment, financial services, and more. The mobile phone has improved communication, flow of information, and productivity and increased the GDP and foreign direct investment in Africa (Frost and Sullivan Research Group 2006). Its ease of use lowers the learning curve required for both teachers and students to utilize educational technology. Additionally, the content distributed via a mobile device can be updated easily to be contextual and relevant to students and educators alike.

## 8 Mobile Telephony to Increase Learning Outcomes

The humble mobile phone is a powerful device. The basic mobile phone is particularly valuable for use in developing countries, thanks to their affordability, high penetration, ease of use, and relatively long battery life. A basic mobile phone (GSM only) can cost as little as nine US dollars, with new entry-level 3G smartphones being relatively affordable 30 US dollars; however, it still faces additional challenges in the cost and availability of data and electricity. From an educational perspective, basic mobile devices can deliver content to engage students using bidirectional SMS and voice interactions. Literacy barriers can be bridged using audio content, enabling students to listen to learning and reinforcement material as a supplement to reading or for visually impaired or illiterate students even as a substitute. Full pedagogy can be delivered via the use of a mobile phone, which includes SMS interactions to test reading and writing and microphone interactions to enable listening and speaking. Mobile phones allow students to literally carry educational content with them, enabling them to consume and interact with the material at a time, context, and location suitable for them. Their portability sets them apart from other computing devices, promoting individuality (Park 2011). This can aid in solving equality and accessibility issues that students in developing countries can be challenged with, enabling contextual learning. The simple, short, and engaging interactions offered through SMS and voice make mobile devices an attractive medium for young students. Homework has been found to be most effective at higher frequencies of completion, rather than by increasing the duration of homework (Trautwein 2007). This further supports the use of mobile technology as an interactive channel for distributing and consuming educational content. UNESCO and United Nations (2012) suggest creating fluid education systems, which allows for flexibility in content and distribution, so that content and technology remain up to date and relevant.

The fast and simple SMS and voice interactions support both learning outcomes for students and content creation and distribution for teachers. Sharples et al. (2009) suggest that content distributed via mobile phone should be flexible for a range of contexts, as well as to create content which facilitates the learning process, such as reinforcement and quizzes. These recommendations support the instructional principles derived by Barak (2006), which explain that learning should be contextual and based upon student-situated cognition and environmental and cultural references and that effective learning processes should be transient. By putting students in charge of their learning process using accessible technology, which they already know how to use and are familiar with, learning outcomes can increase. Teachers are encouraged to design content for mobile learning, driven by learning objectives as an enabler for student comprehension, supplementing learning rather than replacing it (Sharples et al. 2009). By taking a teacher-driven approach to educational content delivery via mobile phone, teachers can produce hyper-relevant, contextual resources, which effectively engage and reinforce learning outcomes.

## 9 What Works: Designing Effective Educational Content for Mobile Devices

Consideration is required when designing and engaging effective educational content for developing countries. Access to technology is fundamental to the adoption and retained use of mobile phones as an educational content delivery mechanism. Access can be achieved either by developing platforms and devices which are already recognized in the market addressed or by providing the facilitating hardware (Sharples et al. 2009). If the facilitating hardware is provided, cultural measures should be addressed, including student and teacher training for effective use and understanding of the potential and use of the device. Similarly, connectivity, such as via strong network coverage when using mobile devices, is essential in promoting effective engagement. Student and teacher frustration can arise when a learning system is implemented which lacks effective network support or if access to electricity prevents device usage. Providing new hardware of course comes at a higher implementation cost than using existing infrastructure such as the basic mobile phone.

Integrating mobile learning to curriculums directly has been found to increase the success of mobile learning projects (Sharples et al. 2009). Integration allows tight consistency between in-classroom course content and reinforced mobile learning, including homework. The use of interactive SMS and audio content can effectively compliment major concepts which have been taught to students, allowing for fast and direct concept reiteration. Giving teachers and students ownership of the content, technology, and device gives them a deeper investment into using mobile phones as a means of comprehension, thereby aiding retention and effectiveness. Owning the mobile device and allowing interactive and reinforced content to be developed collaboratively between educators and students is ideal, where teachers can gain insights on both individual students and the effectiveness of teaching methods. Teachers can rapidly amend their efforts based on the results, leading to higher-quality, more contextually relevant content and teaching methods. By giving students ownership of part of the process, their motivation to learn increases alongside their learning outcomes. In their 2012 Think Piece, UNESCO and United Nations suggest that for learning quality to increase, more effective targeting of poor and marginalized individuals is essential; one can see that the basic mobile phone, especially one which does not require Internet connectivity, would be the most useful. UNESCO and

United Nations (2012) further recommend more effective measurement and assessment of industry applications, especially over long-term time frames.

Sharples et al. (2009) suggest that frameworks for evaluating mobile learning should include assessment of usability, educational effectiveness, and overall impact. Evaluation should focus on three assessment levels. Microlevel evaluation examines the user experience, where issues in effectiveness, efficiency, satisfaction, and technology facilitation can be considered. Meso-level evaluation assesses the value of the learning experience as a whole, taking into consideration the integration with parallel learning outcomes and the positive and negative transformation of the learning practice. Macro-level evaluation examines the long-term implications of the introduction of technology by assessing how comprehensively the new technology achieved initial goals and motivations. Effectively measuring the long-term impact of introduced mobile learning across assessment levels assists in the design, implementation, and organization of future methods to enhance learning outcomes via mobile devices.

## 10 Engaging Students Using Mobile Learning: Recent Industry Approaches

Mobile learning has been successfully measured, often leading to positive outcomes. Specific case studies identify the potential of the use of the mobile phone as a medium to engage students and increase learning outcomes. In addition, field applications of mobile technology can provide insight on effective design and implementation of mobile technology in schools. Mobile technology has been used widely to teach basic literacy and numeracy skills to improve individual future prospects (Fozdar and Kumar 2007). The constant presence, intimate nature, social acceptance, and widespread adoption of the mobile phone tend to make it a suitable medium specific to the demographic, as well as indicate a high potential for learning both individually and collaboratively (Naismith et al. 2004). A range of examples demonstrate the requirement of further impact studies and long-term data on their impact.

### 10.1 Sterio.me

Sterio.me engages students in schools across Lesotho with educational content, delivered via basic GSM mobile devices to reinforce school curriculum. Students access interactive quizzes by sending an SMS including code relating to a specific quiz and receive an interactive voice call or SMS lesson. Their results are automatically graded and can be viewed by the teacher via email or in Sterio.me's dedicated teacher portal. The teacher portal displays insights, enabling teachers to make decisions based on learning results, as well as individually engage those who are struggling. Additionally, SMS text content can be sent directly to students to support revision of concepts and provide further engagement. Sterio.me is currently partnering with Vodacom Foundation, Lesotho, to implement their pilot project in 2015 to offer educational content for free to both educators and students. Sterio.me takes a teacher-driven approach to content generation and distribution by having teachers partake in the content creation process and deliver codes as homework to engage their students. Sterio.me has met wide industry acceptance as well as support from the Ministry of Education, teacher unions, and Lesotho Distance Teaching Center.

### 10.2 MobilED

MobilED (Mobile EDucation) is an international collaboration with pilot projects which in the first phase deliver voice, text, and visual content through low-cost mobile devices to compare poor, rural, and affluent private school environments in South Africa (Ford and Leinonen 2009). Using SMS and text-to-speech (TTS) technologies, students could both access information and additionally contribute themselves by generating content in a Wikipedia-style platform. The second phase of the project united "advantaged" and "disadvantaged" schools and enabled students to contribute richer content, including sound, voice, and video. The results from developing countries were compared and were contrasted to developed countries. Due to the initial success of the pilot, future pilots will be replicated in Finland, India, and Brazil. The findings of the initial pilot project, implemented in the private school, can be summarized as follows: students were found to prefer individual access to mobile phones, rather than sharing between groups. Students were already familiar with the use of mobile phones, therefore not requiring training or usage assistance. They also enjoyed the use of mobile phones in a classroom context while being skeptical of the sound of the TTS voice quality. It is worth noting that TTS technology has improved a lot since 2009. Based on the success of the pilot from both students and teachers, another pilot was requested for continued use of the technology. The second pilot implemented in the government school was successfully supported by teachers and students, and the learning process was enjoyed, partly attributed to the novelty of the use of the mobile device, which in contrast was used socially by students in the private school. It was also found that students informed themselves about additional learning topics without direction. Both teachers and students required training and support to use the technology and develop content, however were fast to understand how to effectively use mobile devices. English was the preferred learning language, which was seen as an international opportunity for their future; however it was found that in terms of contribution to the platform, writing quality was occasionally of poor quality. MobilED can be seen as a successful implementation of mobile learning and provides interesting comparisons of government and private schools, as well as developing markets compared to developed markets, which will be explored in the next pilot.

## 10.3 Eneza Education

Eneza Education uses mobile phones to make educational content accessible to Kenyan students. Eneza offers SMS subscriptions, for students to receive quizzes and tutorials, search Wikipedia, view reports, and ask questions via bidirectional SMS. Their student and teacher web portals give students access to lessons and quizzes, as well as allow them to ask teachers live questions; and teachers can view data on student performance. Eneza Education operates across 3,000 schools in Kenya, with over 150,000 registered users. Their strategic partners include service providers such as Safaricom as well as school administrators and support from the Kenyan Primary School Head Teachers Association (KEPSHA). With the objective of measuring their impact, Eneza conducted an impact study, and their service was found to effectively support student revision, with a 22.7 % growth in student scores across the 153 class 7 students across four schools in Meru (Eneza Education 2014). Particularly impressive was that Eneza students received 9.5 points higher on test scores in mock KPCE exams, than students in the control group at the same schools with the same teachers. Teachers are trained to use the Eneza SMS platform as well as motivate their students to use it, while students receive and access quizzes, lessons, reports, and Wikipedia, as well as ask their teachers questions via the platform. Eneza takes a teacher-driven approach, which was found to be a highly successful strategy of positively impacting students, as well as allowing them to take ownership of the project, thereby motivating themselves as well as their students.

## 10.4 Rethink Education via Mxit

Rethink Education is a technology startup with multiple Web-enabled platforms for enhancing the teaching and learning experience. On their Mxit app, the content is delivered in a social media style chat format, which breaks concepts into short messages. Their online platform complements math and science concepts in multiple languages, specific to South African schools for both in- and out-of-classroom learning. Rethink Education reported 202,000 downloads and 7,780 monthly online users (Rethink Education 2014). Clear impact and results of the long-term use of Rethink Education via Mxit in terms of learning outcomes would strengthen and measure the effectiveness of the platform.

## 10.5 m-Learning

m-Learning aims to change youth attitudes toward learning rather than increase learning outcomes directly. m-Learning is a 2011 research and development initiative, which engages 16–24-year-old European adults across the United Kingdom, Italy, and Sweden, deemed at risk of not meeting their potential due to being outside formal education, in low-skilled employment, or unemployment. Users access the m-learning content, including Web and TV content through the learning management system via their mobile phone, smartphone, tablet, or PC. VoiceXML was used to deliver interactive audio narratives, quizzes, and lessons, while SMS instructions and reminders were sent regularly. Richer, browser-based material included soap operas, animations, quizzes, and interactive material. Attitudes toward learning improved, as reported by the 34 youth in the first-phase trial. Additional phases are planned, focusing on larger sample sizes.

### 10.6 BBC Bitesize

BBC Bitesize is a mobile revision platform which provides cross-subject content to students in the United Kingdom and covers the national curriculum key stages via mobile phone (FTI UK Holdings Limited 2010). It has reached over 650,000 General Certificate of Secondary Education (GCSE) students and adult learners (Naismith et al. 2004). While it reached a wide audience, various issues have been raised, such as local content relevance to students in various locations. Students reported a lack of detailed feedback to their responses, due to small mobile device screen size and limited memory capacity, and in addition found that the implemented technology, Java, was not compatible across multiple devices. One needs to keep in mind that the project was implemented in 2003, and Java as such is only relevant today to the "feature phone" market. The popularity of BBC Bitesize caused BBC to charge for the SMS service, considerably reducing user numbers (Naismith et al. 2004).

## 11 Digital Education as an Effective Learning Resource

### 11.1 Khan Academy

Khan Academy is the world's most popular education site, providing education through over 5,500 short, instructional videos and over 100,000 practice math problems, aiming to create "free world-class education for anyone anywhere" (Noer 2012). Khan Academy is nonprofit and has been a pioneer in digital learning for K-12 education, boasting around 10 million unique users per month (Murphy et al. 2014). More recently, Khan Academy partners with institutions including museums, universities, and think tanks and has added coaching features, which assist teachers, tutors, and parents to work with students to achieve learning outcomes. Specific learning materials can be assigned to students, which send them automated electronic alerts when new assignments are posted, and provide a dashboard for the facilitators to monitor student progress. In order to generate information for educational systems regarding support of personalized math learning, Khan Academy was supported by the Bill & Melinda Gates Foundation, to conduct a two-year study in 2011, which included 20 schools and over 70 teachers across nine sites (Murphy et al. 2014). The study found that 71 % of students enjoyed using Khan Academy, while 32 % reported an increase in enjoyment for math since using Khan Academy. Student engagement was also found to have increased during class, where 62 % of students were moderately engaged and 25 % reported as highly engaged while using Khan Academy during class time. Students expressed greater learning independence when using Khan Academy, attributed to the immediate feedback, tips, and supplementary learning materials, allowing 45 % of students to report their ability to better self-education without teacher support. Teachers also reported satisfaction with the use of Khan Academy, with 86 % of teachers expressing the desire to recommend it to other teachers and 89 % planning on continued use of Khan Academy in the following school year. Schools with limited resources or budget restrictions found particular value in Khan Academy as a resource, considering it is free. The major barriers to adoption are simply resources including time and access to computers and a stable Internet connection. Where access is available, digital education can be used both in and out of the classroom to facilitate higher levels of student engagement, as well as teacher and student satisfaction, leading to increased learning outcomes.

## 12 Future Directions for Continued Student Engagement to Increase Learning Outcomes

While learning outcomes and student engagement can increase through educational content delivery via a mobile phone, measures should be taken to ensure effectiveness is maximized. Particular attention should be placed on environmental and cultural context, especially in developing countries, where educators, students, and their parents may face limitations, such as lack of resources including electricity, learning resources, access to technology, and individual behaviors. For rural areas in developing countries, contextual constraints can place significant limitations, but, when designed correctly, can enable significant positive learning impact, both for educators and learners. Contextual awareness extends to the content itself, where material should be relevant and beneficial for consumption on small mobile phone screens, while ideally offering a complete pedagogy of reading, writing, speaking, and listening if context permits. To successfully facilitate mobile learning, a collaborative effort from teachers, parents, and students is required, where autonomous learning is further reinforced in school, and in-classroom concepts are reinforced outside the classroom. Taking a teacher-driven approach to engage and incentivize students can support the adoption of mobile learning technologies, also giving teachers greater control of the relevance of the content and individual teaching methods, aiding scalability across both rural and urban locations. Further long-term impact studies of the effectiveness of mobile devices to reinforce learning and engage students are required in order to provide more comprehensive guidelines for teacher support, effective content delivery and creation, and optimal student engagement leading to increased learning outcomes.

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# Mobile Web 2.0 Tools and Applications in Online Training and Tutoring 28

Zuzana Palkova

## Contents



**Abstract**

Today over six billion people have access to a connected mobile device, and for every one person who accesses the Internet from a computer do so from a mobile device as well. Mobile technology is changing the way we live, and it is beginning to change the way we learn (UNESCO. 2014. Retrieved from http://www.unesco.org/new/en/unesco/themes/icts/m4ed/).

Mobile learning (m-learning), referred also as "anytime and anyplace learning," has evolved with the introduction of mobile and handheld devices, such as mobile phones, laptops, notebooks, and tablet PCs, in teaching and learning, together with broadband and wireless data transmission. This greater connectivity creates opportunities for flexible, collaborative modes of learning while supporting stronger links between learning at work, in the home, at school, and in the community.

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As main advantages of mobile technologies in education can be considered spontaneity (learning activities take place when the learner feels ready or can be used to fill "dead time"), immediacy (learning becomes possible at the point of need, regardless of location), increased access (learning resources can be accessed from the workplace and in the field while traveling, during classes, and lectures), and last but not least portability (communication with peers and tutors and the capture, storage, and retrieval of information in multimedia formats are possible from one device at any location).

This chapter aimed to present the new trends for education – mobile learning, through the outcomes of the Leonardo da Vinci project *MobiVET 2.0 – Mobile Web 2.0 e-Training for Vocational Education Trainers* (MobiVET 2.0. 2014. Retrieved from www.mobivet2.eu). The *MobiVET 2.0* project aimed at filling the online training gap between the self-directed learners and VET trainers by developing mobile e-learning 2.0 knowledge and skills of the trainers, thus turning them from in-class trainers to skilled online tutors (e-tutors).

## 1 Introduction

From the last 10 years, e-learning technologies use interactive multimedia and allow user interaction with controlling computer software programs and may be used effectively in education and training (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). Sophisticated computer hardware and software are available for the production of high-quality flexible training materials and at low cost.

Interactive learning materials enhance the learning process; are enjoyable; and, using wireless networks, may be used anywhere, at any time, and by anyone. An individual has the freedom to learn at one's own pace, to select the appropriate level, and to pick times for study, so as to be able to study at work, at home, or in travel. The use of these forms of materials, if prepared carefully and comprehensively, can eliminate the need for face-to-face workshops, seminars, conferences, site visits, and attendance at technical fairs, saving time, travel, and fuels and so also reducing polluting emissions to air.

## 2 A Brief History of e-Learning

In the last century, an effort to carry out the educational process through new technologies occurred when at the half of the twentieth century, linear (Skinner 1954) or ramified (Crowder 1969) training programs were used within the program learning in order to increase the effectiveness of the educational process. In the coming years, this effort was supported by some philosophical theories (Wiener 1961), characters of which became to be a basin for some programming languages (e.g., Prolog, Cobol).

In a field of hardware, development carried over air-conditioned computer halls onto work tables in the form of PCs; however, at the turn of the 1970s–1980s, information and communication technologies occurred in the educational process without any complex conception. Attention was focused on the study of informatics or on programming as an individual study subject.

The start of multimedia computers provided more options for video and audio presentation. The requirement on training programs' interactivity is highlighted, and the view on possibilities of ICT application in education significantly changed. A beginning of new millennium brings a necessity of lifelong learning, causing a development of distance learning based on principles of ICT exploitation in education. "Internetization" of all levels and forms of schooling is getting to be one of the main program objectives of the EU states' national governments, various "information strategies" are being formed, and virtual training centers interconnecting universities, libraries, research institutes, government, and public and commercial organizations are being created (e.g., virtual collaboration (Hossain 2004; Wainfan 2004)).

Historically, educational and corporate training managers have always looked for ways to reduce the cost and improve the effectiveness of training programs and processes through the use of technological advances. Prior to 1980, in-class instructor-led training dominated, although some organizations used mainframe and interactive video approaches. By 1990, the delivery of CD-ROM content became possible. Since 1998, Internet-based approaches (e.g., web-based learning) have become the dominant delivery method for creating fast, scalable, low-cost learning and corporate training (Fig. 1).

Those methods usually follow the "classic" form of class-based learning, moving only the content from the paper book pages on to the computer screen. The participants in the process (teachers and students) still remain "tied" to the school LAN, which connects them to the learning content and the school learning management system (LMS). The "traditional" pen has been replaced by the keyboard and mouse. But, in most cases, these changes do not give the freedom that teacher's and student's "hands" may need, especially teaching and studying some specific subjects, such as art, drawing, design, and architecture.

## 3 Key Trends in e-Learning

During the last few years, e-learning has rapidly entered the educational sector, and, as a result, more and more new learning tools are appearing. This changes the way how teachers and students work and interact thus enabling a more effective learning process.

Advances in ICT define the latest trends in the e-learning industry. New hardware devices and application programming interfaces (APIs) are shaping the present and future of how learning organizations will manage (e) learning. In 2014, new technology developments are making their way into e-learning

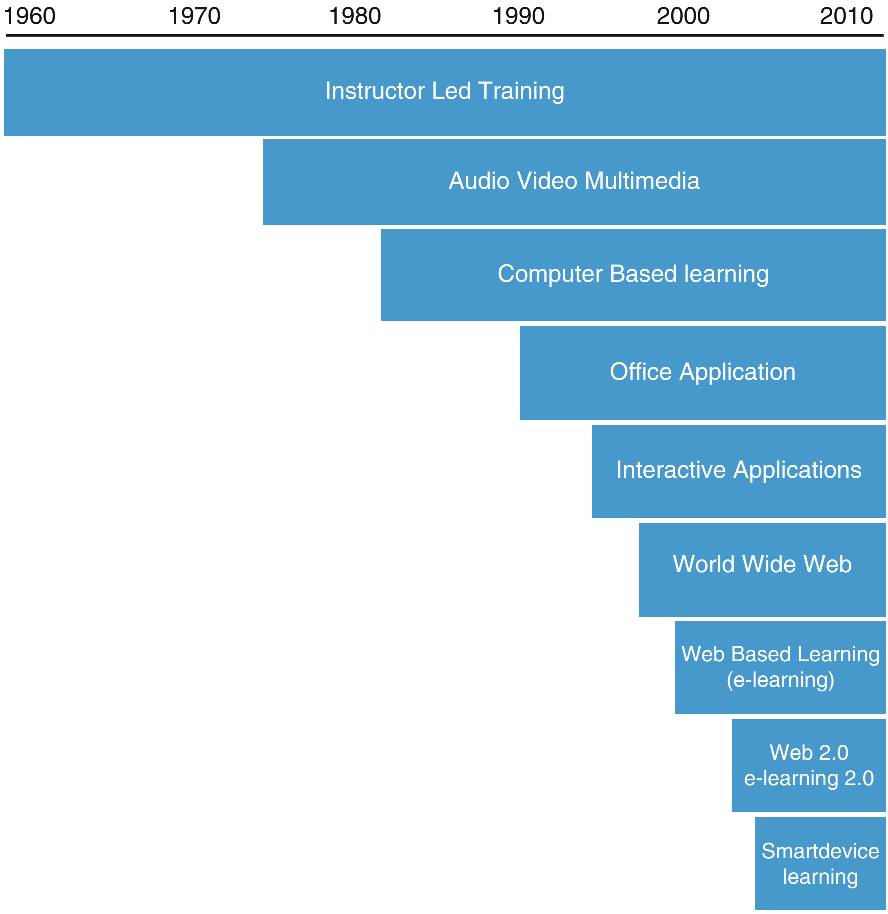



**Fig. 1** Evolution of e-learning technologies

delivery. Some of the more significant trends in e-learning in 2014 include (Learndash 2013; JRC 2009):

– **Social networking services (SNSs)** – virtual communities of practice constructed through SNSs enable learners to connect and collaborate on global platforms, transcending geographical boundaries (McCann 2009).
– **Massive open online courses (MOOCs)** – possibly is the most promising trend as more and more courses will be published online offering free (open) access to the learners.
– **Gamification** – learning (or "serious") games and simulations (in 2D and 3D worlds) can be implemented quite easily into many e-learning courses and learning management systems (LMSs).

- **Mobile technology** – devices like netbooks, e-book readers, tablets, smartphones, and Wi-Fi communication technology are allowing e-learning to be on the move.
- **HTML5** – this new web publishing standard offers better performance, multimedia, connectivity, and many other benefits for e-learning content design (W3C 2014).
- **TinCan API** – is the next generation of API software developed for reporting for e-learning in LMSs used. TinCan API is expected to replace the old SCORM standard (Tincanapi 2014).
- **Responsive web design (RWD)** – focuses on mobile technology and it is intended that web content displays properly on all devices (no matter desktop or mobile).

### 3.1 Web 2.0-Based Technologies and Tools for Learning

By Tim O'Reilly (2007), who firstly has defined this term as Web 2.0, technologies can be tagged open-source software, online services as blogs, wikis, podcasts, RSS feeds, etc., which facilitate a more socially connected web where everyone is able to add and edit the information space. Main ideas of Web 2.0 change the key aspects of schools' curricula and form of learning (Bartolomé 2008):

- NET technology as a platform oriented on multiple tools changes the concept of the learning anytime and anywhere.
- Collective intelligence and wide experiences of users influence the meaning of the expression "authority" in learning systems.
- Tags and RSS give opportunity to repeat browsing of traditional systems, organization of knowledge, and finding information.
- Lots of alternative tools used for the learning activities (tablet, smartphone, notebook, netbook, etc.) give the learners the possibility to learn anywhere and anytime – in a cafeteria or library, waiting on the train, etc. Web 2.0 deletes the difference between time for study and other activities.

Web 2.0 represents a new term for e-learning. What makes Web 2.0 so attractive for learners is that it is almost free and interactive in nature and could be accessible from anywhere and via any mobile device. Because of the accessibility feature of Web 2.0 applications, learners are now able to interact in a virtual community and be exposed to sounds, images, moving pictures, colors, and text that are characterized to be ideal for the cognitively diverse classroom.

In this context, the Web 2.0 is the next level of the World Wide Web (W3C 2014). The most basic characteristics of Web 2.0 include:

- The read/write web
- The web as a platform
- Rich user experiences

– Data as the driving force
– An architecture of participation
– Harnessing collective intelligence
– A rich, interactive, user-friendly interface
– Leveraging of popular trends, including blogging, social tagging, wikis, and peer-to- peer sharing
– Inclusion of emerging web technologies like RSS, AJAX, APIs (and accompanying mashups), Ruby on Rails, and others
– Open-source or sharable/editable frameworks in the form of user-oriented "create your own" APIs

New innovative learning methods require new training methodologies as well as new ways to deliver the learning content to the target groups, considering the growing need of mobility, availability, information aggregation, and very fast response times among both students and adults in the labor market. Between up-to-date Web 2.0-based technologies and tools for e-learning, we can include:

– **RSS** (Rich Site Summary) feeds offer the ability to automatically fetch new content instead of having to search for it. By using special software called RSS aggregators, teachers or trainers can subscribe to multiple web pages that publish material relevant to the subject that they teach. This way, students can visit a single place that is constantly updated when new articles are published. Feed aggregation clients are available for all platforms, including mobile devices.
– **Audio/video conferencing** refers to services and tools that allow conferencing events to be shared with remote locations. These are sometimes referred to as webinars or, for interactive conferences, online workshops. These tools can be used to record and share live events. The teacher/trainers can use them to cover a real-time event such as a lecture or a tutorial, to capture teaching resources, and at the same time to allow students to collaborate with their own responses. Example tools are *Skype*, *BigBlueButton*, and *eLecta Live*.
– **Online presentation tools** give teachers or trainers the ability to share their presentations as well as enhance them with added functionality and take advantage of user feedback to replace traditional desktop presentations. These tools have no software requirements since everything is done online through the web browser. The presentations can be embedded into websites, blogs, and wikis and can be used by students and teachers to collaborate remotely. Example tools are *VoiceThread*, *Prezi*, and *SlideShare*.
– **Social media/networking applications** offer users the ability to easily communicate and share resources. Most of them offer capabilities to create groups or communities so they can be used for specific courses or learning topics. The main advantage of these applications is that the students are already familiar with their use and are highly motivated to use them. Example tools are *Facebook*, *Twitter*, *LinkedIn*, *Edmodo*, and *Elgg*.

– **Content management systems** allow publishing, editing, and modifying content as well as maintenance from a central interface. Such systems of content management provide procedures to manage workflow in a collaborative environment. Furthermore they can easily integrate most of the above technologies. Learning management systems are specialized for the needs of teachers offering a great set of tools for every aspect of the learning experience. Examples tools are *Wordpress*, *Drupal*, *Moodle*, and *Schoology*.

## 3.2 The Technologies for Web 2.0

Web 2.0 is not a new network technology but a network application (Anderson 2007), and most used techniques of the Web 2.0 website can be defined as follows:

– Cascading Style Sheets (CSS), semantically valid XHTML markup, and microformats
– Significant and clean URLs
– Aggregation of RSS/ATOM data
– Syndication of data in RSS/ATOM
– REST or XML Webservice APIs
– Some social networking aspects
– Support posting to a weblog

The base principle of Web 2.0 is the creation of new relationships through electronic connections and social collaboration. Between main concepts that have been created for Web 2.0, we can include:

– **Mashups**, which allow to use services from different users for creation of completely new service.
– **Tagging**, keywords represented by non-hierarchic metadata which allow to descript the content and find topic by browsing or searching.
– **Folksonomy**, very often refers to as social tagging, allows users to tag their content, and enables other users to find and use it.
– **Blogging** is one of the most characteristic features of Web 2.0, and Tim O'Reilly (2014) defines the basic form of blog as a personal home page in diary format.
– **Virtual worlds** represent simulated 3D environments, usually gaming environments, which allow users mutual interaction with the environment and between characters known as an avatars.

Web 2.0 technologies offer new methods for learning delivery by providing teachers with new ways to engage students and even allow student participation on a global level. Web 2.0 tools are online and mostly free applications that can be used in innovative ways by teachers or tutors to support their teaching. Teachers have new ways to express their learning material into and share them with the students and other teachers as well as allowing them to collaborate with their own ideas or resources. Audio and video sharing is easier than ever and allows learning sessions to take place online instead of the classroom in ways that can be more motivating and exciting for students. The vast amount of information available online can finally be organized by taking advantage of social bookmarking tools. Students, in a Web 2.0 classroom, are expected to collaborate and to interact with one another and the content of the class. By making the shift to a Web 2.0 classroom, teachers are creating a more open atmosphere where students are expected to stay engaged and participate in class discussions.

## 4 Mobile Learning (m-Learning)

**Mobile learning (m-Learning)** referred also as "anytime, anyplace learning" (Caudill 2007; El-Hussein 2010) has evolved with the introduction of mobile and handheld devices, such as mobile phones, laptops, netbooks, and tablet PCs, in teaching and learning, together with broadband and wireless data transmission. This greater connectivity creates opportunities for flexible, collaborative modes of learning while supporting stronger links between learning at work, in the home, at school, or in the community (see ▶ Chap. 6, "Framework for Design of Mobile Learning Strategies").

From this point of view, mobile learning allows truly anywhere and anytime personalized learning, which through nonconventional devices and methods makes traditional lessons or courses more attractive. Using mobile communication – for young people native forms of communication – helps learners and teachers to recognize and build on existing basic literacy skills and can help deliver and support literacy, numeracy, and language learning.

At last but not least, mobile learning helps to combat resistance to the use of ICT by providing a bridge between mobile phone literacy and PC literacy.

In present time, a great variety of mobile computers and devices are available. Laptop computers outnumber desktop computers, while notebook computers, tablets, and cellular "smart" phones are considered to be the most important hardware items used for m-learning activities.

Mobile devices can bring users the following advantages (Learning 2014):

- Spontaneity – learning activities take place when the learner feels ready or can be used to fill "dead time."
- Immediacy – learning becomes possible at the point of need, regardless of location.
- Increased access – learning resources can be accessed from the workplace and in the field while traveling and during classes or lectures.
- Portability – communication with peers and tutors and the capture, storage, and retrieval of information in multimedia formats are possible from one device at any location.

## 4.1 Mobile 2.0

Mobile 2.0 is considered to be the combination of the Web 2.0 philosophy with the mobile devices. Firstly, Mobile 2.0 is bringing the Web 2.0 to the user's mobile device. However, Mobile 2.0 goes further in the adaptation of web content to the user's mobile device and also the personalization of the content the user's characteristics. Thus, a key point to Mobile 2.0 is leveraging Web 2.0 to take advantage of the strengths of user's mobile device. Mobile Web 2.0 applications that are delivered to mobile devices need to be adapted to the characteristics of the mobile devices.

Several years ago, the big question was "Should we do mobile learning?" Today the question is "How should we do mobile learning?" TeachThought (2014) defines 12 principles of mobile learning:

– Access (any time, any place)
– Learning metrics
– Cloud (content and learning delivery via cloud)
– Transparent
– Play (include serious games and gamification)
– Asynchronous learning mode
– Self-actuated (personalized: just in time, just enough, just for me)
– Diverse e-pedagogies
– Curation/learning management
– Blending different learning modes
– Always on
– Authentic

## 4.2 How to Design m-Learning Using Web2.0 Technologies

Adopting a mobile-friendly content strategy enables many benefits that go far beyond delivering the right learning content to the right device at the right time – including collaboration via social networking platforms, multimedia (audio and video) enhancements, interactivity (quizzes, simulations, and exercises), annotations to content, and much more.

But what is the most efficient way to produce and deliver learning content optimized for the unique dimensions and firmware of every mobile device? How do the mobile learning designers enable the interactive features that make the content more than just a "page-turning application"? These are just some of the questions that a mobile content strategy needs to addresses.

The instructional design is a systematic process for creating effective instructional solutions. This requires designers to analyze the desired outcomes and content and apply the appropriate design model to achieve the learning outcomes. The instructional design of m-learning solutions must first consider the fact that learner is not in a traditional classroom setting with a motivational and/or supervisorial instructor facilitating the learning process. Learner motivations, attention to learning content, understanding of the relevance of the subject matter, and ability to have social interaction with peers are not as easy to facilitate. The mobile learners can acquire learning content from the centralized shared resources and engage in anytime-anywhere context-aware learning via portable devices in wireless communication environment.

E-learning design can only be generically applied to m-learning. Many of the current elements of m-learning are built upon a solid foundation of learner needs, learning outcomes, cognitive processes, and instructional strategies. Each of these foundational elements is critical for the creation of effective m-learning and involves a strong collaboration between instructional designers, educational technologists, graphic designers, web/software developers, educators, and students/users. However, m-learning instructional design as an emerging subject requires a more dynamic approach than traditional instructional design. Therefore, the need for more dynamics in instruction combined with the high demand for more m-learning solutions requires an evolution in m-learning design and a higher level of productivity. More use of current user-centered and evolutionary design methodologies like that of agile design (Agilemodeling 2014), rapid prototyping, and successive approximation instead of the antiquated and less iterative methodologies such as ADDIE model (ADDIE 2014) will allow m-learning designers to create more robust m-learning solutions rather than the typical unidimensional solutions currently being developed. In addition, in order to meet the need for increased productivity in m-learning, it is clear that there should more use of rapid development applications. The reality is that creating m-learning solutions is more time consuming than traditional learning solutions; therefore, using software applications that do not keep up with the high demand for productivity does not allow the actual design to make it into production on regular basis.

At present, it can be concluded that m-learning will continue to use some of the same software applications and more iterative instructional design methodologies in order to keep up with increased demand in the coming years.

## 5 Case Study: Mobile Web 2.0 e-Training for Vocational Education Trainers – Project MobiVET 2.0

From 2012, seven organizations from Malta, Slovakia, Bulgaria, Germany, Greece, Romania, and Spain focused their joined efforts in implementing the project called "Mobile Web 2.0 e-Training for Vocational Education Trainers – MobiVET 2.0." This project aims to fill the online training gap between the self-directed learners and VET trainers by developing mobile e-learning 2.0 knowledge and skills of the trainers, thus turning them from in-class trainers to skilled online tutors (e-tutors). In this way the project offers a strong support for current and further development of innovative Web 2.0-based mobile learning methodologies, pedagogy approaches, and practices, thus improving vocational and lifelong learning in the European Union.

*MobiVET 2.0* project developed innovative learning methods, m-learning methodology MobiVET (2014b), and m-learning materials as effective tools to improve the e-skills and competencies of European VET practitioners (teachers, trainers, and tutors) MobiVET (2014a) and helps develop adequate online training practices for effective distance tutoring of lifelong self-learning or vocational education activities at the workplace and while being mobile, without time and distance barriers.

## 5.1 Mobile Learning Course Preparation Methodology

During the preparation of educational materials for m-learning, it is necessary to consider the following MobiVET (2014c):

– Composes a mobile learning course
– Tools to produce m-learning course
– Form of learning – self-paced or instructor-led learning

Each m-learning course combines several main components – learning resources, trainer's involvement like e-tutoring, e-coaching, e-mentoring, peer's involvement, collaborative learning, and the environment where all are housed, a virtual classroom. As a base of m-learning, courses can be considered simple learning resources, such as noninteractive text documents, PowerPoint presentations, video, and/or audio files. The learners can read or watch content without being able to interact. The augmented part represents interactive content, which is created by a sequence of screens and can include text, graphics, audio, video, and interactive elements such as questions and feedback. The m-learning lessons can also recommend further reading, additional information, and links to online resources.

Mobile course can offer activities like simulations and games. Its aim is to offer real-world situations, ideally immersing the user in a simulated environment that responds and provides feedback in real time. They can emphasize on the informal aspects of the learning and provide educational element to a course.

When starting to design any e-learning course, a needs analysis should be conducted to answer the following questions:

– Is the training required to fill a gap in professional knowledge and skills?
– Is the e-learning the best solution to deliver the training?

The next step is to identify learner-related factors that will influence the course design:

– Type of organization or institution in which learners work or study and their professional role(s)
– Learners' previous knowledge and expertise on the subject

– Learners' computer skills and previous experience with e-learning
– The time that can be allocated to e-learning
– The physical location where e-learning lessons will take place – at home, at work, or in a learning center
– Connection speed and computer and software capabilities

Content analysis is a critical step in the instructional design process. The course designer should include accurate and relevant content. Without this, even the best instructional methods and media will fail to transfer useful information to learners. Content identification and analysis can use the following methods:

– **Task analysis** identifies the job tasks that learners should learn or improve and the knowledge and skills that need to be developed or reinforced. This is mainly useful when preparing courses for specific job-related or interpersonal skills.
– **Topic analysis** identifies and classifies the course content. This is mainly suitable for broader educational objectives.
– **Definition of learning objectives**. Whereas the aim of any learning objective is acquisition of competences or capabilities by the learners, objectives should be specified for the course as well as for the individual learning resources/activities. Learning objectives combine two main elements – the expected level of performance and the learning content (the type of knowledge and/or skills that should be learned).

Usually the course content is provided by experts in the training topic. Even existing materials can be adapted to a specific course. However, if the existing materials were designed for face-to-face training or paper, they should be transferred and adapted for m-learning. Lessons and presentations designed for face-to-face courses should be reworked to include all explanations that were delivered verbally. Longer texts should be cut into separate short "chunks" that will allow them to be easily mixed with visual, audio-video, and interactive content. Wherever a longer text is published, it has to be available in downloadable form – this will allow students to read it offline at the most convenient time.

The way how content is presented depends on the topic, content, target group, and – not last – creativity of the instructional designer. Due to all these variables, many different approaches exist:

– **Scenario-based content presentation** – the content delivery follows a predefined scenario; often, the learners are facing situations requiring answering questions and making choices.
– **Storytelling content presentation** – puts the information in certain environment and uses a narrative to gradually present the learning topics. There might be real or fictitious character(s) taking the role of a narrator and leading the students through the lesson.
– **Demonstration and practice content presentation** – very suitable for practical tasks. The lesson demonstrates selected simple or more complex procedures and

steps, and then the learners are asked to repeat the lesson learned using the available interactive tools.

– **Toolkit content presentation** – as the name suggests, the learners are presented with content divided into specific chunks forming a set of resources that can be studied independently of each other and without following a predefined path.

## 5.2 MobiVET Mobile Learning Courses

With the aim to evaluate developed methodology, how to create and use mobile courses from both the teachers' and the students' perspectives were developed in seven m-learning courses. These mobile courses are available at MobiVET 2.0 platform http://mobivet2.eu/courses. Four of them were developed with the aim to introduce a sample of m-courses for teachers:

– *Emotional Intelligence in the Workplace*
– *Green Office*
– *Intercultural Skills*
– *Leadership Skills*

The last three courses are targeted primarily to improving the skills of teachers/trainers in the field of m-learning and developing of m-courses:

– *E-Learning Practices in VET*
– *Applying Social Media in VET*
– *Web 2.0-Based Mobile Technology in VET*

The courses' main objectives are to help teachers to understand Web 2.0 and support them to use in teaching/virtual classroom, the online and mobile training technologies, and tools.

During the pilot testing phase of the project, we collected the feedback from the VET students and their teachers. Results are presented in the following paragraphs.

The primary descriptive analysis indicates that the field of studies in which the MobiVET 2.0 students participated in the training course is mainly represented by theoretical studies in sciences as engineering, electronics, and telecommunications but also by theoretical studies in humanities (Fig. 2).

The students could attend to more than one course offered by MobiVET 2.0 training. Consequently, the majority – almost 90 % of the population that has studied the courses – headed toward the *Green Office* course, followed by *Emotional Intelligence in the Workplace* (3 %), *Leadership Skills* (3 %), and *Intercultural Skills* (3 %).

The availability of the courses was extended to different devices such as laptops (43 %), desktop PCs (41 %), and smartphones (16 %) with Android (70 %) (Fig. 3).

With a majority of 71 %, students declared that future courses should continue being structured and contented in the same way the ones that they have studied did;

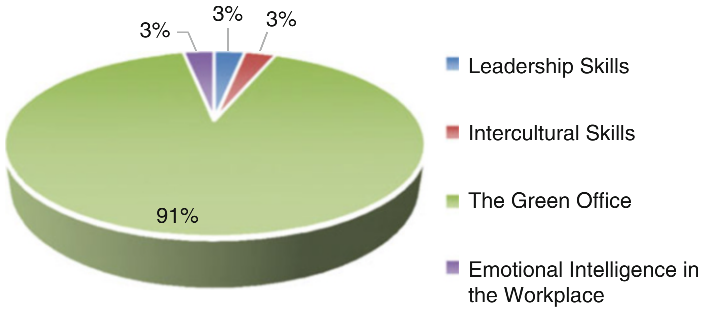
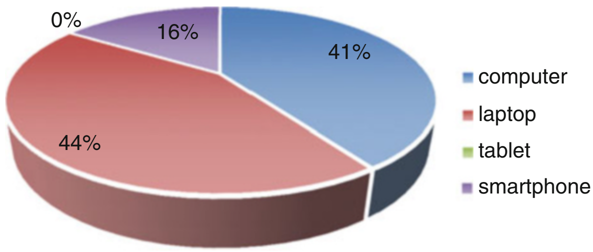



**Fig. 2** MobiVET 2.0 course(s) participation

**Fig. 3** Devices used by students



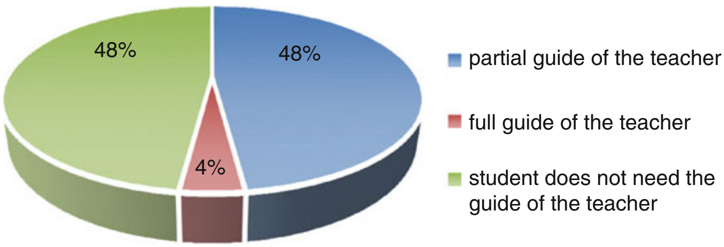




**Fig. 4** To take the course, student needs

meanwhile, the other 29 % suggested the extension of the courses with further information and additional materials, and none of the respondents indicated that the courses should reduce their size or change the form.

More than 90 % of the students indicated the fact that they didn't need or needed only partial guidance from their teachers; contrariwise, the small proportion of students – 4 % – needed full guidance (Fig. 4).

Regarding the need of guidance, considering the expectations of the students to the eventual study of the courses, there can be observed an extension of the figures, therefore, indicating again the fact that self-learning is considered to be useful and efficient by the students.

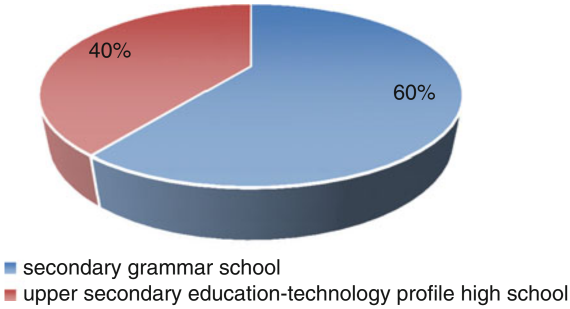



**Fig. 5** Distribution of the educational levels in which the respondents are teaching

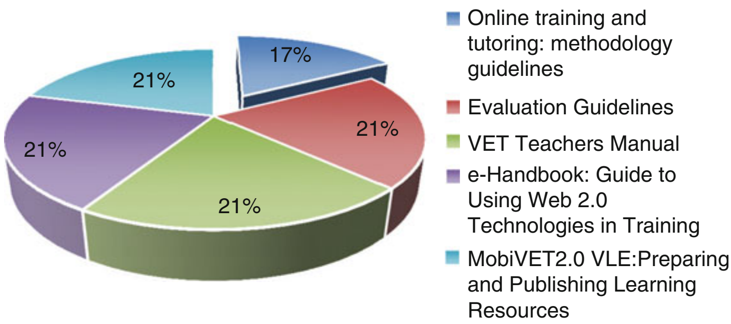



**Fig. 6** Training resources used by teachers in order to evaluate the courses

The second evaluation form created had the purpose to evaluate teachers' overview about the utility of didactical aspects of the MobiVET 2.0 m-learning courses.

The primary descriptive analysis indicated that the respondents are almost equally distributed by gender with ratios of 60 % male and 40 % female. Regarding the respondents' age, it can be observed that 80 % of teachers are over 40 years old.

As seen in the pie chart, 60 % of the teachers are teaching on the secondary grammar school and 40 % are teaching in upper secondary education – technology profile high schools (Fig. 5).

In the didactic evaluation process of MobiVET 2.0 m-learning courses, teachers used most of the prepared guides and manuals (Fig. 6).

The availability of the courses was extended to different devices such as desktop PCs, laptops, tablets, and smartphones. In the evaluation and testing of the courses, the most used devices were laptops, followed by tablets and smartphones with Android and iOS operating systems in the same portion (Fig. 7).

Regarding the form of the courses, the teachers indicated that the length and form of the courses is the exact one in order to complete the didactic requirements and for the future courses should be the same.

The perception of the teachers regarding the form of the courses is very important for the general feedback, revealing the following aspects: 80 % of the teachers

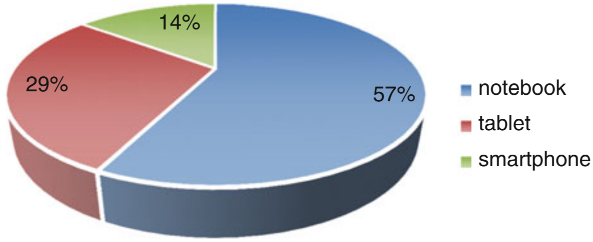



**Fig. 7** Devices used by teachers

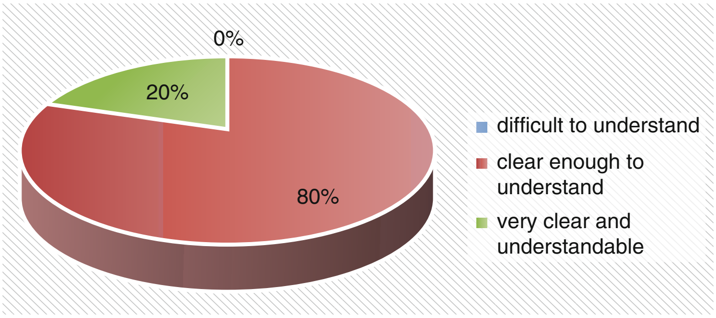



**Fig. 8** The information within the *e-Handbook: Guide to Using Web 2.0 Technologies in Training*

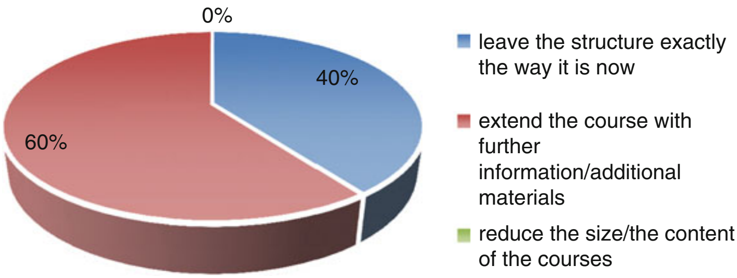



**Fig. 9** Participants' suggestions

evaluated that the content of the courses was clear enough to be understood; meanwhile, 20 % considered that the courses were very clear and easy to understand, and none of the teachers found the courses difficult to understand.

In order to complete the information about teachers' evaluation over the MobiVET 2.0 courses that they have studied, the respondents were asked to give additional feedback and further suggestions in order to improve future m-learning courses. With a majority of 60 %, teachers declared that future courses should be extended with further information or materials; meanwhile, the other 40 % suggested to leave the courses exactly the way as they are, and none of the respondents indicated that the courses should reduce their size (Figs. 8 and 9).

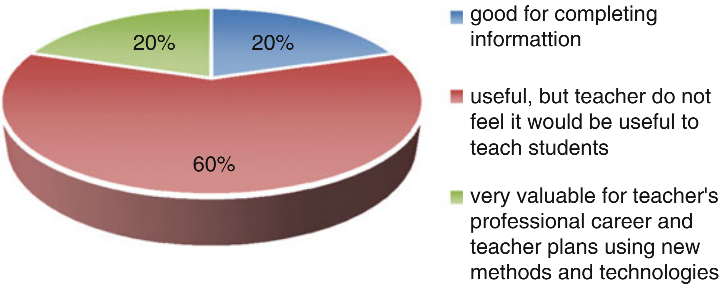



**Fig. 10** Teacher's overall impression of the m-learning course(s)

The overall opinion after evaluating and implementing the utility of the courses indicates the fact that in proportion of 100 %, the teachers found the MobiVET 2.0 training courses being valuable for their professional career and that they feel able to teach students using new methods and technologies (Fig. 10).

## 6 Future Directions

Today over six billion people have access to a connected mobile device, and for every one person who accesses the Internet from a computer do so from a mobile device as well. Mobile technology is changing the way we live, and it is beginning to change the way we learn (UNESCO 2014).

In the context of the MobiVET 2.0 project is presented a way how to fill the online training gap between self-directed learners and VET trainers by developing mobile learning 2.0 knowledge and skills of the trainers, thus turning them from in-class trainers to skilled e-tutors. The results developed in the frame of this project help the tutors get familiar with various m-learning technologies and platforms and learn how they can be utilized in the learning processes.

The presented study collects feedback from the students and teachers from different countries of Europe about the mobile learning and developed m-learning courses.

Mobile technologies and concepts can supplement existing formal learning methods. Mobile learning is growing by leaps and bounds, and mobile learning devices are no longer restricted to the classroom. Most students, including young students, own or have access to cell phones, iPods, tablets, or other handheld devices, and educational administrators are quickly realizing that students can use those devices not only to access school websites but used them for classroom assignments and other educational resources from both school and home.

But to be successful in designing and conducting mobile learning, the online educators have to learn some new techniques such as how to:

– Create online classes with customizable and reusable content.
– Connect students with audio and video while implementing interactive simulations to address a variety of learning modalities and styles.

– Incorporate video and applicable animation to simplify complicated topics.
– Save content as reusable templates and layouts for personal or system-wide use.
– Give quizzes and record and archive the results.

## 7 Cross-References

▶ Characteristics of Mobile Teaching and Learning
▶ Framework for Design of Mobile Learning Strategies

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# Mobillizing the Middle Kingdom: Bringing M-Learning to High Schools 29

Fengyun Cheng and Lucy Haagen

## Contents



**Abstract**

Mobilizing the Middle Kingdom presents a model of teacher-directed mobile learning based on the principle that successful pedagogy – tech assisted or otherwise – must be rooted in cultural and pedagogical realities. In China, three such realities are nonnegotiable: a reverence for the gifted teacher that goes back as far as Confucius, a meritocratic ideal in which examinations serve as the gatekeepers to opportunity, and a political system in which social cohesion trumps individual self-expression. At the same time, globalization-fueled educational reform is stimulating interest in the appropriation of Western pedagogies and technologies.

Yet, like species introduced into new environments, only those technologies capable of adaptation will flourish. When tablets computers designed in the

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United States are transplanted in Chinese soil, two powerful tenets of Western learning must be reexamined:

1. Students learn best when they are allowed to make choices about what, how, and when they learn.
2. Learning is most effective when teachers play a facilitating rather than a directive role in the classroom.

The chapter describes the problems encountered, solutions developed, and lessons learned by a team of Chinese and American educators charged with designing, piloting, and evaluating an m-learning program for senior secondary 2 (11th grade) English learners. The program was developed around four premises: (1) the future of mobile learning among precollege learners in China lies in formal rather than informal settings; (2) educators, not technologists, university researchers, or policy makers, will determine whether mobile technologies become woven into the fabric of learning or remain a peripheral appendage; (3) broad mobile learning uptake and dissemination will depend on educators' connection to the "big picture" and professional communities of practice beyond their own students and school settings; and (4) consistent with the technology acceptance model (TAM), mobile learning in China will be adopted strategically and selectively when it provides solutions to problems and opportunities perceived to be both important and inadequately addressed by other means.

## 1 Introduction

For more than a decade, technology pundits have been predicting that mobile devices and digital content are poised to transform education in China. This prediction is grounded in a mobile device penetration rate exceeding 90 %, a culture where education is universally prized among citizens across the socioeconomic spectrum, and a government willing to fund technological innovation. As early as 2003, "Hello China" pioneered the use of radio and mobile phones for large-scale training by sending English vocabulary words to the mobile phones of participants throughout China (De Lotbinière 2003). In the decade that followed, predictions that m-learning would match the astronomic growth of mobile devices and mobile content have yet to prove accurate. Hello China and Koolearn have not catalyzed a tidal wave of m-learning, even among the legions of iPhone-sporting digital natives. Like their counterparts around the world, Chinese students use their digital devices to socialize, play games, and consume entertainment media. In the informal learning space, described by many as the classroom of the twenty-first century, educational content still barely registers on the radar or screens of China's digital natives.

The first premise upon which Mobiliz-Ed China was conceived is that the future of m-learning among precollege learners in China lies in formal rather than informal settings. The second premise is that in China, educators, not technologists, university researchers, or policy makers, will determine whether mobile technologies become woven into the fabric of learning or will remain an appealing but peripheral appendage. The third premise is that mobile learning dissemination will depend on educators' connection to the "big picture" and professional communities of practice that enlarge their vision beyond their own students and classrooms. The final premise, in keeping with the well-established technology acceptance model (TAM), is that mobile learning in China will be adopted strategically and selectively as a solution to problems and challenges perceived both to be important and as yet unaddressed.

This chapter describes how these four premises have been tested in the laboratory setting of a Chinese high school by a team of American and Chinese educators. The chapter will be divided into four parts:

1. Present State of Mobile Learning in China
2. Applying the Technology Acceptance Model
3. Problem to Solution Mobile Learning Design
4. Outcomes, Lessons Learned
5. Future Directions

In 2014, a team of American and Chinese educators launched Mobiliz-Ed China with the complementary goals of improving teaching and learning at one high school and developing pedagogical insights and products that would draw from and contribute to the evolving global knowledge base of "best practices" in mobile learning.

## 2 Current State of Mobile Learning in China

### 2.1 Great Expectations

The mobile learning market in Asia is booming. Revenues soared to $2.6 billion in 2012 and industry insiders predict them to reach a staggering $6.8 billion by 2017, the year when China will become the largest buyer of mobile learning products and services in the world (Ambient Insight 2014). Four catalysts are driving this explosive growth: affordability of mobile devices fueling a mobile phone penetration rate approaching 90 %, meteoric rises in mobile Internet users (upward of 450 million), government policies supportive of digital learning, and increased demand for digital content, particularly related to English language learning. China's Ministry of Education has valued the English language learning industry in China at close to $5 billion, with an annual growth of 12–15 % (Ambient Insight 2014).

China's engagement with mobile learning goes back more than a decade. In 2003, "Hello China" pioneered the use of mobile phones for large-scale training by sending English vocabulary words to the mobile phones of participants throughout China (Burston 2013). In 2007, Nokia and New Oriental, China's mammoth private tuition provider, collaborated to launch Koolearn, an entertaining English language instruction delivered to the handsets of tech-loving learners across China (Xiang 2013a). Mobile learning has also been advanced through a series of university-based pilots. Between 2002 and 2005, a Beijing University project developed a learning platform designed to take advantage of the growth in smartphones connected to GSM and GPRS networks. Subsequent projects have focused on building the infrastructure for digital publishing and curating open education resources. In 2011, China announced ambitious plans to create a universal digital learning environment, promising broadband connectivity in all K-12 classrooms by 2020, and urged all provinces to start digital education pilots no later than 2015. In 2012, Shanghai's Municipal Education Authority announced that by 2015, "digital book bags" would replace printed textbooks in the city's schools (Xiang 2013b), an initiative undertaken with backing from Intel. 2012 also saw the introduction of iPads into public schools in Beijing and Nanjing, an initiative heralded by Apple as game changing. The authors of the most recent assessment of mobile learning in China conclude that technology and access, once major barriers to m-learning, no longer pose obstacles to its future development (Shiliang and Hongtao 2013).

## 2.2 Stakeholder Demand

There is mounting evidence that openness to new educational technologies among all stakeholders is at an all-time high in China. A 2013 survey sponsored by Dell comparing attitudes toward educational technology among learners, teachers, and parents in the USA, Germany, and China is particularly telling. Ninety-five percent of Chinese respondents favored more classroom use of technology, in comparison to 74 % of American respondents. When asked whether technology was overused in their schools, 20 % of German and American students answered affirmatively as compared to a mere 4 % of Chinese students. Perhaps the most interesting results relate to how technology is actually being used in schools.

The survey revealed that a majority of American and German students use educational technology primarily for research and special assignments, most often outside of class time. In contrast, a majority of Chinese students reported devices being integrated into the curriculum and used for collaboration between students within the regular school day (Berland 2013).

Surprisingly, given that China is often faulted for its one-size-fits-all educational philosophy, Chinese students were more likely than their American or German peers to report using technology to personalize instruction. Analogously, when asked whether they approved of students using social media in class to share learning, fewer than 1 in 4 Western respondents responded affirmatively in contrast to more than 6 in 10 Chinese respondents, parents, teachers, and students, even though China bans access to popular social media platforms including Facebook, Twitter, and YouTube (Berland 2013).

### 2.3 Countervailing Influences

Even after a decade of experimental projects, strong encouragement from the government, willing audiences, and affordable access to appropriate technologies, mobile learning in China remains in its infancy. Hello China and Koolearn have not catalyzed a wave of m-learning in China, even among the legions of iPhone-sporting digital natives. Like their counterparts around the world, Chinese teens use their digital devices mainly to socialize, play games, and consume entertainment media. In the informal learning space, predicted by many to be the future of m-learning in China, mobile educational content barely registers on the mobile screens of most learners. The majority of projects deemed successful on the basis of a short-term pilot have failed the test of scalability and sustainability (see ▶ Chap. 26, "Mobile Learning in Southeast Asia: Opportunities and Challenges").

Several factors account for the relatively slow rate of mobile learning uptake in China. The first relates to the limitations of commercially driven initiatives. Most of the first and best publicized m-learning pilots have been conducted by technology companies eager to enter new markets or expand their market share. Promotional in nature, these pilots have been of too brief duration to yield hard data on learning impact, with project evaluations limited to reports of stakeholder attitudes and intentions rather than the educational outcomes. At the opposite end of the spectrum are the university projects led by IT specialists that focus on building the technological infrastructure to support mobile learning on a national scale.

### 2.4 Beyond the Novelty Effect

Collectively, private sector and university initiatives have dramatically expanded the frontiers of mobile technology and raised the hopes of a new generation of Chinese teachers and learners. However, initial enthusiasm is no guarantee of sustained usage and positive educational outcomes and novelty's motivational impact is short lived. To wit, an international industry survey recently reported that between 80 and 90 % of all apps downloaded onto mobile devices are used only once (Pramis 2013). Educational researchers have coined the phrase "wow factor" to describe the difference between curiosity-driven "dabbling" and sustained adoption of learning technologies (Murray and Barnes 1998). Related research has explored the gap between learner intentions and actual completion of technology-mediated learning tasks (Donghua 2009).

In one study, motivated volunteers from US government agencies were given the opportunity to learn new languages using a popular commercial software product. Of 150 course registrants, fewer than half accessed their accounts to begin study, only 14 % completed the first 50 h, and just one learner completed the entire course including the final assessment. In a longitudinal study of 15 email messages by advanced learners of Japanese to Japanese native speakers sent over 5 weeks, Stockwell and Hubbard (2003) noted a pronounced "first-message effect," where initial emails were richer, longer, and more frequent at the outset than as the project progressed. "Technology innovation," note the authors of a recent survey of tablet use in Chinese schools, "requires more work than merely purchasing the new devices for the school" (Long et al. 2013). Shiliang and Hongtao (2013) note that technology is an important driving force for catalyzing mobile learning but that its ongoing development will be determined far more by pedagogy and pedagogues.

### 2.5 Mobile Technology Adoption and Teachers

One of the lessons to come out of the most ambitious mobile learning initiative to date, One Laptop per Child, is the price paid for discounting the influence of teachers. In the excitement of putting learning technologies in the hands of the world's poorest children, OPLC technologists, and the government ministries who invested millions, teachers were largely overlooked. When a belief in student-centered learning fails to engage, empower, and support teachers, even the most learner-friendly technologies will fail to gain an enduring foothold (Warschauer and Ames 2010).

As the authors of a comparative analysis of four laptop projects in the USA concluded: It's "impossible to overstate the power of individual teachers in the success or failure of 1-to-1 computing," said the study. "Teachers nearly always control how and when students access and use [the] technology during the school day. In addition, teachers must make massive investments in time and effort to adapt their teaching materials and practices to make the 1-to-1 environment effective and relevant" (Weston and Bain 2010).

## 3 Applying the Technology Acceptance Model to Mobile Learning

OLPC's failure to achieve measurable and sustainable results provides evidence in favor of bottom-up strategies favoring stakeholder empowerment and grassroots innovation. However, if mobile learning is put in the hands of individual teachers working autonomously in their own classrooms, its adoption is likely to remain only sporadic and isolated. David Hopkins of the University of London Institute of Education Improvement provided a useful paradigm for understanding the role of teachers as mobile learning leaders. He describes a model in which educational change agents work intensively in their own schools, and at the same time connect with, and contribute to, the bigger picture (Hopkins 2011).

A time-tested framework of technology integration can help teachers grasp the bigger picture. As practitioners, the Mobiliz-Ed China team needed a model that focused on factors directly relevant to teaching and learning. The TAM (technology acceptance model) represented in Fig. 1 met those needs.

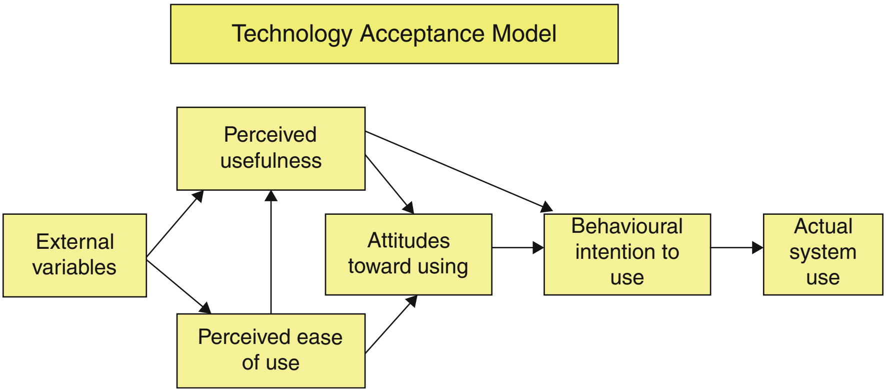


**Fig. 1** Technology Acceptance Model

TAM evolved out of studies comparing successful and failed introduction of computers into schools, universities, and workplaces (Davis 1989). Grounded in theories of rational decision-making, TAM has been proposed as valid framework for understanding the likely development of mobile learning in China as determined by and reflected through teachers and learners.

## 3.1 External Variables

External variables are a catchall category for all those factors that are either constants or lie outside the power of teachers and learners to influence. These include factors such as cultural norms, educational policies, technology infrastructure, and school leadership as elaborated below.

### Cultural Norms

Even though iPhones and ipads have taken China by storm, American-style m-learning is unlikely to gain traction in China. As a growing body of case studies attests mobile pedagogies, unlike mobile devices, it cannot be simply exported from one country to another. The viability of a pedagogy (tech assisted included) like that of a species depends upon its ability to adapt to a particular cultural environment – in China's case, one governed by deeply rooted cultural norms. Even the most progressive and globally minded Chinese questions two of the premises upon which Western-style m-learning is predicated:

1. Students learn best when they are pleasurably engaged and allowed to make choices about what, how, and when they learn.
2. Education should be learner centered with teachers playing a supporting rather than a directive role in the classroom.

Mobile learning in China must take into account two particular cultural norms: a reverence for the gifted teacher that goes back as far as Confucius and a belief that examinations are the most equitable means of controlling access to opportunity.

#### Educational Priorities

China's educational priorities distinguish it both from more- and less-developed nations. Unlike nations where access to school is limited, China has invested heavily in expanding the reach and extent of formal education. As a result, 99 % of children in even the poorest and most remote Chinese villages are enrolled in schools where they follow a national curriculum for 9 years of compulsory school attendance (UNICEF 2015). While educational outcomes and access to higher education correlate with income as they do worldwide, more than 80 % of young people now complete senior secondary school (UNICEF 2015). However, like the USA, in the wake of the successful Soviet launch of Sputnik, China urgently recognizes that its education system must adapt to the demands of a global economy that rewards resourcefulness, critical intelligence, and global communication skills. To that end, the government is supporting a network of "experimental" and "international" programs in both public and private schools. This window of openness to reform makes Chinese schools particularly fertile ground for innovation in general and m-learning in particular. Several studies have confirmed that when new technologies are introduced alongside other educational reforms, positive synergies occur. While technology does not radically change teaching, its introduction can serve as a tangible "symbol of change, granting teachers a license for experimentation" (Sandholtz et al. 1997).

#### Government Policies

Government policies can also inadvertently foster innovation. Recently, the Chinese government raised the level of teaching experience required of foreign teachers seeking visas to work in Chinese schools. Since many foreign teachers are interested in teaching abroad early in their careers, this new policy is reducing the pool of eligible foreign applicants at a time with the expansion of international precollege programs increasing demand. As a result, schools are turning to Chinese bilingual teachers for English language instruction and the teaching of Western curricula, with the expectation that classes will be conducted in English and use English-only textbooks. Rising to the challenge of teaching new content and new skills is likely to motivate Chinese teachers to seek new teaching models and technologies.

### 3.2 Institutional Variables

#### Mission-Driven Leadership

It is widely accepted that the transformational leadership behaviors of principals play a crucial role in technology integration into the curriculum and promoting students' learning (Betz 2000). According to Schepers et al. (2005), the most important of these behaviors is the communication and embodiment of compelling values and ideals that inspire and motivate others and, in particular, teachers to put institutional goals above narrow self-interest.

Mobiliz-Ed China owes its existence to a transformational and pro-technology school leader. Unlike that of most school principals, Wang Guangfa's path to educational leadership was singular and circuitous, following successful ventures in law, politics, real estate, and medical care. The fact that technology proved indispensible in all of these business ventures made it a natural centerpiece for an international school.

### Technology Infrastructure

From its inception, the school has sought to integrate ICT into all phases of teaching and learning. From classroom computers, projectors, and interactive whiteboards to digital translation devices that support real-time multilingual communication and satellite videoconferencing capabilities, technology is being used both to enrich the learning on campus and to expand the reach of that learning to less-advantaged learners in rural China and southern Africa.

Although the school's technology infrastructure is well-developed, its IT staff had virtually no experience with mobile devices. This influenced the project's choice of mobile technologies. First, even though a majority of students owned m-learning-capable personal devices, we decided to have the school provide a standard device known for reliability, long battery life, and interoperability with a Windows computer network, the norm in Chinese schools, universities, and businesses. It was essential that the project uses a mobile device and operating system that was ubiquitous and affordable enough for future partner schools in rural China and southern Africa. A 7-in. tablet running the Android operating system fit this bill.

Across East Asia, Internet access via mobile devices is still more expensive and less robust than on Ethernet-enabled desktop computers (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). Moreover, even when Wi-Fi is made available at no cost to students and teachers is subject to intermittent and unpredictable bandwidth reductions and government-imposed site blockages (i.e., YouTube, Facebook, and Twitter). This combination of constraints prevented the use of a full-feature learning management system for digital content delivery and management. The compromise was Dropbox, a file sharing system that requires the Internet only periodically to sync folders. It was also crucial that essential apps and digital content be accessible and operable offline.

### Faculty Characteristics

Two characteristics of the faculty were contributed to a successful m-learning launch: international diversity and support for faculty collaboration. In most Chinese international schools, foreigners hired to teach English remain cut off from their Chinese colleagues. In contrast, at the implementing school, foreign teachers are paired with Chinese teachers, many of whom the school sponsors to pursue masters degrees in the USA. Foreigners also have opportunities to teach subjects other than English, especially in the school's ambitious and expanding advanced placement program. Interaction is further facilitated by faculty cubicles grouped according to subject and grade level, this proximity fostering easier interaction. Second, in comparison to their American counterparts, most Chinese high school teachers teach fewer hours and class periods per week, have few extracurricular duties, and spend more time at school planning lessons, providing individual help to students and participating in professional development. Sharing the same free periods also supported weekly collaboration.

#### Parental Expectations

The school's most powerful external stakeholders are parents, who have selected the school because it is a gateway to a Western university education. Thanks to China's One-Child Policy, most students are only children in whose education much is invested and from whom high levels of achievement are expected, especially related to college entrance examinations (Li and Prevatt 2008).

#### Curriculum

Unlike international schools in China that serve Western expatriates, the school's students are primarily Chinese. The ambitious goal of preparing them for admission to and success in top international universities has put unusual pressure on the curriculum.

In China, high school is compressed into 3 years during which students in international schools must fulfill three parallel curricular requirements: the mandatory curriculum set by the Chinese government, intensive courses in academic English, and American style college preparatory courses. During the first term of 11th grade, for example, one student's schedule will include courses in Chinese language and politics, mathematics, biology, chemistry, and physics, as well as fourteen periods of English language and college entrance test prep (TOEFL, IELTS, O-Level, SAT). Thus, during an average school week, 11th graders will spend the overwhelming bulk of their waking hours (more than 50) engaged in teacher-directed classroom learning. Into scarce out-of-class hours and weekends, students must compress homework, extracurricular activities, community service, and social time with family and friends.

### 3.3 Usefulness, Usability, and Use

The heart of TAM is its emphasis on usefulness as a determiner of technology adoption and actual use as the "proof of the pudding."

*Perceived usefulness* can be defined as a user's degree of confidence that a particular technology will help them perform an important activity or achieve an important goal. In the case of teachers, perceived usefulness applies to their own efficiency and professionalism, as well as the impact on learning outcomes of their students. Perceptions of usefulness are also influenced by the teacher's belief that he/she will be given the resources (time, training, and support) to use the new technology successfully. Finally, "opportunity cost" also factors into teacher assessment of usefulness: asking themselves, will time devoted to adopting a new technology interfere with achieving more important goals or fulfilling more significant professional responsibilities (Zhao and Cziko 2001)?

*Perceived ease of use* refers to users' estimation of their ability to master the technology and use it efficiently. When confronted with new technologies, teachers, like other rational decision-makers, employ cost/benefit thinking. The more effective a teacher believes that a new technology will be in solving a problem or achieving a goal, the more time and effort he/she will be willing to invest in mastering that technology.

*Attitude toward behavioral intention* describes what users intend to do based on the previous three factors. Typically, these intentions are gathered via interview and survey and as previously discussed often reflect unrealistic positive expectations.

*Actual system use* describes the nature and extent to which the technology is used and becomes an integral part of teaching and learning.

## 4 Solution-Centered Mobile Learning Model

### 4.1 Project Leadership

If the school's CEO provided the vision and resources crucial to project initiation, it was the school's academic principal who drove project implementation, guided by three proven tenets of successful educational technology integration: personally model technology use, encourage collaboration, and create an environment that fosters innovation (Demski 2012).

#### Modeling Technology Use

In preparation for mobile learning, the principal took advantage of a research year in Canada to explore the use of mobile devices in North America. She focused particularly on mobile learning in her own academic field, chemistry, and upon returning to Beijing began integrating mobile apps in her own teaching to help students master the periodic table and document laboratory experiments (Fig. 2).

#### Encouraging Collaboration: Pilot Project

Mobile learning officially began with the formation of a project team charged with "testing the waters" through a 6-month pilot conducted in the subject area most in need of immediate improvement: academic English for US university entrance examinations.

Research into workplace teams has established that diversity across dimensions, such as functional expertise, education, and cultural background, can increase performance by enhancing creativity and group problem-solving (Rigoglioso 2006).

**Fig. 2** Periodic teacher workshops facilitate peer exchange and collaboration

The Mobiliz-Ed China team reflected such diversity being composed of educators from both China and the USA with backgrounds in management, modern languages, program evaluation, and information technologies. Collectively, the team had experience working in public and private schools as well as research institutes and universities on three continents.

The pilot was conducted with two groups of 11th grade (secondary year 2) students, one of which consisted of "average" students and the other of students who in the USA would be classified as academically gifted.

## 4.2 Needs Assessment Drives Project Goals

Usefulness is not an independent entity but is meaningful only when attached to particular goals and institutional priorities, which in turn, are influenced by characteristics of the potential users – in our case teachers and learners. For this reason, Mobiliz-Ed China began with a needs assessment consisting of: interviews with school administrators, classroom observations, and online teacher and learner surveys. In addition to gathering project-focusing information, needs assessment served also as a means of engaging stakeholders by demonstrating a genuine interest in their input.

Out of the needs assessment emerged a clear set of functions ranking high on the perceived use scale. These were grouped by priority and likely effectiveness, resulting in the following plan:

### Goal 1: Increase Academic Vocabulary

Where communicative competence in English requires a vocabulary of between 3,000 and 5,000 English words, the English vocabularies of successful undergraduate students are estimated to range between 12,000 and 15,000 (Adolphs and

Schmitt 2003). With the expansion of the school's advanced placement program, academic vocabulary acquisition has become an even more pressing need. Focusing on vocabulary acquisition also made sense because it accords with a well-established principle of mobile learning: keeping tasks and activities short, focused, and succinct, especially outside the classroom, where interruptions are inevitable (Stockwell and Hubbard 2013).

**Solution 1: Mobile Vocabulary System**

Build a mobile, academic vocabulary suite consisting of an e-textbook, digital flashcards, and an interactive practice app to be used independently by students. Instead of weekly vocabulary quizzes, students would be assessed twice weekly on words introduced that week and a random set of words from previous weeks. Vocabulary learning also lends itself well to the gamification that is proving motivating to language learners (see ▶ Chap. 45, "Mobile Language Learning: How Gamification Improves the Experience").

### Goal 2. Improve Student Performance on College Entrance Exams

With the number of Chinese applicants to Western universities rising, competition for admission to selective institutions – those listed in the international rankings that count in China – has become fierce. Over the past several years, qualifying scores on the TOEFL and IELTS English proficiency assessments increased significantly. Even more of a challenge is the expectation that foreign applicants are held to the same standards as their native-born peers. As a result, foreign applicants to top American universities take the SAT or ACT, examinations designed for American high school graduates. To be competitive, foreign applicants are also encouraged to take advanced placement courses, once a way to earn college credit while in high school, now a de facto admission requirement at elite institutions. Moreover, because Chinese transcripts are harder for Western universities to evaluate – and in some cases, trust – standardized test scores weigh disproportionately in Chinese admissions decisions.

At present, exam preparation in international precollege programs in China and across Asia consumes vast amounts of class time and consists of repetitive drill and practice. This regime has several negative consequences. First, it places "skills" above "content" depriving teachers and learners of the opportunities to read and discuss literature, conduct independent research, and participate in project-based learning that is the norm in American and European high school English classes. Second, not only are Chinese English teachers unfamiliar with Western college entrance examinations like the TOEFL, IELTS, SAT, and ACT but the English language proficiency required to excel is higher than that required of English majors at even the top Chinese universities. This results in teachers who are tethered to the answer keys provided in the test prep books. Most test prep classes follow the same, boring routine in which Chinese teachers laboriously make their way through sample reading passages, hoping students will volunteer answers to sample questions but most often supplying those answers themselves. Repetition and passivity have the effect of suppressing students' ability to respond to material they have never seen before, absorb it quickly, and make and think critically, skills required both on university entrance exams and more importantly in university courses.

### Solution 2: Flip the Classroom with Interactive Test Prep Apps

Replace repetitive teacher-directed drill and practice with test prep apps that solve two problems. This solution is based on the belief that the best learning emerges when teachers are freed to do what human beings do best and machines are enlisted to do what machines do best. For three key elements of learning – memory, practice, and personalized feedback – machines out-teach human beings. Even inexpensive computers can store and instantly retrieve vast quantities of factual information like correct multiple choice answers and word meanings. Machines, unlike humans, also do not become bored by the repetition required to master new information and skills. Finally, interactivity requires students to attempt answers instead of waiting passively for teachers to provide them. Second, immediate and individual feedback makes learning more efficient and personalized (see ▶ Chap. 24, "Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom").

By outsourcing repetitive and finite learning activities to mobile devices, teachers can use class time for the higher-order teaching and learning for which human beings are uniquely qualified. Teachers can, for example, introduce Chinese students to Western culture through short stories with compelling characters, plots, and themes. Students can build social skills through small group discussions, critical thinking skills through analytical essays, and creativity and productive technology skills by creating their own digital stories based on the models studied in class.

## Goal 3: Increase Reading Motivation and Proficiency

In their precollege courses, students use English-only American and British textbooks. Over the past decade, like the American and British populations, textbooks have been expanding in size. In contrast to a typical Chinese textbook which averages about 150 pages, most American textbooks range from 500 to more than 1,000 pages, each with significant numbers of unfamiliar words which, when definitions are provided (in English), may still be confusing. To cope, students use dictionaries – electronic ones if they can afford them, halting their already slow pace to flip through dictionary pages or type the mystery word into their translators and then copy the definition into the margins of their textbooks and/or notebooks. In addition to making reading a laborious and lengthy process, reducing reading speed also has the effect of lowering comprehension by focusing attention on individual words rather than whole sentences and ideas (Nuttall 1982).


**Fig. 3** E-book reader with built-in translation and quiz functions expedites reading and language acquisition. (Source: http://slideme.org/application/zo-reader)

### Solution 3: Bilingual Digital Reading Platform

Use a digital reading platform that allows learners to import an English-Mandarin dictionary. The best of these provide finger touch translation, audio pronunciation, and the ability to save words to a flashcard program and personal dictionary for easy review and self-testing. Zo Reader, pictured in Fig. 3, is an example of a genre of reading platforms that provide offline multilingual translation tools to significantly increase reading speed and comprehension.

## Goal 4: Improve English Speaking Skills

Since most high school classes at the school are taught in English, students have considerable opportunity to hear English and improve their listening comprehension. In contrast, opportunities to speak English are limited. In most classes, teachers do most of the talking, with only the more confident and proficient students responding orally to questions. Although teachers encourage students to talk in English with each other outside class, because most of the community is Chinese, speaking in English feels artificial and rarely occurs except as a necessity with a small group of foreign teachers who do not speak Chinese. Class periods limited to 45 min make assigning oral presentations possible only a few times a term. Oral English evaluation poses an even greater challenge. Standard practice is for teachers to pose interview style questions (i.e., in what country are you are planning to attend university and why have you chosen this country?) requiring impromptu answers. Typically, this is done one student at a time, with the teacher having to come up with equivalent but different questions for each student. Getting through an entire class of 25 students can consume nearly a week of class time. Moreover, because the teacher's assessment is based on a "once-only" listening, it is subject to error.

### Solution 4: Voice Recorder and Simulated Conversation App

Berking and Haag (2012) in their discussion of mobile learning design have coined the phrase "microstrategies" to describe particular learning activities that are sequenced within a single "instructional event."

The effective language classroom relies on just such a dynamic series of learner interactivities. In the case of assessing impromptu oral expression, mobile devices can transform a once prolonged, tedious, and wasteful use of limited class time from a fast-paced instructional and tedious process into a fast-paced microstrategy. Instead of assessing each student seriatum, teachers can pose a single question to an entire class, who then can respond simultaneously using the audio recorder and stopwatch functions of their mobile devices. Their recordings can be saved as audio files to their own devices and sent via email or offline, via Bluetooth, to their teacher for more considered assessment.

For conversation practice outside class, students can use a mobile app built around lively scenarios in which the student converses with a digital speaking "pal." Students are further motivated when they receive points for correct idiom use and accurate pronunciation (determined by the mobile app's speech-to-text function).

### Goal 5: Improve Learning by Reducing Clutter

Figure 4 says it all. High school students at the school and across China spend up to 10 hours per day at desks piled to overflowing with the dozens of textbooks and notebooks required in their many courses, not to mention the drinks and snacks needed to sustain them through this marathon.

Clutter not only wastes valuable learning time in the shuffle to find the right book or paper, but it also negatively affects cognition by reducing the brain's ability to process information (McMains and Kastner 2011).

**Fig. 4** In the typical Chinese high school, learning is impeded by the sheer volume of physical books and papers

#### Solution 5: E-Books and Digital File Sharing

Replace paper textbooks with eBooks and paper notebooks with virtual notebooks that support handwriting. Use a device camera function to capture and save paper documents to device folders and to submit paper assignments electronically. As noted previously, digital textbooks have the added benefit of built-in translation tools.

### Goal 6: Build Cultural Knowledge and Academic English Skills of Chinese English Teachers

With stiffer eligibility requirements for the hiring of foreign teachers, more Chinese teachers are faced with teaching cultural content and language skills for which their own training has not prepared them. Most secondary English teachers were trained in Chinese universities where language instruction focused on "communicative" competency and literature at the expense of academic English for university study across disciplines. Encountering English reading content drawn from the sciences, Western history, and literature, Chinese teachers find it difficult to master, let alone teach skills and content they themselves have not had the opportunity to master. Bringing in Western curriculum experts to conduct training is both too expensive and time-consuming to be the most practical solution.

#### Solution 6: Collaborative, Teacher-Built Presentations

Pair Western and Chinese teachers to create culture-rich, error-free learning modules. In China, even more than in the USA, the educational technology of choice remains the slide presentation software like PowerPoint. Recently both Microsoft and Apple have released mobile-friendly versions of their presentation software, enabling cross-platform use. Through this courseware collaboration, Chinese teachers help their Western colleagues better understand the learning needs of their Chinese English learners. At the same time, Western teachers serve as cultural guides and English usage coaches for their Chinese peers. The time saved through shared material development is invested in the kind of visual and multimedia concept "enhancers" that have proven effective in fields such as economics (Zhang 2012).

The collaboratively developed slide presentations also serve the double purpose of whole class presentation and anytime, anywhere access on student devices for independent study and review outside of class.

## 5 Evaluation and Outcomes

Unlike an academic research study, the Mobiliz-Ed Pilot was designed as a "trial run" for an expanded school-wide implementation of mobile learning. Evaluation, therefore, is centered not on *whether* the pilot would be extended and expanded but on *how*, *when*, *and with what modifications*. To that end, we administered post-pilot surveys aligned to the pre-pilot surveys for both teachers (80 % response rate) and students (72 % response rate). Rather than presenting detailed evaluation data, we will highlight findings applicable to practitioners involved with or interested in mobile learning implementation at the high school level.

## 5.1 The Big Question: Did Mobile Technologies Improve Learning Outcomes?

Although computer-assisted learning has long been considered an effective means of improving learning outcomes in a cost-effective way, the actual empirical evidence of its impacts on improving learning outcomes is mixed. While modest but significant positive effects have been found for math outcomes, research has yet to conclusively establish positive impacts for language-based computer learning (Fang et al. 2011).

### Quantitative Evidence

In one of the two classes that participated in the pilot, pretest/posttest data confirm significant learning gains, which both teacher and students believe are attributable to mobile learning. For 90 % of this class of 22, we were able to match reliable pre- and posttest scores on timed practice SAT examinations administered under controlled and identical conditions. As the chart below indicates, score gains following instruction were significantly higher in the mobile pilot classes than equivalent norms recorded in research studies conducted by the Educational Testing Service (Fig. 5).

Many more students take the TOEFL (27 million in 2013) than the SAT (1.7 million in 2014) because the former is taken by a majority of nonnative speakers seeking entrance into English medium universities worldwide. The TOEFL is also a particularly effective measure of the full gambit of skills (speaking, reading, writing, and

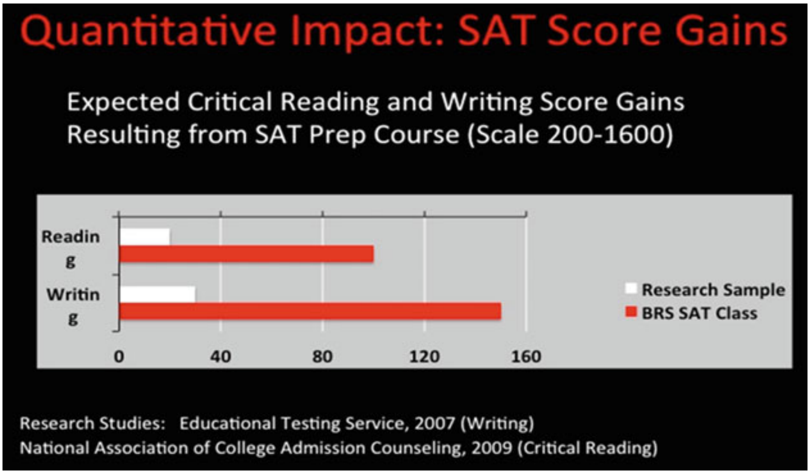


**Fig. 5** Gains in SAT Reading and Writing Scores Confirm Positive M-Learning Impact (Mobiliz-Ed Internal Evaluation Report, 2014)

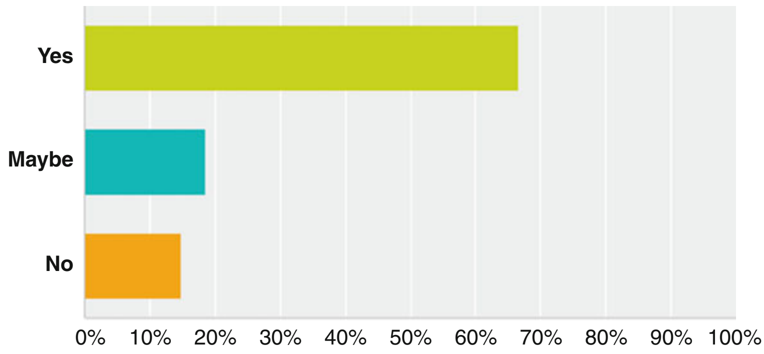


**Fig. 6** Student responses to Survey Question "Would you be interested in volunteering to help teachers and other students use mobile devices?" Source: Mobiliz-Ed Internal Project Evaluation Report, 2014

listening) that constitute English mastery, providing sub-scores for each skill. Additionally, because the TOEFL test content is drawn from disciplines outside English literature and language, it measures proficiencies relevant to all nonquantitative high school courses. Thus, in the future, it is recommended that TOEFL pre- and posttest diagnostics be a mandatory component of program evaluation.

### Qualitative Evidence

On post-pilot surveys, 90% of students surveyed reported that mobile devices had proven "useful in learning English." Reasons given by the 10 % who had not found mobile devices useful included "inability to keep myself from listening to music or playing games" and "didn't get enough opportunity to use the devices in class." This 10 % "distraction" quotient compares favorably with a recent survey of more than 6,000 mobile learners in Quebec, in which a third of those surveys reported using their devices in class primarily for nonacademic purposes (Karsenti and Fievez 2013).

The predominantly positive attitude among students was also reflected in their responses to a question about interest in volunteering with the project during the following year. Offering to volunteer with the project is especially significant given the time demands and pressure of Chinese students' college preparatory curriculum (Fig. 6).

Analogously, when asked if they would elect to use mobile devices with their students in the future, 100 % of teachers answered affirmatively.

## 5.2 Predicted Usefulness Compared to Actual Usage

The more interesting question was not *whether* mobile devices improved learning but *how* and, especially, *which* particular tools and content most positively affected learning. The table in Fig. 7 compares *anticipated* usefulness with *actual* usage.

| **Predicted Usefulness. Actual Usage** | **Predicted Useful** | **Not Predicted Useful** |
|---|---|---|
| **Used Frequently** | E-Textbooks<br>Voice, Image and Video Recorder<br>News Sites*<br>Video Lectures*<br>Digital Flashcard Apps | E-Fiction<br>Bilingual Reading<br>Dropbox File Sharing<br>Offline File Transfer<br>Audio Podcasts<br>We-Chat Instant Messaging App |
| **Used Minimally** | Internet Research Tools<br>Test Prep Practice Apps<br>Creative/Production Tools & Apps<br>Web-Based Apps | Edutainment Apps |

**Fig. 7** Mobile Apps, Tools and Content: Predicted Usefulness Versus Actual Use

Within each category, items in **bold** show strongest effects and therefore have the greatest relevance for m-learning implementation both locally and more broadly.

## Positively Congruent: Predicted Useful and Used Frequently

### E-Textbooks Rated Very Useful

As hypothesized, a majority of students preferred e-textbooks to paper ones noting the appeal of vibrant and realistic color visuals, ease of access, and the efficiency of built-in translation tools. The one negative aspect of e-textbooks noted by a minority of students was the difficulty posed by digital annotation. In contrast to their teachers' preference for typing, students preferred to handwrite their notes, which in a digital context necessitated the use of a handwriting app and a stylus whose functionality did not quite match paper and pencil. And for some students, digital note taking posed such a hurdle that they chose to work from paper copies printed from the digital textbook files. Several resourceful students reported using "capture" tools to record class lectures, take pictures of notes on the whiteboard, and keep digital copies of written assignments (Fig. 8).

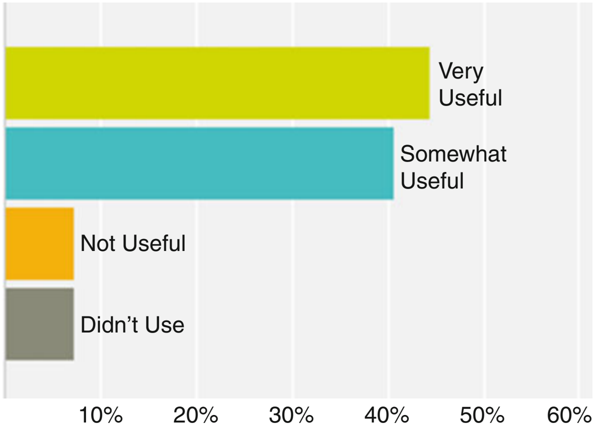


**Fig. 8** Student Rating of E-Textbook Usefulness (Source: Mobiliz-Ed Internal Project Evaluation December 2014)

### Negatively Congruent: Not Predicted Useful and Used Minimally

As the bottom right quadrant of Fig. 7 indicates, students neither expected nor found “edutainment” apps to be useful, a finding that was consistent with surveys of American and German high school students (Berland 2013) but contrasts with American surveys of primary school tablet users for whom “fun” was an essential usage criterion. While students noted the benefits of interactivity and feedback, often present in edutainment apps, enjoyment and engagement were notably absent from their predictions of usefulness and actual usage.

### Positively Incongruent: Not Predicted Useful but Used Significantly

#### Bilingual E-Novels Rated Very Useful

What teachers and students did not expect was the extent to which mobile technologies would promote independent literature reading. In previous years and in non-pilot classes, students typically read only the short fictional excerpts included in their *English for Speakers of Foreign Languages* (EFL) textbooks. As Figure 9 confirms in contrast, students in the mobile learning pilot classes reported (and teachers confirmed) the reading of full-length English language novels.

Four factors can help to explain this unanticipated usage:

(i) Wide availability in China of digital versions of popular high school literature, in contrast to the USA where intellectual property law restricts access to most contemporary literature.
(ii) Free reading platforms and bilingual literature collections created by Chinese app developers for Chinese English learners. One of these, DiDa bilingual reading app, presents the full texts of modern and classic novels in English, with the ability to click on a paragraph for a Chinese translation (Fig. 10).

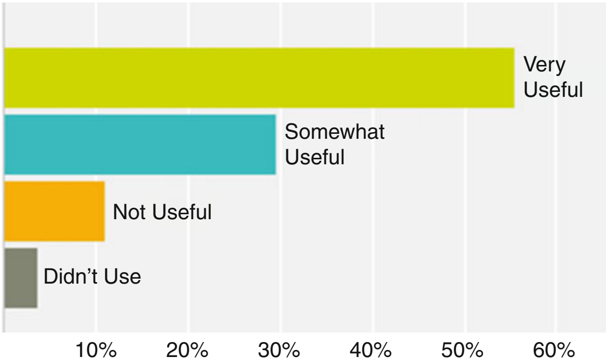


**Fig. 9** Student Ratings of Bilingual Literature (Source: Mobiliz-Ed Internal Project Evaluation December, 2014)

(iii) Introduction of "independent reading time" at the beginning of the school day.
(iv) Written assignments that drew on and rewarded students for their independent reading.

A Note on Bilingual Reading Apps Versus Parallel Paper Texts

Bilingual reading is not new to Chinese learners. Many textbooks include parallel reading passages in the original English and in Chinese translation. When interviewed about how they used print versus digital bilingual readers, students noted that seeing the Chinese translation has the effect of drawing them away from the English text. In contrast, when the text appears in English and the user has to click on a word or a paragraph to access the Chinese translation, students reported a greater tendency to decipher the English, using the Chinese translation as a comprehension check rather than as a substitute for English.

### Negatively Incongruent: Predicted Useful but Infrequently Used

Students' predicted use of mobile apps differed from their actual usage in two significant respects.

#### Web-Based Apps

In China, there is an inverse relationship between media-rich interactivity and reliable performance. Because of their high memory demands, many richly interactive apps function poorly as native applications (those that can be downloaded to devices for offline access). To avoid overtaxing device memory, many of these apps are designed to be launched and operated on the web. As anyone who has experienced the frustration of trying to access the web during a technology conference where the broadband is inadequate to accommodate high user demand knows, when all 25 students in one class tried to use web-based apps, they experienced cyber gridlock. This was especially problematic when teachers attempted to use interactive student response apps like Socrative and Poll Everywhere.

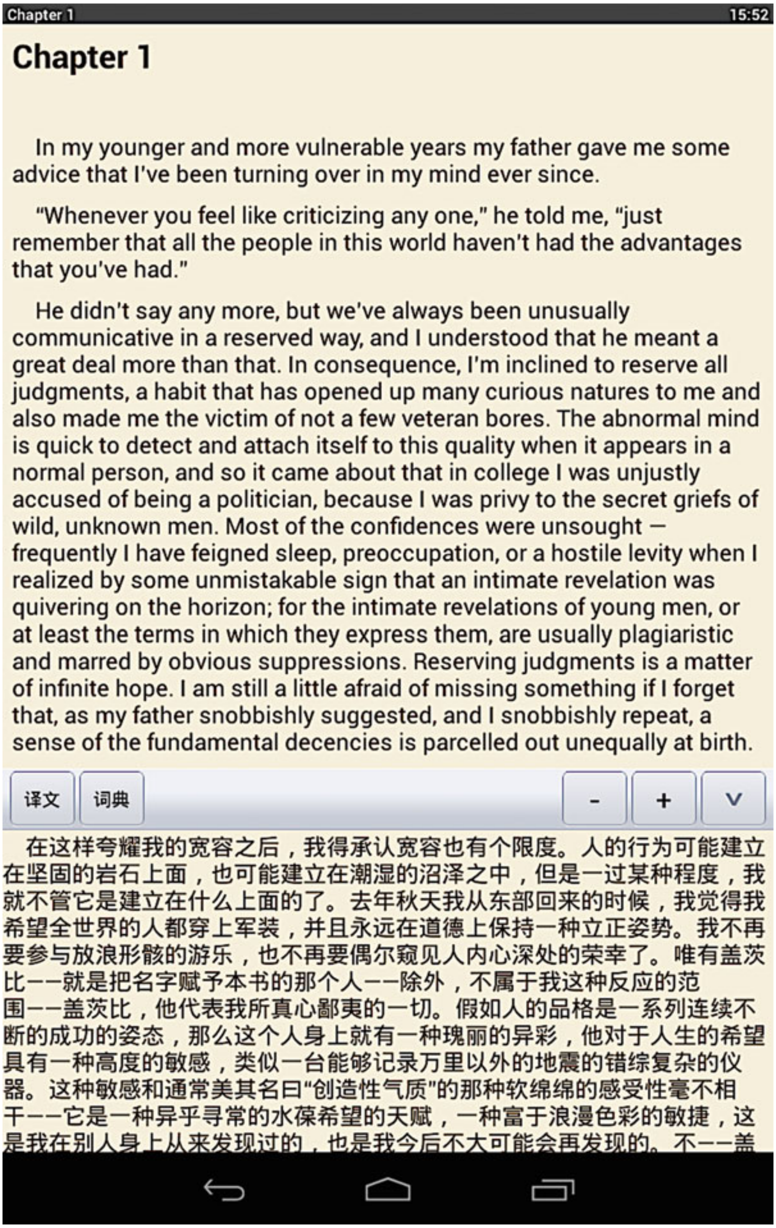


**Fig. 10** Bilingual reading apps like Dida (http://www.didaenglish.com/) exemplify effective adaptive learning technologies that accommodate readers of varying English abilities

### Test Prep Practice Apps and Independent Learning

Much of the mobile learning market is predicated on the paradigm of the self-directed learner for whom accessible and engaging applications will serve as motivation to engage in independent learning. While students both requested and voiced enthusiasm for mobile test prep and vocabulary apps they could use independently, few students used these practice apps frequently enough to derive benefit. Apparently, the prospect of college entrance exams was too distant to motivate students to engage in independent and optional learning. In the class that experienced gains on the SAT, the teacher promoted student use of vocabulary and test prep apps through in-class assessment for which the app use was essential preparation.

### The Long Tail of the Bell Curve: Independent Learners

While most students' use of mobile technologies remained limited to uses directed by their teachers, a significant subgroup of students, approximately 20 %, made extensive and informed independent use of mobile tools and apps, extending to video lectures and news media. Two students reported accessing English language MOOCs from Western universities.

## Observations

### Educational Media Consumers not Creators

The Mobiliz-Ed China pilot revealed the same mixed picture of perceived and actual technology expertise documented by a recent study of first year Hong Kong University students (Kennedy 2014). As in Kennedy's pilot, Mobiliz-Ed China confirmed that urban Chinese high school students and their teachers (most under 30) are indeed digital natives as defined by daily use of a wide range of mobile technologies for personal empowerment, communication, and entertainment. However, the pilot also confirmed that among the majority of these teachers and students, their mobile tech literacy did not extend to the full range of competencies required to use mobile technologies to improve teaching and learning. For example, few teachers and students came to the project with experience using digital tools to create their own educational content. Thousands of classrooms in the USA and Europe have their own "channels" on YouTube where teachers post video presentations and students share videos related to class assignments. In contrast, on China's equivalent video sharing sites, Tudou and Youku, most of the free educational videos are the ones created by American teachers and students which Chinese consumers have appropriated and shared. Interestingly, China has a booming market in commercial educational videos produced by private education companies, like the test prep giant, New Oriental.

### Preference for Teacher-Directed Mobile Learning

Consistent with the 2013 Dell study comparing the use of educational technologies in Chinese, German, and American schools, Mobiliz-Ed China confirmed a decided preference for mobile learning activities directed by teachers and directly related to the formal curriculum. Evaluation surveys of teachers and students revealed a strong positive correlation between a teacher's use of mobile technologies and that of his or her students. That students looked to their teachers for direction recalls another distinctive finding in the Dell survey: when asked whether they agreed with the statement "My teacher knows how to use technology better than I do," 70 % of Chinese students responded affirmatively as opposed to only 40 % of American and 26 % of German students (Berland 2013). No doubt a reflection of the comparatively greater respect with which teachers are viewed in China than in the West, this finding further confirms the power Chinese teachers will wield when it comes to determining how and whether mobile technologies will play a major role in shaping precollege education in China.

### Building a Professional Learning Community

Mobiliz-Ed China is catalyzing the development of a professional learning community at the school. The excitement generated by a new technology is driving a spirit of innovation and shared expertise. Instead of bringing in outside experts or purchasing premade curriculum, it has put its faith in its own teachers as drivers of educational improvement. Teachers have been given a license to experiment and are both encouraged and rewarded for sharing the results of their experimentation. This is being accomplished through three channels: a monthly faculty newsletter; a lively series of faculty demos, panel discussions, and peer trainings; and support for teachers to present at international conferences.

### Faculty Newsletter

Every month sees the publication of the Ipad News, a newsletter featuring articles written by faculty for their peers. Edited by Dr. Cheng, the tone is friendly and down to earth. Recent articles have provided "baby steps" for less confident teachers such as having students research and present an analysis of a current event related to their course.

### Peer Coaching

In monthly panels, "pioneering" teachers share the gains and challenges encountered as they have sought to integrate mobile technologies into their courses. The informal format has allowed teachers to address both successes and failures, the latter being offered in the spirit of helping their peers avoid the mistakes and detours they had encountered. "Pioneers" also provide hands-on mini-trainings on particular mobile apps and tools, connecting these to particular teaching strategies. More than demos, these mini-trainings are coaching sessions with teachers helping teachers learn by doing. As use of mobile devices becomes more mainstream, effective mobile technology integration will be added to the school classroom teaching observation protocol.

### Participation in a Global Conversation

Incentives for teachers using mobile technologies extend beyond their immediate school community. The school has sponsored teachers to attend conferences and visit schools where mobile learning is being successfully implemented. Even more significant, teachers have been encouraged to present at conferences both in China and internationally. In October 2014, as host of the New York based College Board's annual China AP Summit, the school encouraged teachers to offer demo classes that showcased how mobile technologies could be integrated into an international program of study. Several teachers had workshop proposals accepted at the UNESCO's Mobile Learning Week, an event that draws hundreds of mobile learning practitioners and educational policy makers from around the world.

## 6 Future Directions

The next step for Mobiliz-Ed China is more formal evaluation and to this end the project will build a team of internal and external researchers. To date, most evaluations of mobile learning have been both limited in scope to user surveys designed to determine (1) levels of learner satisfaction, (2) attitudes toward technology-mediated interaction with fellow learners and their instructors, and (3) nature and extent of learner mobile device usage (Diaz 2014). More challenging but potentially more useful to educators is information related to learner outcomes. Do mobile technologies help students learn faster, learn more, or learn more deeply? The most important questions also will require a longitudinal approach, with impacts measured over time. Among the specific questions to be addressed are:

1. In what areas do mobile devices improve student and teacher organization and efficiency?
2. To what extent is the engagement promoted by mobile devices related to learning outcomes?
3. Have mobile devices fostered productive collaboration among students?
4. Have mobile devices strengthened students' relationships with their teachers?
5. Have mobile devices contributed to higher levels of independent (as opposed to teacher-directed) learning?
6. Do mobile devices make teaching more adaptive to the differences in students' learning preferences and academic levels?

Answering questions like these will help determine whether mobile technology will play an integral role in improving teaching and learning or whether, like many educational technologies, remain peripheral.

## 7 Cross-References

► Characteristics of Mobile Teaching and Learning
► Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom
► Mobile Language Learning: How Gamification Improves the Experience
► Mobile Learning in Southeast Asia: Opportunities and Challenges

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# Networked Teleoperation Applied in Mobile Teaching: Study

# 30

Qiongjie Luo and Haiping Du

## Contents



**Abstract**

In the last few decades, an increasing number of people are beginning to realize that bilateral teleoperation plays an important role in the extension of human manipulation in fields such as space, underwater exploration, medical surgery, and hazardous environments. There is also enormous and untapped potential in applying bilateral teleoperation in mobile teaching especially networked scenarios. Nowadays, education not only focuses on the passing on of knowledge but also the interaction between teacher and student. Meanwhile, increasing numbers of people are beneficial from mobile/distance education. While due to the limitations of practicing, students are limited to art subjects. Thus, with the better than better smartphones emerging, bilateral teleoperation-based mobile teaching will become a revelation to the existing education structure.

When it comes to the teleoperation system, the greatest consideration is the time delay over the transmission which influences the performance of the system. With the development of the Internet, in recent years, an increasing number of teleoperation applications are applied over this global network. There is no denying the fact that dealing with the time delay issue on the Internet has been considered as the primary challenge as it can deteriorate system performance and even destabilize it. Many studies in the literature address the problem

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of the transmission delay of teleoperation across the Internet. Those among them that consider the controller design and experimental simulations are mostly focused on two kinds of time delays: constant time delay and time-varying delay. As time-varying and asymmetric delays often occur in network-based bilateral teleoperation systems, designing an appropriate control system to maintain their stability has proved to be critical.

This chapter focuses on the control of bilateral teleoperation systems across the Internet which can be potentially applied in numerical mobile teaching applications. We design a controller that takes the time-varying and asymmetric delays into account. Its key features include adaptability to time-varying asymmetric delays and stability with good transparency performance. We use new controller synthesis methods to develop the system by defining appropriate Lyapunov–Krasovskii functional. This method is developed by applying tighter bounding technology in a cross terms and weighting matrix approach. Furthermore, the controller synthesis conditions are expressed as matrix inequalities, which are solvable by existing methods. We then apply the designed controller to a linear system model with increasing forward and backward delays. Finally, an experimental validation of the developed theoretical methods is used to demonstrate the effectiveness of the proposed method, and the results show that the proposed criteria improve the force tracking with less response time and less overshoot as well as with an acceptable position error.

# 1 Introduction

## 1.1 Background

In the 1940s the first master–slave teleoperation system was built. Since then, a great deal of research on this topic has been conducted, and it has been recognized that teleoperation systems can be applied in many areas such as aerospace, undersea, medicine, and operations in hazardous environments. With the development of the Internet, teleoperation across this global network has attracted attention in recent years. In such systems, the transmission time delay on the Internet has been considered the primary challenge as it can deteriorate system performance and even destabilize it. Many studies reported consider the transmission delay of teleoperation across the Internet. Those among them that concern the controller design and experimental simulations are mostly focused on two kinds of time delays: constant time delay and time-varying delay. Since time-varying and asymmetric delays often occur in network-based bilateral teleoperation systems, designing an appropriate control system to maintain its stability has proved to be critical.

A bilateral teleoperation system is typically composed of a human operator, a master (manipulator), a communication channel, a slave (manipulator), and an environment. The motion (position information and velocity information) and/or force information in a bilateral teleoperation system can be transmitted from both master to slave site and slave to master site so that the slave can try to mimic the behavior of the master which in turn takes into account the input forces from the slave. The bilateral teleoperation system has been extensively studied for decades, and it can be applied in many different areas such as space and underwater exploration, medical surgery, and any general tasks operated in hazardous environments.

The first teleoperation application was able to replace human hands to deal with hazardous materials (Lichiardopol 2007), and numerous applications based on teleoperation systems have since been developed. A novel application is named Robonaut which was developed by the National Aeronautics and Space Administration (NASA)'s Johnson Space Center and the Defense Advanced Research Projects Agency (DARPA) (Johnson Space Centre and the Defence Advanced Research Projects Agency). The Robonaut is classified as a telepresence application referring to the system by which the slave sends sufficient information back to the master, for instance, visual feedback, acoustical feedback, and tactile feedback. Those feedbacks result in the manipulator feeling a lifelike remote site environment. In the Robonaut project, the information feedbacks to the human site are visual from a helmet, tactile from a pair of gloves, and positional from the tracker. The Robonaut is able to bring sufficient site information to the operator and is flexible enough to track detailed human hand operations.

The aim of the Robonaut is to help humans extend ability to explore in space and assist or replace humans to construct and work in high-risk places. To meet increasing requirements for extravehicular activity (EVA) and dexterity on space works, the Robonaut has been developed based on mechanisms, computational architecture, and teleoperation control. It also can be used as a validation tool for controller performance and mobility.

## 1.2 Problem Statement

There are two concerns from control point of view in designing a suitable controller for a teleoperation system: stability and transparency. Sufficient information must be transmitted between master site and slave site, while more information means more transmission which results in large time delays in the communication channel.

On the other hand, in terms of existence of time delays in most communication channels, we are confronted with the delay-induced instability of bilateral teleoperation systems. In particular, a network (such as wired or wireless Internet) has been adopted as a communication medium where the delays will be time varying, irregular, and asymmetric (i.e., the time delays will be different in the forward and backward transmissions).

Thus, the problem is to design a controller that can guarantee system stability while providing an acceptable transparency in a required environment.

### 1.3 Contributions

In this chapter, the study will primarily focus on developing effective control strategies for network-based bilateral teleoperation system so that the system stability and transparency performance can be guaranteed even when there are asymmetric time-varying delays across the network. The proposed research includes theoretical study and experimental investigation.

This chapter makes the following contributions to both theoretical study and experimental investigation:

The author has developed an effective control strategy for a network-based bilateral teleoperation system with asymmetric time-varying delays. This new control strategy was developed by defining appropriate Lyapunov–Krasovskii (L-K) functional and by applying tighter bounding technology for cross terms and free-weighting matrix approach. The developed control strategies guarantee system stability and transparency performance at the same time. The controller design procedure is completed by solving matrix inequalities and trial.

The author has built a network-based bilateral teleoperation system platform under the MATLAB environment. A HILINK microcontroller board and MATLAB/Simulink are used to construct the real-time hardware in the loop control system. The built teleoperation platform can be easily used for different purposes. Under the MATLAB environment, different controllers can be easily implemented and validated.

This research has validated the developed control strategies numerically and experimentally through three main scenarios: simulation, one PC with two motors in a realistic communication-free environment, and two PCs with a network-based teleoperation platform environment.

## 2 Network-Based Teleoperation Literature Review

### 2.1 Overview

Teleoperation systems have been developed for the last few decades, and many new novel technologies have been applied to the original system to enhance its performance. Numerous new applications have emerged which contribute to human life. In this chapter, we present background on bilateral teleoperation systems, design criteria, existing design methods, and applications.

### 2.2 Bilateral Teleoperation Introduction

Generally, a bilateral teleoperation system is composed of a local master site, which is driven by a human operator, and a remote slave site, which is in contact with the environment. In such a system, the slave follows the movement of the master and the master receives feedback information from the slave. With the development of

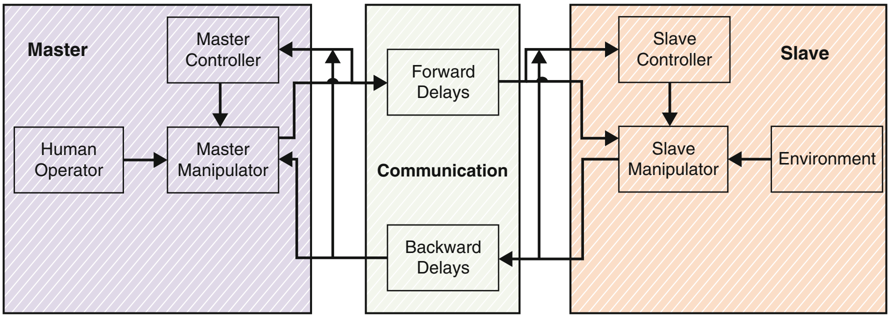


**Fig. 1** The bilateral teleoperation control system

computer networks, bilateral teleoperation systems operating over the Internet communication channel are becoming popular. However, the control of these systems is an open issue.

A typical teleoperation system which includes a human operator, a master operating stick at a human operator site, a slave operating stick at the environment site, a communication channel through which force and position information is transmitted between the master and slave, and visual feedback from his camera at the slave site and presented via the monitor at the master site. In this system, the control commands from the master to the slave and the feedback from the slave to the master can be transmitted electrically by wire, wire network, or wireless network. The control progress can be applied with one feedback or more feedbacks depending on different control strategies.

**Bilateral Teleoperation Formulation**

Figure 1 shows the architecture of a bilateral teleoperation control system. The human operator sends an order to the master manipulator, after which it is transmitted over the communication channel. The order received by the slave is then subjected to forward delays. The slave then issues feedback to the master regarding its execution of the order, which is subjected to backward delays. In an ideal situation with no environment influences, both master and slave are in synchrony. However, in practice, this cannot be achieved. Hence, controllers are added to the master and slave sites. Their duty is to stabilize the system and help the slave track the master.

## 2.3 Stability and Transparency Analysis

There are two main design criteria used to assess the performance of teleoperation control systems: stability and transparency. Stability is one of the most important requirements for teleoperation systems. Theoretically, we can apply the Nyquist stability criterion, i.e., the number of characteristics roots of the closed-loop system on the right hand plane to judge system stability (Ogata 2002). Practically, if the system input is bounded, the corresponding output should be eternally bounded

(Zhu et al. 2011). Transparency is another important performance requirement in teleoperation systems. It is an index that describes how realistic the operation is to the operator. Ideally, a good transparency would create a feeling that the operator is manipulating the remote object in person even when it in a virtual environment (Lichiardopol 2007).

#### Trade-Off Between Stability and Transparency

Achieving perfect transparency requires constant feedback from the slave. This results in large feedback delays which in turn can eventually destabilize the system (Lawrence 1993; Polushin et al. 2008a). Hence, the two criteria are in conflict with each other and a trade-off solution must be reached (Hokayem and Spong 2006). The constraints on the physical communication media lead the trade-off between stability and transparency in a teleoperation system. Thus, researchers are faced with options either to focus on one or to compromise between the two. For space applications, Lawrence (Lawrence 1993) has explored the necessary levels of transparency for efficient task execution. While the optimal transparency depends on research objectives, higher transparency would significantly improve the maneuverability of teleoperation systems. Many studies have analyzed the trade-off between stability and transparency. In Polushin et al. (2008a), the authors propose a projection-based force reflection algorithm, which could arbitrarily decrease the feedback gain value when long delays result in high feedback gain. In this approach, the constraint of subsystem feedback gain is removed to ensure stability with good transparency under communication delays.

### 2.4 Networked Teleoperation: Introduction

Since the TCP/IP protocol was proposed in 1974 (Zakon and The Internet Society 1997), the Internet has been consolidating its role as the main information media in the world. The teleoperation system over Internet studies started in 1995 (Hokayem and Spong 2006). While in bilateral teleoperation systems, information as force and position are influenced by random uncertain delays based on Internet transmission. The fundamental networked teleoperation system is presented in Fig. 2.

Packet-switched network is afflicted with time-varying delays and packet loss issues; if there is not a robust control strategy to the networked teleoperation system, destabilization will ensue.

### 2.5 TCP and UDP Protocol Networked Systems Analysis

In Lichiardopol (2007), a performance evaluation is carried out between TCP (Transmission Control Protocol) and UDP (User Datagram Protocol) which are the most popular transmission protocols used in the Internet. TCP guarantees transmission quality but needs acknowledgement to continue transmission, while UDP is less time costly to transmit because it does not need reception. Moreover,

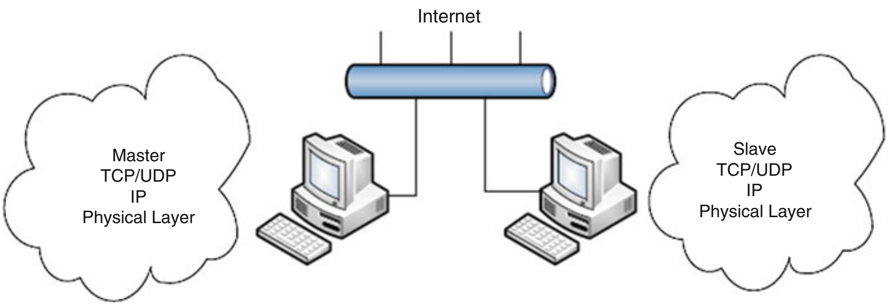


**Fig. 2** Networked teleoperation system

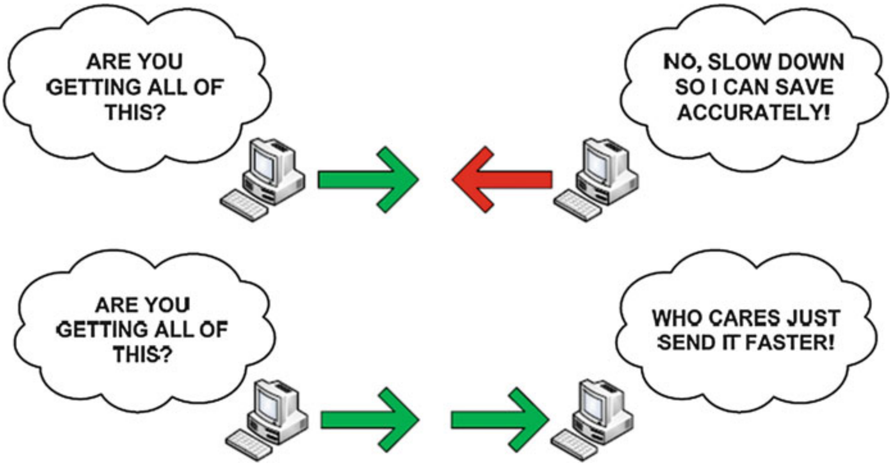


**Fig. 3** TCP (*upper*) and UDP (*lower*) transmission

the state proposes three policies to deal with packet loss problems: null packet replacement, previous packet, and passive interpolation. In Hokayem and Soong (2006), the author proposes UDP as more suitable for real-time applications such as a teleoperation system based on the Internet.

According to Fig. 3 (Kurose and Ross 2007), UDP is superior since compared to TCP, firstly, there is no connection setup in the UDP; hence, there is no additional delay. Secondly, there is no congestion control in the UDP, so it can transmit as fast as desired. Lastly, UDP is simple, and there is no connection state that needs to be kept at the sender and receiver.

## 2.6 Applications

Teleoperation systems are widely used in space, military/defense, security, underwater, forestry, mining, telesurgery, and nuclear industry (Lichiardopol 2007).

The teleoperation “master and slave” model was developed in the 1940s to protect operators when handling radioactive materials.

### Space

As introduced in the previous chapter, it is beneficial to use extravehicular activity (EVA) in developing bilateral teleoperation systems. Space walks are often required at the International Space Station. It is a high-risk task for an astronaut to stay outside the station and quite dangerous to deal with missions in unknown situations. Thus, bilateral teleoperation is the cornerstone of extending EVA and lowering the risk. R1 and R2 (Johnson Space Centre and the Defence Advanced Research Projects Agency) have different abilities to help astronauts finish space missions. R1 can carry heavier objects, while R2 can move faster than R1. They both send sufficient visual and sense feedbacks to human operators.

### Military/Defense

As with space applications, unknown and high-risk tasks in military/defensive situations are putting teleoperation systems into practice. The most remarkable application is the unmanned combat air vehicle (URAV). The URAV enable air forces to detect and defend via air without an onboard pilot (Wired for War). It can be used to collect an enemy’s information such as geography, population, and weapons. It also can attack an enemy after locating position and giving feedback to a pilot in a safe environment in real time. This teleoperation application avoids losing human life by substituting with an aerial vehicle.

Figure 4 is the WZ-2000 URAV which was revealed by Guizhou Aviation Industry Group in the 2000 Zhuhai Air Show in the People’s Republic of China.


**Fig. 4** The model of WZ-2000 URAV

The endurance of this URAV is 3 h and the speed is 800 km/h which satisfies the needs of long-term missions.

#### Telesurgery

It is commonly recognized that our society has dramatically changed by telecollaboration, and humans have made extraordinary progress in telesurgery specifically with the collaboration of a surgeon and a remote-manipulated "assistant." In a real operating room, surgeons demand that the teleoperation system has enough feedback accuracy and speed. The challenges faced by this medical technology are as follows: the teleoperation system should be guaranteed stable under unexpected communication environments; sufficient information about the patient should be sent to and presented to the surgeon instantly; and sufficient information takes a long time to transmit, especially video feedback which is utilized in telesurgery. One of the advantages of telesurgery is the telerobotic remote surgical service (Anvari et al. 2005).

The world's first telerobotic remote surgical service was established in Canada. It is mainly used to help rural hospitals apply advanced laparoscopic surgery. In this application, the master and slave are located in two hospitals which are 400 km apart, and a commercial IP-VPN network with 15 Mbps was established. The 21 telesurgeries that have applied this system have helped patients in rural communities.

## 3 Future Directions

In this chapter, firstly, background information about teleoperation was introduced, and secondly, Internet environments and teleoperations based on Internet transmission were analyzed. Lastly, several popular applications based on bilateral teleoperation were introduced. To sum up, in our teleoperation system:

The passivity-based method has been applied which guarantees stability to the design controller. More exactly, the PE scheme has been adopted in which position information is transmitted between the master site and the slave site to develop the controller. It is simple to apply and study.

The Internet environment which has been chosen is UDP as no reception is required in this protocol. It is one of the most popular protocols, and since it is focusing on the control field, spending time on developing new transmission protocols suitable for teleoperation systems is not the research goal. Furthermore, facing the challenge of compatibility of software with hardware has been avoided. With passivity theory and UDP transmission in our system, it is guaranteed to be stable and less influenced by the Internet environment. The fact that it is compatible also means it has wide potential in applications.

Consequently, the updated controller is proofed with two HIL control platforms, and then the results show the designed controller is suitable for practical use (Luo 2012).

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# Use of Mobile Digital Technology and iPod Touches in Physical Education

# 31

S. Crawford and Patricia Fitzpatrick

## Contents




**Abstract**

The use of mobile digital technology as a teaching and learning medium in physical education is gaining momentum. This chapter opens with an introduction to mobile digital technology in general, in education, and in physical education. It proceeds to examine the use of iPod touches to enhance teaching and learning in a physical education setting. While anecdotal evidence exists as to its use, greater empirical evidence is required to establish the efficacy of the iPod touch from a teaching and learning context across all physical education settings and with different ages and abilities.


## 1 Introduction

Published empirical research to date indicates that information communication technology (ICT) has been used in higher education for a number of purposes. Information communication technology encourages the presentation of students' work and experiences and also promotes reflective writing. ICT affords commentary on work


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presented and provides for peer learning and collaboration. It has also been used to establish communities of practice in particular settings (Papastergiou et al. 2011). According to Papastergiou (2010), information and communication technologies have become an integral component of physical education and sport science communities and professions. Mobile digital technology (MDT) is a core part of information communication technology. Mobile digital technology includes iPhones, personal digital assistants (PDAs), iPod touches, and other devices. Researchers indicate the benefits of mobile digital technology in areas of education and personal development (Lunsford 2010). In particular, Garrison (2011) identifies these technologies as having potential to create and sustain communities of learners. The immediacy of being able to post, share, and comment from in situ situations using mobile digital technology has instant appeal. This has been dealt with in detail in ▶ Chap. 40, "Mobile Technologies for Teaching and Learning". Frohberg (2006) has explored the many different contexts of mobile digital learning. These he have identified to include free, formalized, digital, and indeed informal settings. Physical education can, and does, embrace all of these contexts at different times due to the potential for both online, in situ/practical, and classroom-based teaching and learning of the subject. When aspects of the digital learning context spill over into the physical environment, they impact students in a significant manner. This is known as "physical learning" (Engel et al. 2011). Similarly, in the world of informal lifelong learning, scholars have established the many benefits of mobile digital technology (Frohberg 2006; Beddall-Hill and Raper 2010). As physical education seeks to establish patterns of holistic healthy physical activity and physical learning across the life span, these are key aspects in considering its use. Frohberg highlights how the actual mobility of digital technology enhances this process as students of all ages and abilities can manage information wherever they are. Despite these obvious advantages for the use of mobile digital technology, Engel and Green (2011) indicate that second- and third-level institutes are still reticent about its use. This was initially thought to be due to physical limitations about size, shape, and ease of access. These issues are no longer pertinent in the current climate of variations in size and ease of availability of such technology. Herrington et al. (2009, p. 2) argue that the use of mobile digital technologies in third-level education is "pedagogically conservative and regressive" and in the main are used to promote a teacher-centered rather than learner-centered environment. Researchers also indicate that concerns about academic integrity have been raised, but these can be and are addressed with clear guidelines on violators and student safety rules. Readers are directed toward the earlier chapter addressing ▶ Chap. 46, "Moving Towards the Effective Evaluation of Mobile Learning Initiatives in Higher Education Institutions" for a greater discourse on this topic at third level.

## 2 The Use of Interactive Multimedia in Physical Education

Sorrentino (2000) has established that software applications are used in physical education for a number of purposes. These include the evaluation of physical fitness, the collection of data on athletes' performance (time, distance, rates, etc.), and the teaching of sports skills, tactics, and rules as well as exploring topics like health and related fitness. In relation to sport-specific software applications, Sorrentino (2000) tested the effectiveness of the use of the Internet in the teaching of motor and cognitive skills during swimming lessons. In her study, she examined the Internet as a means for enhancing skill acquisition, knowledge, and attitudes in school-based physical education. In the initial study, modeling delivered through progressive still photographs over a simulated Internet site was found to contribute to significant improvements in front crawl technique. No significant improvements were found for swimming knowledge, front crawl speed, back crawl speed, or back crawl technique that could be attributed to the Internet-based model delivery. A follow-up on the study examined the video and photographic modeling of front crawl and back crawl delivered using a simulated Internet site, compared to traditional swimming instruction. In this particular study, significant intervention effects were found for front crawl and back crawl stroke technique for the two Internet-enhanced groups. These changes were not found for the control group. However, no significant improvements were found for swimming speed or written knowledge. The use of video modeling was expected to lead to a higher frequency of self-instruction, analysis, and correction, resulting in better swimming performance; however, no significant differences were found between the two Internet-enhanced modeling groups. This indicates that both photographic models and video models were equally useful in enhancing front crawl and the acquisition of back crawl technique. In terms of student attitudes, all students of the Internet groups enjoyed the swimming lessons compared with three out of four in the control groups. Further, the majority of students in the Internet-enhanced groups would choose this method of instruction over the traditional one. Similarly, a computer-aided instruction for the teaching of a badminton skill was developed by Chu and Chen (2000). Everhart et al. (2002) examined the effects of high school physical education students interacting with a multimedia software program designed to provide nutritional and physical activity guidance. The study sought to investigate if by maintaining records of physical activity and eating, patterns using multimedia software would positively affect students' behaviors in these areas. Findings indicated that the multimedia software had little effect on participation and nutritional behaviors. However, significant differences were revealed for all students for pre- and posttest scores in physical activity levels which justifies the importance of physical education in the school curriculum. The researchers in this study also surmised that if the intervention group had more frequent access to the multimedia software, there was potential for greater change occurring in the variables. In basketball, Antoniou et al. (2003) compared the use of multimedia computer programs, traditional methods of instruction, and a combination of the two in rule violation in basketball when teaching university students. Results indicated that all students increased their knowledge of rule violation in written tests, but only those in the traditional and combined approaches retained this knowledge. Total performance included the scores from the written test and a video test to assess that of basketball phases. Analysis of overall performance indicated that the traditional instruction group scored higher than the multimedia group, but the video test results were not retained. Hence, the researchers concluded that further research was needed to realistically establish the efficacy of multimedia computer programs. Vernadakis et al. (2008) applied specially designed software for the teaching of rules and ball-shooting skills in basketball, using a similar three-group format. Posttest results indicated no significant differences between the groups in the written tests. However, attitude scores of the combined group were more favorable to the multimedia approach than the traditional method alone. In relation to the dance strand of the physical education curriculum, the majority of the published research projects that concentrate on the use of ICT in the teaching of dance focus either on the development of software or on the design of interactive learning platforms without empirically assessing their influence on actual dance performance in real time (Risner and Anderson 2008). Popat (2002) described the use of a dynamic website for teaching choreography in an international cooperation project between students from Britain, Portugal, and America. Cherry et al. (2003) showed how a digital video annotation tool can be used to teach dance composition. Kavakli et al. (2004) discussed the process in developing a virtual learning environment (WebDance) for teaching traditional Greek and English dances. Parrish (2007) considered how different types of technology have been used to enhance learning and teaching dance.

However, in the words of Penrod (2005, p. 56):

> There is no formula or model that is going to fit every situation, including yours. If you believe there is a place for technology in the education of a dancer, you have to create an environment to make it flourish in your own place in your own time. Dance is the core, technology is the tool.

Embracing Penrod's principle, Leijen et al. (2008) examined how dance students experienced learning in an international distance education program delivered in an eLearning format using a virtual learning environment platform. In order to organize the students' experiences with the various learning assignments, the researchers focused on three learning tasks: individual writing assignments, collaborative assignments, and individual practical assignments. Data were collected using a questionnaire and group interviews. Regarding the eLearning format, the researchers found that the most crucial factor for carrying out all learning assignments was the teacher's guidance and feedback on students' work. With the use of the learning platform, findings indicated that carrying out practical assignments was the most limited with the available tools.

Leijen et al. (p. 148) also felt:

> That besides developing physical skills and learning the domain-related knowledge, students should be encouraged to develop their individuality, reflect on their learning and enhance their creativity and critical-thinking skills.

Interestingly in many of these studies, most of the researchers did not find statistically significant differences between the experimental and the control groups. This was despite the fact that the pre- and post-performances of each group separately often proved statistically significant. Some of the issues identified are the small sample sizes, inadequacies of the technological devices, the cost of applications, or the low quality of their graphics. In relation to personnel, the lack of technology training for the physical education teachers and different users' computer skills also proved problematic. In some studies, it was also impossible to control the time that the students actively engaged with the digital materials. Students participating in the studies with combined options preferred mixed teaching methods that combined interactive multimedia with instruction from the teacher than the use of the software applications alone. In some cases where researchers included interactive multimedia in their teaching practice, it has been found that their impact on the students' motor skills and performance is either nonexistent or moderate compared with the traditional teaching methods. This leads us to conclude that technology can offer opportunities for personalized instruction, cooperation, communication, and feedback (Kwok-Wing Lai 2008; Leijen et al. 2008) as far as it is used with a focus on the improvement of instruction and the promotion of human movement and not its replacement.

## 3 Examining Mobile Digital Technology in General Education and in Physical Education

The use of video recording in education has been commonplace for many years. Video has been used to address teachers own teaching styles (Ammah and Hodge 2006; Calandra et al. 2008), to consider student learning (Blomqvist et al. 2000; Fiorentino and Castelli 2005; Foster 2004), and to provide invaluable feedback for students in situ. Scholars have also advocated this particular approach particularly in the teaching of motor skills (Boyce et al. 1996; Deakin and Proteau 2000; Martindale et al. 2001). The use of digital video recording (DVR) provides for this type of teaching and learning support in situ, especially in physical education. It is advocated in the sport of diving as reported by Chirico (2002). Banville and Polifko (2009) have found the use of a DVR to be effective in training gymnasts ranging in skill from novice boys in recreational classes to elite nationally ranked male and female athletes. These practitioners feel that because of the various learning environments and different teaching and learning styles, educators and students should be encouraged to develop their own way of implementing the described technology in their practice or class. DVR has also been advocated in the world of athletic training. Berry and Miller (2006) indicate its usefulness in training athletic trainers. The researchers also consider the benefits of DVR in physical educational settings where students find the use of videos stimulating and flexible. Digital video recording allows them to work at their own pace and limit passive observation associated with traditional videos. These researchers also comment on the benefits of streaming of videos to allow learners revisit clips and further enhance their learning. In their work, Klubacs Collins and Juliu (2009) advocate the use of the tablet PC in a similar fashion. Several academic institutions have conducted pilot projects to study tablet PCs as a teaching tool to deliver courses and to promote collaborative learning (Mock 2004). Tablet PCs have benefited faculty members in their teaching by facilitating (1) digital note-taking, (2) annotation of presentation materials, and (3) markup of students' assignments (Wise et al. 2006). Such mobile digital technology is also excellent for collaborative and project-based learning experiences in the gymnasium (Gubacs 2004).

The iPod touch is one such mobile digital device. The iPod touch is described as a multipurpose pocket-size electronic mobile device. It was designed and marketed by Apple. It has a user interface that is touch screen based. The iPod touch can be used as a music and video player, digital camera, handheld game device, and personal digital assistant (PDA). It connects to the Internet through Wi-Fi base stations. The iPod touch does not use cellular data and is therefore not a smartphone. The iPod touch has the added advantage of being small, lightweight, and easy to carry. It also has a longer battery life.

The iPod touch was first released in 2001 and anecdotally is being actively used in many educational contexts for many purposes. Recent applications have improved the use of the iPod touch in many such settings:

> From kindergarten to college, in applications of all kinds, what was originally designed as a mere portable music player is on its way to becoming an essential educational tool. (Blaisdell 2006, p. 8)

The iPod touch contains easily accessible audio and visual content in what is a manageable size. Recent iPod touch models have become progressively more versatile with an increasing amount of content that can contribute to teaching and learning. In educational contexts, the use of the iPod touch to accommodate students of different ages and different abilities has been very successful. Patten and Craig (2007) have found that writing skills, vocabulary development, and comprehension skills improved as a result of the use of the iPod touch in the classroom. The use of iPod touch photo features has also been advocated for students with learning disabilities in classroom settings. Students can also record their own voice using iTalk (Griffin Technology iTalk 2009). This is a particularly useful feature as it can record notes which can be listened to at a later time and provides an alternative means of completing assignments. In the constantly changing environments of physical education, this can prove invaluable. Students with hearing and/or visual impairments can also benefit from using the iPod touch in an educational context. Broida (2009) identifies Sound AMP as a useful tool in this regard. This application turns an iPod touch into a hearing aid for individuals who have some hearing capabilities. With the built-in microphone, Sound AMP captures audio input and allows the user to adjust volume and tone to improve any hearing experience. There is also a "repeat" feature that replays the conversation over if needed. Students with severe impairments may benefit from the use of applications that teach sign language, e.g., iSign where each of the gestures is modeled with a 3D character and is completely animated. This application is beneficial in that it can help students learn to sign. Students with visual impairments can access book applications which allow users to customize text, color, and size. In a systematic review of studies that involved iPod touches, iPads, and iPhones in teaching programs for individuals with developmental disabilities, 15 studies covering academic, communication, employment, leisure, and transitioning across school settings, outcomes for 47 participants who ranged from 4 to 27 years of age and had a diagnosis of autism and/or intellectual disability were positive in supporting the use of iPod touches for this particular population (Kagohara et al. 2013).

In the world of physical education, there is a dearth of empirical evidence for the use of actual iPod touches, despite anecdotal evidence from practitioners to the contrary. Physical education teachers and lecturers report the use of the iPod touch to capture video and audio clips in situ, to use as a teaching and learning aid in the classroom, and indeed to encourage and enhance students' engagement in the physical education curriculum. In the Irish physical education context, one third-level physical education teacher education provider indicates that the iPod touch has an integral role to play in the degree program. In the Bachelor of Education Sports Studies and Physical Education program in the University College Cork, the use of iPod touches are an integral part of many modules. The iPod touch has been used to record and inform the teaching and learning of motor skills in skill acquisition. In this module undergraduate physical education gains hands on experience designing and delivering skill acquisition programs to primary school children. Students are encouraged to video primary school children during program participation in action and to use this as a tool to reflect on their own teaching and learning practice. They are also encouraged to consider the children's engagement throughout the session and reflect on this after using the iPod touch. Students are enabled to monitor progression of intervention programs addressing fundamental movement skill development from pre- and post-video/audio clips. The iPod touch can also be used to record their own and their peers' reflections both in action during a session and on action after the session. In addition the iPod touches have been used to record the thoughts and views of participating primary pupils and their teachers on each session. Similarly, in the health stream of the Sports Studies and Physical Education Degree program the iPod touch has been used in a variety of modules. Views and participation of secondary school students, their teachers, community health workers, and undergraduate students are collated during workshops, symposia, and resource development. Again, video footage is also collated in all of these settings for the purposes of informing teaching and learning, module content, and workshop adaptation (Crawford 2015). In the health and aging module, the views of elderly participants are collated on a weekly basis and replayed to students to inform each session as the module progresses. This again has proven invaluable in relation to addressing approaches to teaching and learning and actual program content. In the sport, physical activity, and disability module, the views of participants with disabilities are similarly collated on a weekly basis and again guide the progression through the module (Crawford et al. 2012). This use of the iPod touch to enhance and inform teaching and learning throughout has proven very beneficial to all stakeholders and gives true meaning to the importance of participants' voices informing the scholarship of teaching and learning in physical education degree programs. More recent studies are currently under peer review and will be published in due course (Crawford and Fitzpatrick 2015).

Despite being viewed as advanced and innovative, the current conclusion of contemporary technological media and the use of digital multimedia and iPod touches is that they have not been incorporated in the classroom everyday learning practice yet. Both at third level and secondary and primary levels, teachers have difficulties with new technologies due to the lack of formal training to allow them to integrate these devices in their lessons. The cost of new software, together with its supporting systems and the limited access that a large percentage of the student population has to new technologies, is also prohibitive. There is also the continued fear and anxiety in the educational community about the safety of the use of such media. Teachers are anxious that this kind of instruction will discourage students from actively engaging and bodily practicing and experiencing the motor skills they are taught. However, students seem to be enthusiastic and motivated by some new teaching methods, especially if combined with the more traditional approaches (Leijen et al. 2009; Goulimaris et al. 2008). Another finding is that researchers seem to focus on the numbering of the learning results of each intervention, without checking and testing the cognitive processes and demands of the technologically supported instruction. Moreover, the evaluation of the newly suggested methods is confined either to the interpretive assessment of questionnaires and interviews or to the comparisons between one medium and another.

## 4 Future Directions

Although there are other devices available for teaching and learning in physical education, the iPod touch has the potential to become the preferred device based on its versatility and portability. It is critical to recognize that the selection and design of such a device must reflect a collaborative team approach and must include the student and staff familiar with the device. It is also essential that we remember that while technology can offer many opportunities for enhanced teaching and learning in a physical educational environment, we must use it with a complimentary focus as indicated earlier and not simply as a teaching aid in itself. Ongoing empirical studies are necessary in a sports studies and physical education context to establish its efficacy going forward.

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# Part IV

# Higher Education Partnerships with Non-profit and Profit Organizations

# Higher Education Partnerships with Non-Profit and Profit Organizations: Introduction

32

Dean Cristol

## Contents



**Abstract**

Higher education institutional partnerships are not purely educational enterprises but are multifaceted collaborations. This introduction outlines the preceding chapters that focus on relationships with nonprofit and profit organizations around mobile learning. The central goal that runs through the chapters is the preparation of students for the STEM focused global economy utilizing the ubiquitous nature of mobile devices. The higher education partnerships discussed in this section run the gamut from within higher education institutions to cross-national boundaries to P-12 school systems to the educational marketplace. The leading researchers from across the globe each address how to achieve better methods to use mobile technology in learning environments, while providing opportunities for future research focused on learning environments in profit and nonprofit organizations.

A product of the new STEM democracy is the development of indigenous high-technology capabilities. When effective mobile learning is incorporated into receptive learning environment, there will be a positive effect on student learning. The ubiquitousness of mobile devices prepares students for the STEM-focused globalized economy because the devices are consistently used for the communication and informational needs of learners and teachers inside and outside of learning environments. Mobile learning provides flexibility and a mechanism for learners to

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experience education seamlessly in most learning environments. Many school systems are using mobile technology as a way for students to connect outside their learning environments. Mobile learning devices are relatively accessible and often reinforce difficult learning concepts and a mechanism for collaboration outside regular school hours. Many management skills used by teachers in formal classroom settings are transferable to the students' devices, such as students' accountability for what they are learning. Mobile learning technology can level the learning field for many school systems and other institutions, due to the relatively low cost and accessibility in most households and workplaces, including those that lack laptop or desktop computers and internet connectivity.

The consistent and effective use of technology in learning environments is recognized as important to student learning by government legislation in many countries and by international and national educational organizations. While the International Society for Technology in Education sets international standards for the use of technology in educational environments, international educational organizations such as the International Council for Science (ICSU) and the American Educational Research Association expect that every student receives access to age-appropriate curricula through essential technological tools. At the international stage, UNESCO (2004) maintains that technology "can contribute to universal access to education, equity in education, the delivery of quality learning and teaching, teachers' professional development and more efficient education management, governance and administration." An example at the national legislative level is the *Individuals With Disabilities Education Act*, *20 U.S.C.* § *1400* (2004) in the United States that promotes the use of "assistive technology to increase, maintain, or improve functional capabilities of a child with a disability."

At the school systems level, those who understand the value of mobile learning face the issue of how mobility should be provided to the students. When done correctly, professional development can close the gap between teachers' knowledge and skills to create classrooms where equity and excellence are the goals for educating all students. Mobile learning provides a digital multimedia medium and a mechanism, for all students to participate equally in the twenty-first century classroom. Professional growth drawing on research-based best practices can help teachers learn how to engage students in hands-on activities to capture and sustain student interest and facilitate both engagement and learning. In response to the gaps and weakness observed from research-based recommendations, learning environments will need reliable infrastructure and opportunities such as digital video broadcasting (mobile TV) through broadband services; mobile devices; software applications for the devices; repeaters (if broadband service cannot reach building); acceptable User Policy that includes smartphones; digitized professional development for staff, administrators, and community members; and opportunities for participants to visit partnering schools to share our individual site's lessons learned. For the twenty-first century learners and educators, interpreting a data and relating it to practice will be more important than being able to collect the data. Since many technologies can execute complex calculations or create many representations very quickly, students' primary responsibility will be to reflect and to interpret the results of those calculations or representations. The technology itself does not always help students' learning, but students' actions on those technologies and their reflections on those actions enhance their learning. So, knowing *how* to incorporate technology in classes effectively becomes vital for teachers and students.

In the following chapters, examples of mobile learning applications, educational collaborations and partnerships, and programs are presented to stimulate the idea that learning can take place anytime and anywhere. These range from early childhood classrooms and partnerships between higher education institutions and industry. Some of the chapters introduce case studies of mobile learning. Ultimately, the presented work by leading mobile learning researchers across the globe addresses better methods to use mobile technology in learning environments. Also, the chapters present opportunities for future research that focus on learning environments in profit and nonprofit organizations.

In ▶ Chap. 34, "Apps in the Field: Prototyping HyperSite for Describing Work Practices in Workplaces," Rodney J. Clarke outlines several key issues concerning the type and kind of technological options for those who would use mobile technologies in university-level teaching and learning praxis. He proposes three questions: Why use these kinds of technologies and what purposes do they serve? Are the kinds of features available on these devices adequate to our tasks as educators? And if they are not, then how do we determine the kinds of features and functionality we need? The author takes the position that the kinds of features we find on our mobile devices were developed for particular kinds of social interaction that may, or may not, be adequate to the kinds of educational tasks of interest to us. Part of the work of professionals in various fields is the description, analysis, design, and evaluation of these actions and activities. Each of these fields can have their own notations, methodologies, and heuristics for assessing, evaluating, describing, and documenting these work practices. Clarke asserts that there are likely to be general principles that could be used to determine the kind of functionality our apps might need to have that make them fit for purpose.

In ▶ Chap. 35, "Cross-Country University Collaboration Barriers and Solutions," Yongzheng Liu and Yu (Aimee) Zhang maintain that university collaboration generates enormous benefits. Previously, the research has focused on the number of co-authored publications as a measurement of success collaboration. However, new student enrolment, increasing of knowledge share, and global influences for both partners have become important indicators for global collaborations. China has been the major source of both undergraduate and postgraduate students for many universities across the globe. Several Australian and New Zealand universities have Chinese universities as their international strategic partners. But the differences between Australian and Chinese policies, structures, and cultures have been major barriers in these collaborations and are discussed in this chapter. For example, to save transaction costs in seeking for suitable collaborators and increase the success rate in current collaborations, it is important to identify the key issues in university collaboration between Australia, New Zealand, and China. This study collected empirical cases from observation of more than 10 years of university collaborations and conducted face-to-face interviews with key personnel at three major Chinese universities. The chapter concludes by offering ways that mobile technology can help solve many of the communication problems and reducing communication misunderstandings. The results shed light on future cross-country university collaborations.

In ▶ Chap. 36, "Designing Mathematical Tasks Within Mobile Learning Environments," Hea-Jin Lee and Jaime Kautz discuss the design and implementation principles within mobile technology environments that promote students' mathematical learning. The authors share a theoretical framework for designing and implementing cognitively demanding mathematical tasks for the use of mobile devices. The framework consists of three phases: content and technological environment evaluation, task design, and task implementation. In the content and technological environment evaluation phase, teachers define the lesson objective, technological environment, and types of investigations. During the second phase, task design, a collection of ready-made resources for m-learning and m-learning implementation ideas that teachers can use in their classrooms. The last phase in the model, task implementation, involves defining rules, roles, and responsibilities, as well as anticipated social interactions and cognitive processes. This framework addresses different phases and variables for designing and implementing a mathematical task for m-learning and can be adapted for other subject areas. The ready-made resources for m-learning that are collected in this chapter can be found on the authors' websites, where they will be periodically updated.

In ▶ Chap. 33, "Higher Education Partnerships for Learning with Mobile Technologies in P-12 Environments," Anthony and Gimbert discuss the advancements in mobile technologies that hold promise for supporting teaching and learning in formal and informal educational settings. Although many primary and secondary schools have yet to fully utilize mobile devices to support teaching and learning, increasingly P-12 schools (prekindergarten through 12th grade) have partnered with higher education institutions to design and develop mobile learning and to seek external funding to support such initiatives. When higher education partners collaborate with primary and secondary educators on mobile learning ideas, they should be mindful to ensure that mobile learning initiatives address historical barriers to successful P-12 technology implementation. The authors draw on literature concerning educational technology design and implementation and offer a framework that higher education and P-12 partners can use to form design teams, conduct needs assessments, develop and test applications, and support leadership for addressing first- and second-order barriers to implementing sustainable mobile learning initiatives.

In ▶ Chap. 37, "iPad Program in K-12 Education: Pilot Year," Moura discusses disconnection between students and teachers in a 1:1 environment supported by tablets, comparatively to the traditional teaching approach. This chapter describes the pilot year of an iPad program which is based on the Modern School Movement in a private elementary school in Portugal. The school's action plan includes three components: learning English, integration of mobile technology in teaching and learning process, and individualized teaching. It is intended to create technologically rich learning environments focusing on learning through projects, to engage and challenge students. Students were given mini iPads provided by the institution to use at school and at home. Teachers and parents were enrolled workshops to learn how to help students optimize the use of apps and the mobile device, in general, in and out of school.

In ▶ Chap. 38, "Health Guidance of Children's Psychological Development," Liu discusses how the developments of science and information technology have grown rapidly since the twentieth century. These technological changes have impacted families and children's lives. The author describes development of infants' mental and cultural health, which ensures the improvement of children's physical and mental aspects. When used correctly, technology, especially mobile devices, has advantages and disadvantages in early childhood education. Liu maintains that teachers should balance the use of these devices and technologies in teaching.

In ▶ Chap. 39, "Mobile Teachers: Becoming Professional Mobile Educators in the Marketization of Education," Vongalis-Macrow and Arber discuss the movement of educators, from local systems into international education systems, focusing on the important development in the internationalization of education. The authors explore the experiences of educators creating mobile careers in education by working outside their local education systems. Drawing on Urry's (2007) concept of mobility, the mobile professionalism of teachers working outside their local and national education systems is explored. The chapter theorizes the concept of mobility as it applies to teaching professionals as they shape their professional and private spaces to construct mobile professional identities, knowledge, and practices. The focus is on a case study of eight mobile educators with an aim to capture their mobility trajectories. Shaped by the vastitudes of cultural and gendered identifications and variegated agency, mobility has differentiated consequences for teacher professional identities, career trajectories, and professional practices. The mobility of educators presents challenges for teacher education what counts as their professional knowledge in the "disorganized capitalism" of international education.

In ▶ Chap. 40, "Mobile Technologies for Teaching and Learning," Ramnath and Kuriakose discuss how mobile information technologies can unshackle students from desks and classrooms and allow them to learn on any time and in any place. Students are given opportunities to explore and consume information, record their learning, and collaborate with mentors and peers. Because mobile devices know user location and identity, learning can be location and situation based, as well as personalized to the user. In this chapter, the authors describe some current mobile computing technologies and their use in teaching and learning. The authors project how mobile technologies will evolve in the future and examine – using the various theories and processes of learning as a lens – how the growing affordances of these technologies will impact student learning and education in the future.

In ▶ Chap. 42, "Mobile Technology in K-12 Environments," Cristol, Choi, Mitchell, and Burbidge describe how some K-12 learning environments are achieving educational technology goals set by the Obama administration in 2010. To achieve these goals, the National Educational Technology Plan (USDE 2010) suggested that education must undergo educational transformation through the use of technology. The authors suggest that K-12 school systems need to capitalize on mobile learning allure and student mobile technology expertise, by promoting mobile technology as an integral part of the learning process. This chapter describes mobile learning through the lens of Kindergarten-Grade 12 education from a sociocultural theoretical approach for student and teacher engagement with technology which will lead to stronger understanding of how actors in mobile learning interact with technology for learning purposes. When understanding how students engage with mobile technology, researchers must consider the roles and behaviors of teachers in the mobile learning environment. Finally, how teachers are prepared to teach in a mobile learning environment is critical to understand the mobile learning process.

In ▶ Chap. 41, "Using Mobile Technology in an Early Childhood Setting," Zipparo describes how early childhood pedagogies evolve, placing greater importance on the acknowledgment of learning within sociocultural contexts and introducing the use of mobile technologies as educational tools within our preschool. The chapter is situated at a preschool, with eight educators, who contribute to the curriculum, deriving content from children's interests, ideas, and questions.

The concepts originating from ideas of 2-5-year-olds help create an educational curriculum, that provides opportunities for children to learn and develop life skills in key learning areas such as literacy, math, and science. Mobile technology is considered a means of providing the children with reliable, current information, accessed without delay, provoking critical thinking in young children.

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# Higher Education Partnerships for Learning with Mobile Technologies in P-12 Environments

# 33

Anika Ball Anthony and Belinda Gimbert

## Contents




**Abstract**

Advancements in mobile technologies hold promise for supporting teaching and learning in formal and informal educational settings. Although many primary and secondary schools have yet to fully utilize mobile devices to support teaching and learning, increasingly P-12 schools (pre-kindergarten through 12th grade) have partnered with higher education institutions to design and develop mobile learning applications and to seek external funding to support such initiatives. As higher education partners collaborate with primary and secondary educators to realize the promise of mobile learning, they should be mindful to ensure that mobile learning initiatives address historical barriers to successful P-12 technology implementation. Drawing on literature concerning educational technology design and implementation, this chapter offers a framework that higher education and P-12 partners can use to form design teams, conduct needs assessments, develop and test applications, and support leadership for addressing first- and second-order barriers to implementing sustainable mobile learning initiatives.



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## 1 Introduction

Mobile learning (m-learning) refers to the use of small, portable, and wireless computing and communication devices to support teaching and learning. In light of rapid expansion of broadband subscriptions globally (International Telecommunication Union 2014), there is growing appreciation for the potential m-learning holds for formal and informal education, enabling individuals of all ages to engage in interactive learning experiences anytime and anywhere (Johnson et al. 2013). Increasingly, school leaders are considering how mobile devices such as laptops, digital tablets, netbooks, smartphones, and e-book readers can be used to support P-12 education (Eisele-Dyrli 2009).

Despite increased interest in m-learning, many P-12 schools encounter a host of challenges with m-learning adoption. Challenges include difficulty with defining learning goals, aligning possibilities for novel teaching and learning approaches with traditional expectations for how schools function (Johnson et al. 2013), and ensuring adequate financial, professional development, and social support (Ng and Nicholas 2013). Although research concerning m-learning design, implementation, and effectiveness in P-12 education is still emerging (Manzo 2010), the aforementioned challenges are rooted in historical barriers associated with integrating information and communication technologies in P-12 schools (Cohen 1987; Cuban 1986; Cuban et al. 2001). Features such as ubiquity and flexibility help address some of the challenges of m-learning implementation (Cuban 1986); however, in many settings, m-learning has not been readily adopted and has not had a substantial impact on teaching and learning (Johnson et al. 2013).

Partnerships between higher education and P-12 organizations can serve as one means for addressing challenges in the P-12 m-learning landscape. In addition to helping P-12 schools design m-learning applications, higher education partners can also contribute to efforts in P-12 schools to make design adjustments that facilitate adoption for improvements in teaching and learning. Through working with P-12 representatives such as teachers, administrators, and educational technologists, higher education partners can build on the expertise of these individuals to design and implement robust solutions to support teaching and learning. Higher education faculty and research centers are not only well-positioned to assist P-12 schools with securing funding for m-learning, but they can also contribute to the m-learning knowledge-base through P-12 partnerships.

This chapter explicates unique contributions higher education partners can make toward designing and implementing m-learning P-12 schools. It offers a conceptual framework higher education and P-12 partners can use to inform m-learning design and implementation. The chapter begins with an overview of various ways m-learning can be used throughout the P-12 educational system. Next, it draws on the educational technology implementation literature to offer insights into how a higher education partner can work with and P-12 representatives through a shared decision making model. The chapter concludes by discussing promising areas for future m-learning research.

## 2 M-Learning in K-12 Education

It has been estimated that more than half of the world's population now owns a cell phone, and children under 12 years of age constitute one of the fastest growing segments of mobile technology users in the US (Shuler 2009). Thus, the popularity and sale of mobile devices is increasing while consumer costs are decreasing (NPD Group 2008). Not only are youth using these devices for playing games, listening to music, sharing photographs, and connecting with peers, but they are also using them to purchase and education and productivity applications. In P-12 schools m-learning can be used to sustain teacher-centered practices such as lecturing, information transmission, and multiple-choice assessment; however, there is great opportunity to use it for transformative purposes. Transformative uses are those that enable multi-way communication, knowledge-sharing, creativity, and design – changing teacher-student interactions, enabling access to multiple information sources, fostering student independence, bringing students' interests and real-world examples into formal learning spaces, and extending academic learning beyond the school walls. The sections below summarize various ways m-learning is used throughout the P-12 educational system to support learning, teaching, and school administration.

### 2.1 M-Learning for Student Learning

It has been suggested that m-learning can help students better understand concepts, increase motivation, and improve problem solving skills (Bebell and O'Dwyer 2010; Kamarainen et al. 2013). The US National Educational Technology Plan recommends that all students be offered opportunities to learn in a one-to-one computing environment that utilizes mobile devices to foster such learning (U.S. Department of Education 2010). M-learning can be used to support student learning in the following ways:

- **Discovery and exploration**: M-learning is particularly well-suited for students' self-directed learning (Johnson et al. 2013). Using web browsers and mobile applications, students can assemble their own learning materials (van't Hooft and Vahey 2007), explore dictionaries and encyclopedias, and conduct Internet research. M-learning that embeds augmented reality such as the EcoMOBILE project enables students to interact with one another and their surroundings during field trips as they take photographs, collect data, and record notes to reference during subsequent class discussions (Kamarainen et al. 2013).
- **Instructional delivery**: M-learning that embeds computer-aided and computer-mediated instruction provides functionality such as tutorial and drill-and-practice applications that can help reinforce students' basic skills while clarifying concepts and providing immediate feedback (Kirkpatrick and Cuban 1998). Such applications may include dialogue functionality that enables students to actively interact with devices as programmed instruction dynamically adjusts to

address students' learning needs (Cristol and Gimbert 2014). However, some have argued that no matter how carefully they have been designed, such applications should not, and cannot, replace classroom teachers (Motiwalla 2007).

- **Organization and communication**: Students can use m-learning and cloud computing to store and organize documents and files. Students can also use m-learning for daily planners, to access productivity software, and to communicate with teachers, parents, and classmates.

## 2.2 M-Learning for Teaching Practice

Although m-learning holds great promise for student learning, it can also be used to support teaching practice. M-learning can support teacher learning by being integrated into preservice and inservice teacher education during and following instruction (Baran 2014). As summarized in the Baran literature review, examples of m-learning uses in preservice education include opportunities for teachers-in-training to receive immediate feedback from mentors, microblogging, virtual training, submission of electronic journals, and designing lessons for mobile device integration.

One of the greatest opportunities for m-learning is to extend teaching, learning, and classroom interactions across multiple locations by using communication networks (Baran 2014; Shuler 2009). For example, teachers can conduct formative and performance assessments while students use mobile devices to interact with real-world learning objects and historical landmarks outside of the classroom (Power et al. 2014; The GeoHistorian Project 2010). In the context of such experiences, teachers can encourage students to quickly access resources that connect the school to the broader community, to collaborate with others, and to engage in deep reflection, thus enhancing opportunities for teachers to encourage students' social interaction and collaborative knowledge construction (Baran 2014).

## 2.3 M-Learning for School Administration

In light of increased affordability and accessibility of m-learning devices, P-12 administrators can allocate funds to purchase instructional resources that provide students with a familiar tool for reinforcing difficult learning concepts, as well as a mechanism to collaborate with teachers and peers outside regular school hours (van't Hooft and Vahey 2007). From a technology support and resource management perspective, it has been suggested that smartphones in particular can be more reliable than computers and laptops (Schachter 2009) and can be easier to replace (van't Hooft and Vahey 2007). Furthermore, one-to-one m-learning initiatives result in fewer textbooks for students to carry, more students with simultaneous Internet access, and a reduced need to manage conflicting schedules for computer lab reservations (Johnson et al. 2013). Bring Your Own Device (BYOD) initiatives can further reduce costs associated with one-to-one student-to-computer ratios, free up space reserved for computer labs, and foster collaboration and communication (Cristol and Gimbert 2014; Johnson et al. 2013). In schools where teachers and administrators are concerned about students using mobile devices in ways that distract from academic focus, smartphones can be configured to temporarily disable voice and texting capabilities so they operate as small computers instead of phones.

In addition to opportunities for administrators to look toward m-learning to expand options for purchasing instructional materials, m-learning can be used to record students' interactions and responses in ways that enable the collection and analysis of student data, which teachers and administrators can access through a desktop computer or mobile device. M-learning can also be used as a tool for teacher observation and evaluation, embedding evaluation rubrics, so data can be collected during classroom walkthroughs, maintained in a secure environment, and archived for subsequent analysis. An example includes the Pivot 5D+ application that was developed by the Center for Educational Leadership at the University of Washington and The Michigan Association of Secondary School Principals (Five-Start Technology Solutions 2014).

## 3 Higher Education and P-12 Partnerships for M-Learning Design

Drawing on literature in instructional systems design and development (Morrison et al. 2007), faculty, researchers, and others in higher education settings can work with P-12 partners to design and develop m-learning applications for use in P-12 schools. Such applications must consider ***end-users*** and relevant content and level (e.g., administrators, teachers, students, early literacy, elementary mathematics, or secondary biology), ***functionality to embed in a design*** (e.g., text-to-speech, speech recognition, hypertext, system assessment and feedback, and user control and customization), and ***interface design*** (e.g., screen size and real estate, programming events to occur on touch or tap, tilt functionality, visual cues to indicate when a user can manipulate objects, and icon placement). The sections below describe how higher education and P-12 partners can work together during design and development activities to form a design team, analyze needs that m-learning is intended to address, design and develop applications, and conduct user testing and evaluation.

### 3.1 Forming a Design Team

An instructional design team typically consists of a variety of individuals who offer unique contributions throughout the design process. Team members often include project managers, instructional designers, subject matter experts, end-users, researchers, graphic artists, and information technology (IT) developers. According to Morrison et al. (2007), the project manager is responsible for ensuring that all team members understand project objectives and deliverables and that development activities are completed in a cost-effective and timely manner. Depending on project scale and scope, the instructional designer either functions as the project manager or works closely with a designated project manager and all other members of the design team to obtain information, provide guidance, and ensure key instructional development tasks (i.e., conducting a needs analysis, articulating instructional objectives, and designing content and instructional strategies to be facilitated with digital technology) are integrated to result in an instructional design solution that has high-likelihood of effectively supporting teaching and learning.

In the context of a higher education and P-12 partnership, project managers, instructional designers, and researchers may have experience working in higher education settings. IT developers may work in higher education or may be industry partners. The P-12 side of the partnership should include representatives such as administrators, educational technologists, other education specialists, teachers, and students. Throughout the design process, P-12 education specialists can serve as subject matter experts, offering details on what is known about child development and learning processes, as well as teaching processes and instructional resources that can help support targeted learning outcomes. Education specialists, along with a sample of end-users (e.g., teachers and students) can offer insights into issues encountered in actual teaching and learning environments. Education specialists, teachers, and students can also provide detailed information on the specific goal or need that the m-learning solution should address. Instructional designers and developers can then draw on such information to suggest instructional strategies, instructional messages, and technological functionality intended to address teaching and learning needs.

Although it is important that teachers be included in the design process, the design team's view towards teachers' work and how the team envisages teachers' future technology use has implications for the ways in which teachers are invited to participate as members of the design team. Drawing on insights from the sociology of work (Howard and Schneider 1984) and innovation research (von Hippel 2005) literatures, if the goal of m-learning is to *replace* aspects of teacher practices, and if teachers are viewed as having little or no choice in which practices will be automated, then the design team holds a "technocentric" view towards instructional technology, meaning that interests of making the research project efficient and technologically novel are a priority. Under such a view, teachers' participation is potentially disruptive to the goals of the design team, and thus teacher participation should be minimal. However, if the design team holds an "organization-centered" view in which the goal of the m-learning is to use technology to *support* teachers in enhancing their practice, and teachers are viewed as active agents in determining how technology is integrated into their practice, then teacher participation in the design process is not only welcomed, but vitally important – not only for the purpose of increasing teachers' commitment to adoption, but also because they have deep knowledge about their own professional practice and are able to determine how best, and under which conditions, to use m-learning.

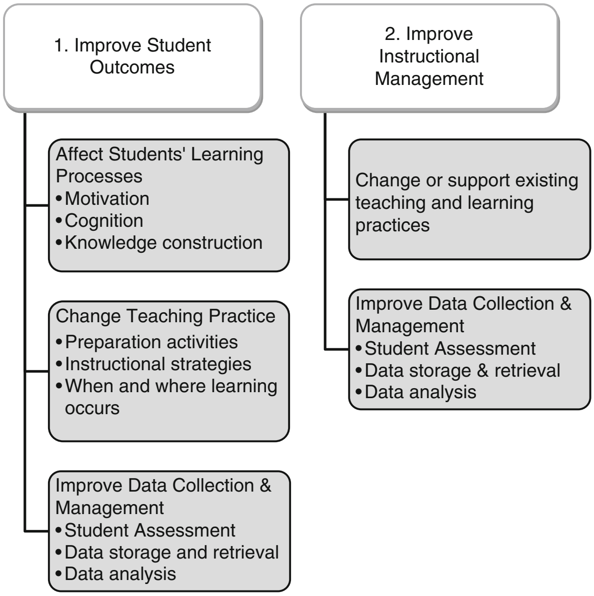


**Fig. 1** Examples of needs and goals an m-learning application can potentially address

## 3.2 Conducting a Needs Analysis

The instructional design process typically begins with an attempt to define target learners and identify their learning needs, which the design is intended to address. An identification of learners' needs helps ensure that cognitive, contextual, and affective needs are met (Eastmond 1994). Data sources for determining which needs m-learning will address may include student achievement data, classroom observations, a review of relevant educational literature, and teacher and student interviews.

It is important to note that m-learning solutions can be designed to achieve multiple goals, two of which are displayed in Fig. 1: (1) to improve student outcomes or (2) to improve instructional management. An m-learning design team may seek to achieve one or both of these goals. Needs assessment results may reveal teaching and learning needs for all students and teachers or needs for only a small group of students and teachers. As displayed in Fig. 1, an m-learning solution that is intended to improve student outcomes may first focus on identifying and addressing one or all of the following needs: (a) how to positively affect students' learning processes such as motivation, cognition, or knowledge construction, (b) how to influence positive changes in teaching practice, such as changing teachers' preparation and lesson-planning activities, their instructional strategies, or when and where teaching occurs, or (c) how to improve assessment practices by providing mechanisms for collecting students' assessments, storing data, and providing tools for data analytics and visualization. On the contrary, an m-learning team may not be primarily interested in changing teaching and learning practices, but instead may be interested in supporting existing instructional management of schools by providing access to tools for mobile data collection, storage, and analysis. The design and use of such systems may or may not necessitate changes in teaching practice, but may have implications for teacher support and professional learning, specifications for a device's platform or application's functionality, and ideas about how end-users may need to customize the application to effectively make use of it.

### 3.3 Designing and Developing M-Learning Applications

In designing and developing an m-learning application, the design team will determine instructional objectives, select appropriate content, design activities that facilitate specified instructional strategies, determine the instructional message, select the appropriate m-learning device, and determine if and how the application will access the Internet and a database. Designers will also program the application for user interaction and learner feedback. Although the design team will consist of instructional designers, researchers, graphics artists, software developers, and system and database developers, Druin (2002) suggests that teachers and students can support design activities through "idea elaboration" (p. 14) by sharing an idea that other members of the design may elaborate upon, or by offering new thought or direction for an idea suggested by a team member. Teachers' and students' ideas can be bolstered by researchers building on robust theoretical or pedagogical perspectives to explain the design, as few m-learning applications developed for teachers are rooted in such grounding (Baran 2014).

Recognizing that each classroom differs across settings, it is important to design the m-learning solution for some level of customization. Customization may support user adoption, as it has been suggested that the acceptance of m-learning systems can be improved by encouraging learners' autonomy (Cristol and Gimbert 2014; Liaw et al. 2010). Drawing on needs analysis findings, the design team may assume some measure of consistency across school settings in regards to teaching, learning, and administrative needs, and thus can develop m-learning software and offer guidelines for its use. Additionally, the team can design for end-user customization that can be done without requiring extensive programming (von Hippel 2005). The iPad is a good example of this principle in action. In many ways each iPad is standardized (e.g., device dimensions, Wi-Fi connectivity, ability to access iTunes or the Apple Application store, and it comes loaded with basic apps like the notepad, clock, web browser, and email access). However, each end-user can customize the iPad (e.g., sounds, background display, access to a specific email server, and ability to purchase new apps that extend functionality). Furthermore, the way each person uses a certain iPad application may differ (e.g., a user may use the music application to access select music files, create a playlist, and/or shuffle the order of music playback).

### 3.4 User Testing and Evaluation

Researchers can serve an integral role in the design process by working closely with all team members to collect and analyze needs analysis data and to evaluate usability and effectiveness of the m-learning solution. Once a prototype is developed, researchers can ask a sample of teachers and students to test it. The goal in asking them to assist with testing is to solicit their input in shaping the solution before it is ready for use by a larger audience (Druin 2002). In conducting the evaluation, researchers should examine whether the m-learning solution is implemented, which factors may have impeded implementation, and whether the solution is effective. It is up to the researchers and other members of the design team to determine how effectiveness will be defined and evaluated, as definitions of effectiveness depend on how the m-learning solution is conceptualized (Traxler 2007) – whether the goal of the solution is to improve teaching practice, provide students with new learning experiences, or to enable the collection and analysis of data to support organizational learning.

Drawing on evaluation findings, team members can then work together to iteratively improve the functionality, usability, and content (Cobb et al. 2003) of the m-learning solution. Design team members should expect that preliminary designs will need to be adjusted based on evaluation findings. For example, adjustments may be needed if the m-learning application was designed for end-user customization to support teaching and learning; yet customization options were too flexible, threatening fidelity of implementation across practice settings. In addition to using evaluation findings to improve the m-learning solution, researchers working for higher education institutions can disseminate findings to a wider audience to contribute to the growing m-learning research literature and to inform subsequent m-learning efforts.

## 4 Higher Education and P-12 Partnerships for M-Learning Implementation

At the most basic level, m-learning design entails the conceptualization and development of applications; however, beyond applications, design can entail the creation of techno-social learning environments that integrate new technologies, while also calling for new practices, organizational structures, and cultural norms. Clearly, the effectiveness of tools depends on how they are implemented within a comprehensive educational program. Thus, it may be necessary for higher education and P-12 partners to work together not only on m-learning design, but also on m-learning implementation.

Implementation is more complex than simply convincing students and teachers to adopt a new m-learning application. Ideally, when schools adopt technology, they are not just taking technology in and neatly fitting it into their existing routines. Instead, schools may need to make adjustments to their goals for student learning and teaching practice, as well as considering what needs to happens throughout an organization to support new goals and practices, such as creating new job titles and positions for technology integration support, professional development offerings, instructional materials, and means of obtaining information and communicating with teachers.

The following sections explain how higher education partners can work with P-12 administrators, practicing teachers, educational technologists, and other education specialists to seek input on not only how new technologies may support their existing practices, but also how new goals for student learning, teaching practice, school policies, and structures for teaching and learning may be aligned in the context of m-learning initiatives in order to fully implement and sustain new technologies and practices.

## 4.1 Supports and Barriers to Technology Implementation

Higher education partners seeking to develop m-learning solutions for use in P-12 schools must understand factors that may impede and support m-learning implementation, especially if effectiveness is to be demonstrated beyond controlled experiments and in natural educational settings. Some of the implementation supports specific to m-learning include the increased receptiveness of P-12 educators to online and hybrid learning, their increased use of social media to connect with families and community members, increased access to open resources and cloud computing, and the decreased cost of technological devices (Johnson et al. 2013). According to Ng and Nicholas' (2013) review of the literature, the following components support sustainability for m-learning in P-12 education: (a) financial capability of the school and multiple channels of funding; (b) involvement of parents, political leaders, and business partners; (c) leadership and institutional policies for political sustainability; (d) making decisions about which technologies may serve institutional needs and goals over time; and (e) ensuring alignment between m-learning, teaching and learning practices, and peer collegiality for pedagogical sustainability.

Unfortunately, few schools have all recommended components in place to support m-learning sustainability. Prepared with an understanding of contextual nuances and circumstances, higher education partners can support P-12 schools in addressing implementation barriers and developing conditions for sustainability. Barriers to m-learning implementation are likely linked to barriers to the overall limited adoption of technology in P-12 schools, which tend to exist even after the hurdle of equipment purchases has been addressed (Anthony 2012). Historically, teachers have not adopted digital technologies such as radio, television, and film into their instructional routines because the limited flexibility of these technologies made it difficult to adopt them to fit classroom routines and address diversity in students' learning needs (Cuban 1986). However, as mobile devices become smaller, less expensive, more customizable, and ubiquitous, m-learning risks becoming too flexible for effective use in P-12 schools. It has been argued that increased flexibility of digital technologies presents a new challenge in that it becomes easier for educators to use technology to support or sustain traditional bureaucratic, teacher-centered modes of teaching (Cohen 1987; Cuban et al. 2001). Thus, the inherit flexibility of m-learning may become in and of itself a barrier to schools adopting it to transform teaching, learning, and traditional notions of schooling.

A common barrier to technology implementation that is related to flexibility concerns traditional models of teaching, school operations, and management. Despite P-12 interest in m-learning, one of the greatest challenges to its meaningful and transformative use is organizational constraints (Johnson et al. 2013; Traxler 2010) such as "traditional models of teaching and learning that are deeply embedded in the structure and cultures of schools" (Cohen 1987, p. 155). These traditional models influence school policies and department and daily scheduling that keeps technology divorced from school-wide curricular and instructional decisions, scheduling that divides the school day into periods to accommodate all curricular subjects, self-contained classrooms, lack of collaboration within and across departments and grade levels, large class sizes that encourage standardization in instructional delivery or use of programmed instruction for personalized learning, and bureaucratic rules focused on keeping schools running smoothly but that do not support reforms (Cuban et al. 2001). Again, these traditional models and conceptions of teaching and learning result in technology typically being used to do "old" tasks first (Cohen 1987). However, once a school has already embraced new possibilities for teaching and learning, then technology can be used to support new tasks. Given how the bureaucracy of schools and "old ways of doing things" may impede P-12 schools' efforts to adopt m-learning, Sects. 4.2 and 4.3 offer suggestions for how higher education partners can work with P-12 teachers, administrators, educational technologies, and other school staff when seeking to develop m-learning applications and support its adoption in practice.

## 4.2 P-12 Technology Leader Representatives

A recurring theme throughout the educational technology and m-learning implementation literatures speaks to the importance of collaborative decision making and distributed technology leadership (Dexter 2008) in the planning, implementation, and continuous improvement phases (Anthony 2012) of such initiatives. A shared decision making model works well to enable higher education and P-12 partners to discuss plans and improvements for m-learning design and implementation (Anthony and Patravanich 2014). Building on the work of Vroom and colleagues (Vroom and Jago 1998; Vroom and Yetton 1973), P-12 administrators or educational technologists alone do not have adequate knowledge to define content- or grade-specific teaching and learning problems, nor do they have sufficient knowledge or expertise to define solutions and chart out a course of action that teachers must then implement using m-learning. Because the use of m-learning to support education is a "group problem" that has the potential to affect multiple people (teachers, students, parents, educational technologists, administrators, other support staff), a shared decision making model is ideal. Using such a model, problems are shared with team members who help with further defining problems, generating alternatives, and devising solutions.

According to Hoy and Tarter (2007), in situations where there is a high degree of organizational trust, a Group Consensus or Group Majority decision making structure works best. Group Consensus means the administrator involves participants in decision making and all members share equally in developing and evaluating a decision. Group Majority means the administrator involves participants in decision making, but the final decision is made through majority rule. In situations of low organizational trust, Group Advisory decision making works best such that the administrator solicits group members' opinions, engages the group in discussing implications of various decisions, and then builds on that information to make a final decision. Employing the Group Consensus, Majority, or Advisory decision making models, higher education representatives may either actively engage with P-12 partners in reflective group deliberation about identified needs or ideas for m-learning designs, or P-12 partners can engage in this work on their own and report decisions to higher education designers, who can then use such information to offer design recommendations.

At a minimum, the P-12 representatives who engage in Group Consensus, Majority, or Advisory decision making should include an administrator such as a principal, head master, or superintendent; educational technologists; and teachers. School ***administrators*** are critical to the success of educational technology initiatives in general (Anderson and Dexter 2005; Yuen et al. 2003) and m-learning initiatives in particular (Ng and Nicholas 2013). In the context of Group Consensus decision making, the administrator ensures that all individuals share equally in developing and evaluating a decision. However, in the context of Group Majority decision making, the role of the administrator is that of parliamentarian who promotes open discussion and supports reflective group deliberation. Finally, in the context of Group Advisory decision making, the role of the administrator is to be the educator, explain the issue, solicit group input, and seek acceptance of the final decision.

The role of the ***educational technologist*** is relatively new and still emerging in many schools. These individuals are responsible for school technology integration and often carry out combined roles of classroom teachers, computer lab teachers, computer technicians, managers, and curriculum specialists (Davidson 2003). They are well-suited for supporting vision-development, planning, professional development, co-teaching, and helping school administrators make informed decisions (Devolder et al. 2010; Moursund 1992). Despite how important educational technologists are to informing school technology planning and implementation, the following are decisions senior administrators, as opposed to IT specialists, should make: (1) how much to spend on IT; (2) which IT-supported initiatives should be funded; (3) which IT capabilities are needed organization-wide; (4) quality, security, and privacy risks that will be accepted; and (5) who is ultimately accountable if educational technology initiatives fail (Ross and Wiell 2002).

***Teachers*** who have developed technological, pedagogical, and content knowledge (Mishra and Koehler 2006) are not only equipped to focus on improving their individual practice with m-learning, but they may also view their responsibilities as extending beyond their own classrooms to be concerned about how other teachers are adjusting (York-Barr and Duke 2004) their practices as they adopt new technologies. Such teachers may be willing to open their classrooms for others to see how they are using technology to support teaching, learning, and instructional management (Riel and Becker 2008). They may be skilled at fostering social relations that can positively influence other teachers' decisions and understandings about integrating technology (Frank et al. 2004). Teachers can also draw insights from their own and their colleagues' experiences with technology integration to offer suggestions for school-wide technology program continuous improvements (Anthony 2012).

### 4.3 Making First-Order and Second-Order Implementation Changes

The content of Group Consensus, Majority, or Advisory decision making deliberations may focus on higher education and P-12 partners working together to identify first-order changes that need to be made to address implementation barriers in a given school context. First order changes are those made to improve the efficiency and effectiveness of a given process. In the context of school technology and m-learning initiatives, first-order changes include addressing external barriers such as equipment, time, or scheduling conflicts, limited funding, access to basic training, and inadequate technological and integration support (Ertmer 1999). Nearly, every m-learning initiative implemented in a P-12 school will have first-order implementation barriers that need to be addressed. An initiative that seeks to support existing school operations and does not intent to radically transform when, where, and how learning occurs can expect to limit organizational adjustments to the previously mentioned first-order changes that will support implementation.

Unlike schools that only require first-order changes, schools in which an m-learning solution does not seamlessly support existing teaching, learning, and administrative practices will necessitate first-order *and* second-order changes in order to ensure a good fit between the m-learning solution and the organization to support implementation and sustainability (Fishman et al. 2004). Second-order changes entail addressing internal barriers concerning teachers' underlying beliefs about teaching and learning that may impede fundamental change as well as beliefs shared across individuals in ways that shape school culture. Such second-order barriers are more personal and ingrained than first-order barriers (Ertmer 1999). If a P-12 school seeks to transform teaching and learning with m-learning, but has not yet reconsidered individual and shared beliefs about teaching and learning, higher education representatives can assist P-12 school representatives with making internal second-order changes before attempting to define needs and design an m-learning solution.

For P-12 partners who have already initiated the work of reconsidering beliefs about teaching and learning, higher education representatives can assist P-12 partners with simultaneously advancing previously-initiated first- and second-order changes by participating in shared decision making to conduct research that helps with further identifying and articulating needs. Higher education representatives can also help with developing a vision for the m-learning initiative; identifying curricular opportunities; suggesting guidelines for device and software functionality; co-planning and delivering professional development that influences changes in teachers' beliefs *and* practices by including opportunities for collaboration, practice, and reflection; helping to obtain resources such as access to equipment, training, and other support; and co-developing strategies for evaluating student learning.

## 5 Future Directions

This chapter discusses the value of higher education representatives such as researchers, instructional designers, and IT developers working with P-12 partners to develop m-learning solutions for use in P-12 schools. Given historical challenges associated with implementing technology in P-12 environments, the authors suggest higher education representatives can serve a unique role in not only conceptualizing m-learning designs, but also in assisting with the implementation of m-learning in P-12 settings. Higher education representatives can solicit and encourage P-12 participation as members of m-learning design teams by seeking representatives' input on needs and goals the m-learning solution is intended to address. Higher education representatives can also work with P-12 partners through testing and implementation, helping to make first- and second-order changes that ensure an m-learning solution is aligned with visions of teaching, learning, and the organization of schools.

M-learning research tends to focus on one of three categories: (1) research on design and effectiveness of the device and embedded media capabilities, (2) research on design and effectiveness of instructional applications, and (3) research on educational contexts of m-learning use, including subject matter, the immediate learning environment, and a few implementation studies (Ng and Nicholas 2013). Most studies focus on effectiveness, followed by design (Wu et al. 2012). Furthermore, many studies about m-learning are about short-term, externally funded projects. There is limited scholarship that conceptualizes the sustainability of teaching and learning with mobile devices in primary and secondary schools (Ng and Nicholas 2013). Through working with P-12 partners, researchers who are a part of higher education m-learning design teams can collect and analyze data that contributes not only to the testing and refinement of a local m-learning solution, but research findings can also contribute to the emerging m-learning scholarship. Such research can offer insights beyond the design of applications, the capabilities of mobile learning devices, or the effectiveness of m-learning by discussing the conditions of effective m-learning use. This research can explain organizational factors that support m-learning implementation and describe how goals for m-learning influence educators' and school leaders' efforts to bring about changes in the outcomes and organization of P-12 schools.

## 6 Cross-References

▶ Evaluation of Mobile Teaching and Learning Projects: Introduction
▶ Higher Education Partnerships with Non-Profit and Profit Organizations: Introduction
▶ iPad Program in K-12 Education: Pilot Year
▶ iPads as Educational Tools

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# Apps in the Field: Prototyping *HyperSite* for Describing Work Practices in Workplaces

34

Rodney J. Clarke

## Contents



**Abstract**

Mobile applications running on smart phones and other Internet aware devices can and are being used to support teaching and learning. In the Operations discipline, students can benefit from capturing media of work practices in organizational contexts. However, there are limits to the use of off-the-shelf apps and deciding what kinds of app functionality may be required for particular disciplines is being addressed in a program called the App Research and Development Initiative (ARDI). This chapter describes HyperSite, a design and digital prototype for an app that can be used in Operations related studies. HyperSite supports the qualitative coding of digital images, video, and audio. Qualitative codes can be predeveloped by field teams, assigned to media after they have been collected or deferred until subsequent observations and analyses are made. Collected media can be organized into projects and managed within the app. The experience of designing HyperSite provides some insights into how educational technologists can approach bespoke app development including how this process can shift traditional categories by considering, for example, students as researchers and industry organizations as educational partners.

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# 1 Introduction

This chapter outlines several key issues concerning the type and kind of technological options for those who would use mobile technologies in university-level teaching and learning praxis. Who uses these kinds of technologies and what purposes do they serve? Are the kinds of features available on these devices adequate to our tasks as educators? And if they are not, then how do we determine the kinds of features and functionality we need? This chapter takes the position that the kinds of features found on mobile devices were developed for particular kinds of social interaction that may, or may not, be adequate for educational tasks. However, there are educational applications of these technologies that might use specific functionality. The discipline of interest here is called Operations; it's generally associated with the more technical aspects of management and organizations and involves fields as diverse as supply chain and logistics, operations management and quality management, project management, and e-business. What these fields have in common are *work practices* defined here as the social arrangements of participants, engaged in complex structures of interdependent actions, activities and processes of communication, coordination, and collaboration functioning in business settings. Part of the work of professionals in these various fields is the description, analysis, design, and evaluation of these actions and activities. Each of these fields can have their own notations, methodologies, and heuristics for assessing, evaluating, describing, and documenting these work practices. To complicate matters, there is more than one way of studying them. In Sect. 1.1, a justification is provided for using apps to study work practices in workplaces. A debate about using bespoke or purpose-built applications over off-the-shelf or bundled ones is provided in Sect. 1.2; this argument has been an enduring theme within the information systems discipline and some of its ideas are used to approach this topic. This paper demonstrates that there are likely to be general principles that could be used to determine the kind of functionality our apps might need to have that make them fit-for-purpose. Not surprisingly these issues are grounded in the needs of disciplines (see also ▶ Chap. 4, "Design Considerations for Mobile Learning"). In Sect. 1.3, a program called the *App Research and Development Initiative (ARDI)* is introduced that has the purpose of driving innovation in App development based on disciplinary needs (see also ▶ Chap. 15, "Development of Mobile Application for Higher Education: Introduction"). Its first study concept called *HyperSite* is a design and digital prototype for an app that can be used in Operations related studies. The *HyperSite* app is introduced in Sect. 1.4 and described in detail in the body of the chapter.

In Sect. 2, the required functionality of this app is introduced at a conceptual level. *HyperSite* turns a mobile phone into a media capture device that supports qualitative multimedia coding. In Sect. 2.1, the relationship between coding and multimodality is described. In Sect. 2.2, methods for attaching codes to a region or point of interest in an observation of some kind are described using the concept of *binding*. In Sect. 2.3, the idea of partial versus exhaustive coding is described and employing the assumption that more codes are better, how is exhaustive coding possible in the kinds of field conditions encountered during Operations studies? The next section, Sect. 2.4, details the possible ways HyperSite supports coding. In qualitative studies, preexisting sets of codes are often used, but this is not the usual practice when apps off-the-shelf apps provide media tagging capabilities. Building on this discussion, the idea of collaborative and participative code development, rather than conventional tagging practices, is considered in Sect. 2.5. In Sect. 3, the functionality of HyperSite is explained in terms of its Sect. 3.1 basic workflow, Sect. 3.2 operations that are supported on images, Sect. 3.3 high definition video, Sect. 3.4 audio, and Sect. 3.5 media management. In Sect. 4, the strengths and limitations of this app are debated, see Sect. 4.1, the institutional responses to app development that are occurring at universities (as well as some cautionary advice on development matters) in Sect. 4.2, and finally the kinds of beneficial disruptions that these kinds of educational technologies can provide are outlined in Sect. 4.3.

### 1.1 Apps for Media Collection: Implications for Blended Learning

One way of engaging students is to replace the traditional division between lectures and laboratory exercises with cumulative exercises that result in specific milestones in which theory is made relevant through practice. For the Operations discipline, *blended learning* (Garrison and Vaughan 2008) could include workplace excursions or laboratory simulations; these can be recorded and used as data for some kind of analysis. The kinds of data will be varied, for example videos of various types of item movements in a warehouse, the procedure for laser scanning barcodes attached to items, a sequence of images showing the way in which a truck is loaded in the warehouse prior to delivery, or an audio interview with the truck driver. Clearly smart phones and apps can become an extremely useful way of helping to achieve this by collecting media, sending it to a cloud-based storage service, and distributing it either directly to other stakeholders or to other systems and workflows that can ingest this media to provide further analyses or information. But other benefits may be of greater significance. One significant benefit might be the ability to connect to a cloud-storage service, upload these media from the field device, and share them with others either onsite to create a kind of virtual field team or in a workplace-enabled laboratory, a simulated business space or an interactive, project or computer laboratory offsite.

### 1.2 Off-the-Shelf Versus Bespoke Apps

Off-the-shelf or native applications on smart phones have been a boom for Operations discipline related studies. On a factory tour, a student might be able to record video of a business process like a stock take in a warehouse, or take an image of a lay down area for objects too large to fit on warehouse shelves. Usually a native application does not do anything more than take the shot. Captioning the images, let alone tagging areas in the image, is usually not supported. Of course, the tags are likely to be idiosyncratic and become unintelligible even to the person who performed the coding. Now of course the student might abandon the native app and use a service like Tumblr, and that might be a good choice. But to undertake some kinds of studies, lots of apps might be needed and the integration between them is likely to be nonexistent. Bespoke or tailor-made apps offer the promise of simplicity and cohesion; all functions in one package and all working well together. On the downside, bespoke apps require that someone specifies the functionality, develops a specification of some kind and in all likelihood communicates and funds the costs of the development by programmers who are versed in app development processes and environments. Another advantage of the bespoke application is that media collection is simpler to initiate and control in the field. For Operations-based projects, the idea is to get into real-world environments, grab the media that is needed while causing the minimum of disruption to the organizations that host your visit. Unless the media capture requirements are extremely simple (one mode) and good field notes are always kept (probably using another app), then a bespoke app is probably a better solution. These issues really boil down to what app functionality is required? In educational app development, functionality is inextricably linked to disciplinarity. So what kinds of functions are needed to support Operations studies?

## 1.3 Using Disciplinarity to Drive App Innovation (ARDI)

For Operations discipline based studies, the types of apps that were needed didn't exist, and so a project called the App Research and Development Initiative (ARDI) was created to identify and document the relevant functionality and to design prototype apps that could meet these disciplinary needs. Other aspects of ARDI include developing concept apps and an associated virtual community dedicated to those researchers interested in apps and app development. The idea that a device as small as a mobile phone could be used to gather information and media about organizations, and that this media could be of high enough quality to use directly in publications, would have been inconceivable only a small number of years ago. Nonetheless, there are a number of problems for those educators and researchers who want to use these kinds of devices in organizational and social research.

One set of problems involves how to utilize these devices in actual projects. Researchers and teachers need to understand how to incorporate these devices into their studies. For example, media collection by individual workers might necessitate the use of a smart phone, whereas the collective analysis or design of a service might be better served using a pad or slate device that can be passed around a group. At the time of writing, with over 1,200,000 apps available in the App Store alone (Costello 2014), and probably 500,000 native to the iPad, simply identifying which apps can support tertiary education and research is a daunting task. An added complication is that apps are generally developed for home or business applications, so our more demanding applications may need to use combinations of apps each with specific features. Not surprisingly this is a common situation faced by businesses that need to integrate various off-the-shelf software packages and have them work together. Part of the work of ARDI is to identify any existing development methodologies that can handle requirements specification and comparison as well as software package integration that may be applicable to the smaller scale of apps. Starting points for the latter include reworking interesting approaches like that of the venerable SIV methodology (see Nilsson 1990) for use with mobile technologies. Another area of exploration is automation frameworks that are applicable to apps; see for example IFTTT (2014).

Another set of problems involves developing apps for researchers, business process and service designers, supply chain specialists, work study researchers, and other types of research. Here the idea is to develop apps for niche problems, but to do so in a way that might be useful in more than one research niche. An example is *HyperSite* described in this chapter – an iPhone design and concept app for multimedia collection, generalized media coding features, and the ability to manage sets of coded media into projects. This is a useful app for any one undertaking any kind of field-based observation as well as a large array of business applications, including asset auditing and property appraisal. The trick with *HyperSite* was to create a set of features that could be used in a range of practical business applications and business research contexts. The key to these apps is getting the balance right between providing a full range of features, while preserving simplicity so that they work well on mobile devices in field settings.

## 1.4 Bespoke Apps: Designing HyperSite

Smart phone technologies and appropriate media collection and coding apps enable students to gather content from workplaces as part of their assessments. These assessments may involve, for example, business processes/process mapping, service description, and audits or quality surveys. Typical recorder apps have no capabilities for coding within the media being recorded. Because the required app needed access to low-level features of the device as well as a detailed knowledge of the iOS Framework, it was developed in partnership with a professional app developer. *HyperSite* consisted of the ability to record movies pictures and sounds and to organize these into projects. However, the unique capability of this app is that it enables its users to code these media. Codes or labels of significance in a particular study can be created as needed, created as a set during a study or imported as preexisting code sets prior to media collection. Code sets could be created to code media based on particular methods for example. This enables the user to code an activity or event in a manner that could be related to the media and used to form some aspect of an interpretation or observation that could form a part of a subsequent assessment or report. Regions of interest in a *HyperSite* image can be defined and labeled. The label forms a code that can be reused across all the media in a project. Digital video recorded with *HyperSite* could be coded as well – a box could be draw around part of a scene at a point in time. Of course, the app has no knowledge of the underlying scene content and so this region will not accurately track over time with the object of interest. Nonetheless, the coding of video can be used to highlight an area of interest at a particular point in time in a video sequence. Sound recorded by the app can also be coded. For example, a point of interest in an interview could be assigned a code from a previously defined set of codes or a new code could be created for it if needed. In *HyperSite*, sets of codes form a *code pad* – a keypad that facilitates the quick assignment of a specific code to a point in time or a region of interest. The requisite functionality of *HyperSite* is described in the next section.

## 2 Requisite Functionality for Analyzing Work Practices in Workplaces

There are many applications that require the physical description of spaces, objects, and activities. Beyond simply taking an image or shooting video, what is often required is the ability to annotate what is being seen. *HyperSite* is a design study consisting of a set of paper prototypes to describe proposed app functionality and a proof of concept app created to turn the iPhone 4 into a portable media collection device. It enables users to capture and code still images, high-definition video, and audio. It also allows users to annotate media both during and after the media has been captured.

The most general approach for annotating any media is by using *qualitative coding* – tagging the contents of the media. Coding can be achieved using a *predefined tag set*, perhaps based on experience or described in the literature – qualitative analysts sometimes call these predefined tag sets *code accounting tables* (Miles and Huberman 1994). Predefined tags sets can be *imported* in other words groups of observers can use the same codes allowing a comparison of media collected at multiple places or times. *HyperSite* can therefore be used in *multiple case study* research using multiple analysis teams. Alternatively, media can be coded using tags that are created as needed – this type of *open coding* is associated with a particular form of qualitative analysis called *grounded theory* (Glaser and Strauss 1967). Tags can be defined, renamed, and reassigned as knowledge about the spaces, objects, and activities becomes better known. These ad hoc tags sets can be saved and used as part of new predefined tag sets.

### 2.1 Coding and Multimodality

Multimodal qualitative source material presents real challenges for qualitative data analysis systems (QAS). Not surprisingly, many QAS have been developed exclusively to address textual data sources and so the features that need to be added to support other modalities (for example, images, audio, and digital video) are often built on top of an inappropriate architecture. This reveals itself in awkward stopgap solutions such as auxiliary files used to segregate the underlying architecture in order to handle multimodal qualitative sources. Multimodality must be included into the QAS architecture early in its development cycle; an example of this is Atlas ti. The restrictions on mobile devices (speed, capacity, and so on) means that how multimodality is to be handled in apps must be a major part of the development effort.

## 2.2 Qualitative Coding: Early, Late, and Deferred Binding

Part of qualitative analysis practice is to determine *when* a code can be attached to a point or region of interest in a given media. The assignment of a code to a point or area of interest is called *binding*. *HyperSite* allows for the specification of a range of codes for a study prior to the observations being made. In *HyperSite* parlance, this is referred to as *early binding*. *HyperSite* also supports the identification of a point or region of interest without requiring the immediate assignment of a qualitative code. This is referred to as *late binding*. Indeed codes need not be assigned during the observation at all that might be deferred until the observations can be compared at a later stage. This is referred to as *deferred binding*. The reason for *HyperSite* supporting early binding is that it supports the typical mode in which codes are assigned to points or regions of interest in qualitative analysis systems. *HyperSite* supports late and deferred binding because the actions and activities of interest in workplaces can occur rapidly and there may well not be time at the point where the phenomena is observed to either assign a preexisting code to it or to create a new code to account for it. This is another example of why paying attention to disciplinary knowledge can drive feature innovation in apps.

## 2.3 Partial Versus Exhaustive Coding

Usually code accounting tables are created in order to exhaustively specify all the analysis codes that will be required to fully flesh out the concepts that will be used to account for our observations. So traditional qualitative analysis practice suggests a kind of *exhaustive coding*, that is, the assignment of as many relevant codes as suggested by theory at the point of time when the analysis is being conducted. This implies also that the investigators are experts both in devising code accounting tables and applying them. In mobile teaching and learning applications, this assumption should not be made. Student investigators are not necessarily experts in qualitative coding practice. *HyperSite* therefore supports the idea of *partial coding* that is recognizing that investigators may well have an incomplete knowledge at the time they collect media and that the qualitative analysis will not necessarily be complete at the point where the observations are made.

## 2.4 Code Development: In Situ Code Versus Code Accounting Tables

The real world provides unexpected situations, events, and phenomena. No prearranged *code accounting table* can be expected to account for every circumstance encountered in the field. *HyperSite* supports the creation of sets of *pre-tags* in order to effectively build code accounting tables, prior to any observations being made. But *HyperSite* also supports the ad hoc or in situ creation of codes to account for these unexpected circumstances. These are referred to as *post tags*; see Sect. 3.

### 2.5 Collaborative and Participative Code Development

Through its live coding and postcoding practices, *HyperSite* can be made to promote collaborative and participative code development. Collaboration can be encouraged prior to making any observations by allowing analysis teams to create sets of pre-tags as previously described. But those who are being observed can also be encouraged to annotate the media that is collected in the field by identifying relevant points or regions of interest as well as by constructing codes. *HyperSite* supports a range of qualitative coding practices that accommodate uncertainty, ambiguity, and incompleteness on the one hand and various degrees of collaboration and participation with those who would be observed.

## 3 *HyperSite* Functionality: A Multimodal Qualitative Coding App

Having described some of the methodological questions raised by qualitative multimodal coding in the field, this section describes some of the features of the *HyperSite* prototype app developed to explore these issues. The basic workflow for using *HyperSite* is described in Sect. 3.1. The interface, associated controls, and the various tagging modes (live and post) are described for the supported media (digital video, audio, and image) in Sects. 3.2, 3.3, and 3.4, respectively. Media management operations in *HyperSite* are described in Sect. 3.3.

### 3.1 Basic Workflow

Collections of media are referred to as *projects* in *HyperSite*. There is a common workflow that all projects in *HyperSite* possess: (1) Predefine tags (optional), (2) Start recording media, and (3) Tag your media (optional); see Fig. 1a.

The first step is to load a tag set into the project if it exists. Preexisting tags or so-called *pre-tags* refer to concepts or things of relevance to the user and that the user would use to apply codes to the media being collected. Tags could be based on experience or created out of reference materials like handbooks, manuals, policy documents, and research journal articles. A student might create a tag set out of descriptions they find in the textbook, an operations student might use concepts from the warehouse distribution literature to create tags that describe the warehouse operations they are studying. Alternatively, a tag set might have been developed by a research team. Observations are made more consistent across team members by using pre-tags.

Pressing the *Predefine Tags* button highlights that step, see Fig. 1b. *Pre-tags* can be used to code at the same time as the user collects media; this is referred to as *live mode*. This stage can be skipped entirely by pressing the *skip button* as media can

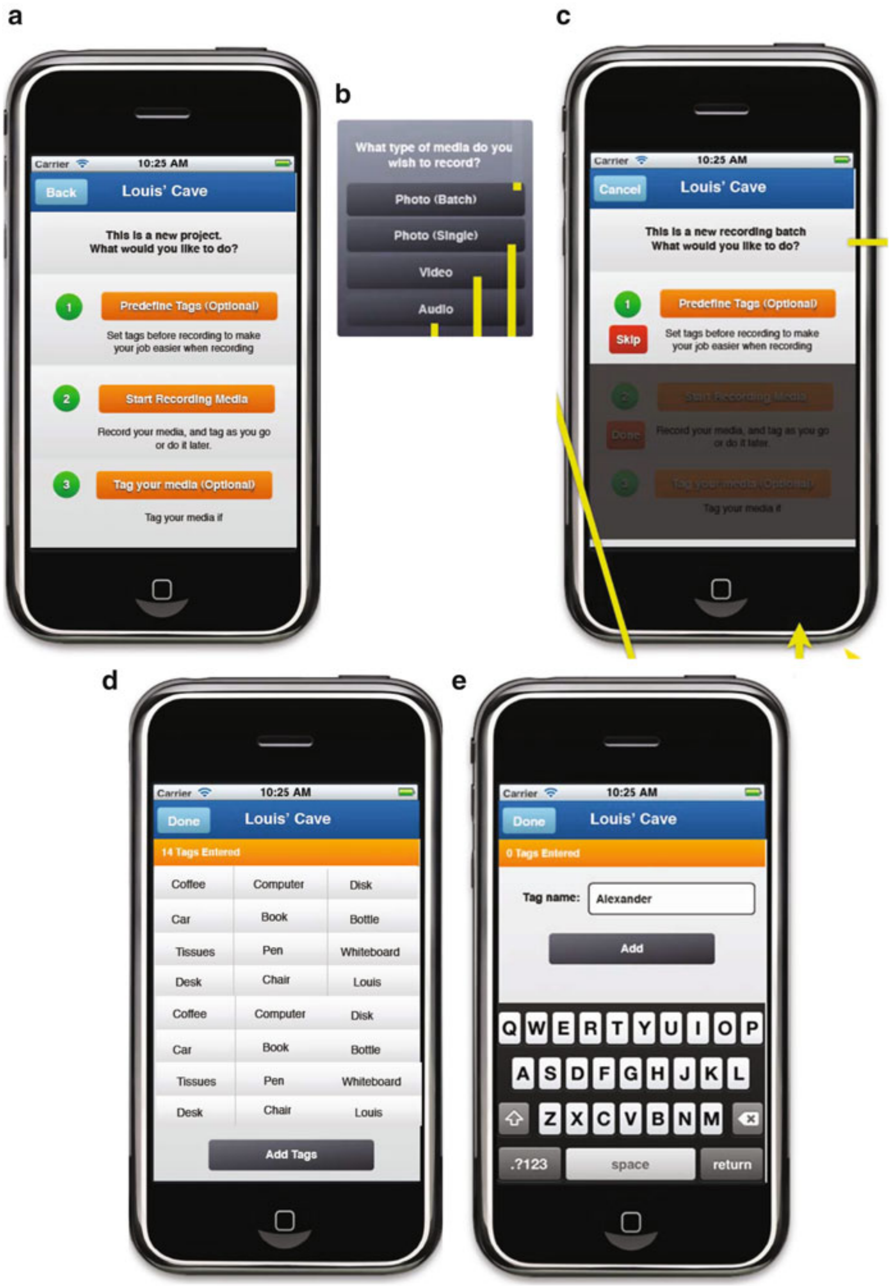


**Fig. 1** *HyperSite* (**a**) Workflow screen, (**b**) Media selection dialogue; *HyperSite* workflow step 1: (**c**) Predefine tags option, (**d**) Defined tags option, and (**e**) Add tag screen

always be tagged after it has been collected – the so–called *off-line coding mode*. At this stage, pressing the cancel button will discard tags. Pressing the *Predefine Tags* button again directs the user to the screen in Fig. 1d. This screen allows existing tags to be loaded or created. Currently, defined tags are listed on the screen shown in Fig. 1c. Pressing the *Add tags* button enables new tags to be created. An example of a new tag being created is shown in Fig. 1e, in this case "Alexander." For this project, 24 tags have been predefined or have already been added. Clicking the *Done button* advances *HyperSite* to the next step in the workflow.

The second step in the workflow is *Start Recording Media*. If we were to have skipped the optional Predefine Tags button above and gone straight to this option, then a dialogue in Fig. 1b would have been displayed that showed the types of media available. Media supported by *HyperSite* include images (still and bracket), high definition (HD) video, and audio. The specific options available for each media type are described for images, HD video, and audio in Sects. 3.2, 3.3, and 3.4, respectively. The photo (batch) is the equivalent of a bracketing option that shoots a sequence of images. The photo (single) option takes an individual image; pressing it goes to a single photo record mode without the batch interface. A single photo or two can be compared without needing to go through a multiple step interface. The *video* and *audio* launch their own combined recording/editing interfaces. If the project is an existing one, then pressing the *Start Recording Media* option would display a dialogue as shown in Fig. 2b.

The final and optional stage in the workflow is called *Tag Your Media*. It allows users to post-tag media- that is to add tags that already exist to media that has already recorded or to add newly defined ad hoc tags to previously acquired media. This mode is called *post mode*. Clicking the "tag your media" button sends the user to the *tag management screen*. The tag management screen allows the user to select individual media items and to tag them as required. Information about media and tags are always visible. The media with the current focus is shown by a tick on the right hand side of the screen (Fig. 3b).

## 3.2 Images

There are two shooting modes that are of use in *HyperSite*, a *continuous shooting mode* (bracket mode) where the images are continuously added to a roll and can be viewed when clicked, and a *shoot and review* mode when the user is able to view and tag images after they have been taken.

There are several image tagging operations. Hyper regions are drawn as rectangles at the point of interest indicated by tapping the image. Handles on the corners of the hyper region can be used to expand or reduce the size of the hyper region. The hyper region will appear grey if untagged, or green if tagged. Image tagging uses the same hyper region definition, look and feel as used in video tagging. *Live and post tagging modes* are supported. Tags can be added before as well as after an image is taken consistent with other media captured by *HyperSite*. As with other media, untagged hyper regions on images are grey, but already tagged ones are colored.

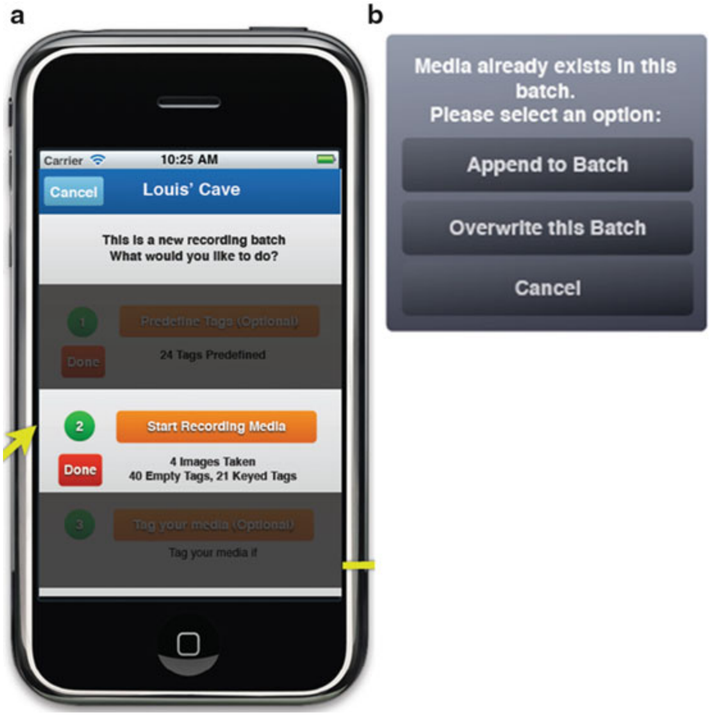


**Fig. 2** *HyperSite* workflow step 2: (**a**) Start recording media screen and (**b**) Append/overwrite dialogue

As each image is taken in the *live tagging mode*, it is added to a *camera roll*; see Fig. 4b. The interface buttons at the bottom of the screen show (from left to right), the “roll” of previously *recorded media* where an image can be selected, viewed, deleted, and tagged, a *snap button* that enables the user to take a shot, and a *review button* that toggles between continuous shooting and shoot and review modes. In *shooting and review mode*, after a shot has been taken the tagging area slides up from the bottom of the screen ready for the user to allocate a tag (if one exists); see Fig. 4c. Clicking the *done button* returns you to the workflow.

In *post tagging mode*, the user can cycle through untagged images and tag them – *selection arrows* allow the user to select images; see Fig. 5a. The actual tag labels can be hidden to reduce clutter when reviewing images by pressing the *hide labels button*. Pressing the green label button will bring up the *label browser*; see Fig. 5b. This feature allows the user to select an existing label or enter a new label. A label may be searched and if it doesn’t exist it can be added. Each hyper region can support many labels. *Post tagging* mode tagging operations are shown in Fig. 4e.

Hyper-region labels can be hidden by pressing the *Hide Labels button*. Pressing the *Done button* returns the user to the current projects workflow screen.


**Fig. 3** *HyperSite* workflow step 3: (**a**) Tag your media screen, (**b**) tag management screen, and (**c**) Media management screen


**Fig. 4** *HyperSite* image live tagging mode: (**a**) Image hyper region, (**b**) Camera roll, (**c**) Shoot and review tagging screen, (**d**) Defined tags option, and (**e**) Add tag screen


**Fig. 5** *HyperSite* image post tagging mode: (**a**) Cycling through untagged images, (**b**) Tag selection, (**c**) Tag search, and (**d**) Tag addition

## 3.3 High Definition Video

To qualitatively code high definition (HD) video, the user first creates a *hyper region* that defines the area of interest. The hyper region is in the form of a *bounding box* created by tapping a point of interest on the screen. The bounding box is a rectangle with handles at it vertices; see the design prototype in Fig. 6a. The current dimensions of the bounding box can be changed using its handles. Clicking the associated *yellow button* fixes the current dimensions and location of the bounding box and "pins" it to the video. Clicking on the *red button* deletes the bounding box and the marker from the timeline. Clicking on the *green button* allows the user to select a tag and provide a comment on the hyper region defined by the bounding box.

Once the hyper region has been defined, the user can either associate a tag with the hyper region or define another hyper region. These codes can be applied either at the point in which the video is gathered – this mode is referred to as *live tagging*, or the hyper regions can be defined but left uncoded; see Fig. 6a. *HyperSite* allows users to step through all uncoded hyper regions and associate tags to them – this mode is referred to as *post tagging*; see Fig. 6b.

In the *live tagging mode*, the user simply taps on the portion of the screen where you wish a bounding box to appear; see Fig. 6a. The app roughly positions a bounding box within the current scene. The user can manipulate the *handles* to expand/contract or change the aspect ratio of the initial bounding box. The current controls allow the user to *delete* this bounding box, stick or *pin* the bounding box to the current location, and select a *tag* (optional).

In the *post tagging mode*, a timeline is shown; see Fig. 6b. The user can move *forward* or *backward* through tags as well as play/pause the associated movie.


**Fig. 6** High definition video: (**a**) Live tagging mode and (**b**) Post tagging mode

The current position on the timeline is shown by a yellow line. Each defined hyper region is represented by a *pin* on the timeline – these are selectable and can be dragged to a new time. If a pin is *horizontally dragged*, the video updates to reflect the pins current location on the timeline. If the pin is *vertically dragged*, this slows the forward or backward movement through the timeline.

## 3.4 Audio

To qualitative code audio, the user taps at a particular point in time forming an *audio mark* that defines a point of interest. Similar to tagging HD video, audio tagging can be done in a *live mode* and *post mode*. The interface is similar in both modes. The screen is divided into a *timeline* where each audio mark appears as a dividing line with a pin head. These pins are selectable and can be dragged to a new time. Below the time line is a set of buttons for adding and removing audio marks from the time line. The lower third of the interface consists of buttons that can be pressed to assign a qualitative code to that audio mark. One difference in the interface between modes is that the timeline will scale when adding codes in the live mode; this does not happen in the post mode when the audio is being played back.

There are several operations that can be performed on audio marks. If the audio mark is grey it has no code associated with it but if it is colored then it has a code

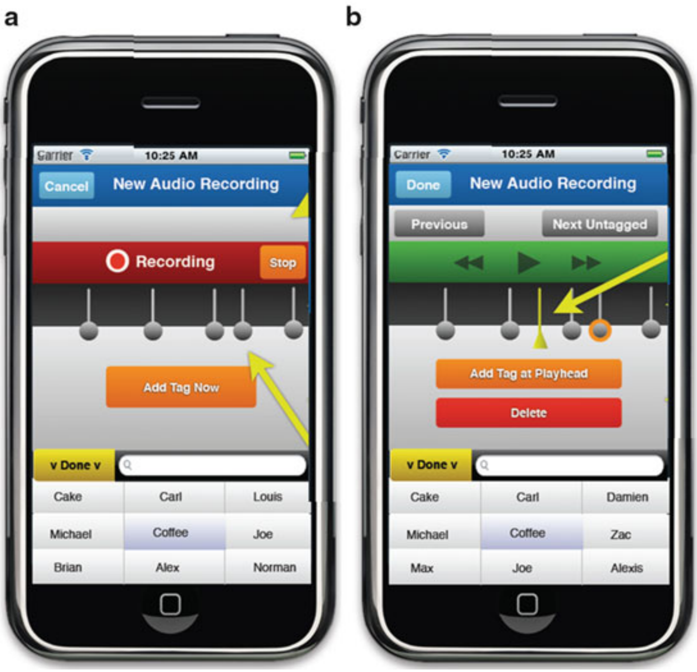


**Fig. 7** Audio (**a**) Live tagging mode and (**b**) Post tagging mode

associated with it. A pin can be *selected* by clicking on it (orange highlight), causing the play head to jump to that location in the audio. If a pin is *horizontally dragged*, the audio updates to reflect its current location on the timeline; however, if a pin is *vertically dragged*, this will slow the forward or backward movement through the timeline.

In the *live tagging mode*, see Fig. 7a, when audio is being recorded the *red record button* is highlighted. When the user hits the *stop button*, they are sent to the post tagging mode see Fig. 7b. Audio is marked when the *add tag now* button is pressed; it can then be assigned a tag. Once defined, a tag may be edited. In *post tagging mode*, the current position on the timeline is shown by a *yellow line*. Additional tags can be added at the current location of the play head by clicking the *orange button*. A tag can be deleted by selecting it on the timeline by clicking on it, and then clicking the *delete button*.

### 3.5 Media Management

Recorded media can be managed within and between multiple projects; see Fig. 3c. Within a project, all associated media can be linked and filtered. Media can be renamed, moved, or deleted individually or by selecting multiple files, projects, or collections of media can be uploaded to cloud-based services or iTunes. For any

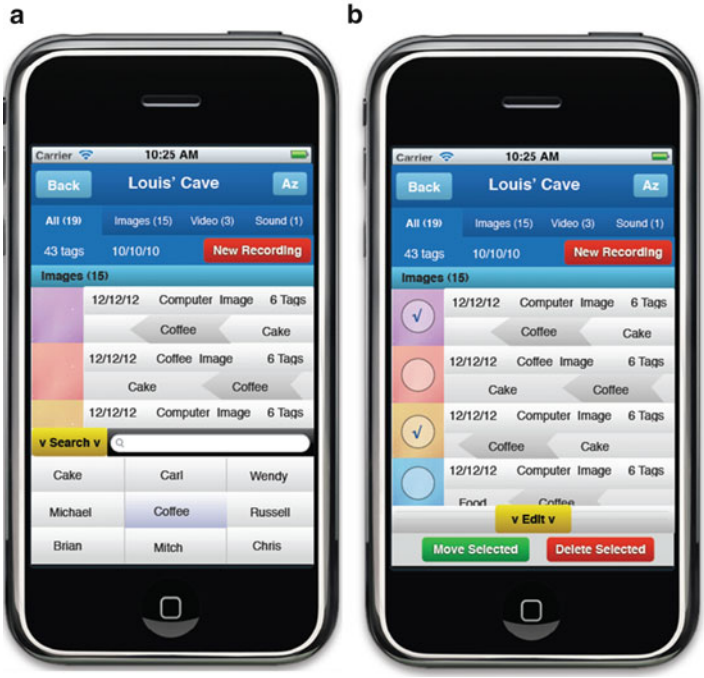


**Fig. 8** Media management 1: (**a**) Search operations and (**b**) Edit operation

given project, media are organized using four tabs: *images*, *video*, *sound*, and an *all* tab listing available media within the current project. Depending on the tab selected, a list of media is displayed with a date and tags displayed in tagging order. Each media item can be selected for subsequent operations. New media can be collected by pressing the *new recording button*; clicking on the *back button* returns to the workflow screen. The current screen contents are sorted alphabetically as indicated by the *sort button* on the top right corner showing "Az." Clicking the sort button again resorts the current media list in time order – the button changes to "t" in order to indicate this. If the media list is long, a vertical scroll bar is provided along the right hand side.

The yellow buttons at the bottom of the screen provide major media management functions: *group tags*, *search*, and *edit*. Clicking *search* in Fig. 3c enables a user to undertake a *tag search* where media items containing matching labels will be displayed; see Fig. 8a. Clicking a *tag button* at the bottom of the screen will filter the search to include media containing the selected labels. Note that "coffee" has been selected in the tag panel and only media items that match this label are listed above. Multiple labels can be selected in the bottom panel. Clicking the *edit button* will reveal the option to *move* or *delete* a selected media item or multiple media items; see Fig. 8b. *Check boxes* appear to the left of all media items, enabling the user to select specific and if need be multiple media items. When the *move selected* *button* is pressed on the edit screen, a confirm dialogue is shown, see Fig. 9a, while selecting move relocates the selected media item/s to the project, see Fig. 9b. The user can cancel the operation by selecting no. When the *delete selected* is pressed on the edit screen, a confirm dialogue is shown and then the selected media item/s are deleted.

## 4 Future Directions

### 4.1 Strengths and Limitations of *HyperSite*

*HyperSite* could be potentially used in a range of applications including field work, incident reporting, situational documentation, and interviewing. Interestingly, the same issue that motivates this paper – the relations between app functionality and disciplinarily – can also be applied to these other application areas. Do these applications need specialized app functionality enough to warrant the efforts and resources required to build them? This must be left as an open question for now. But the kind of functionality provided by *HyperSite* could be further refined to support these other applications. Certainly *HyperSite* can be used to collect media that is subsequently used as a step in other analysis workflows.

*HyperSite* supports qualitative coding of media collected on the device on which the application is running. While some apps allow the user to define hyper regions on images (for the purposes of tagging), there does not seem to be any apps that allow for qualitative coding where the expectation is that codes sit within a meaningful system of classification. Off-the-shelf or bundled apps serve a common denominator and so support a predictable and limited range of functions. Usually the only developments are incremental in nature – faster speed, larger images and so on. "Unorthodox" functionality is both difficult to implement and niche in its application. So not surprisingly there appear to be no apps that use the concept of creating and manipulating hyper regions and applying it to other media – high definition video and audio as is the case with *HyperSite*. The ability to apply a hyper region to sounds is also extremely useful for technical analysis but it's a feature that might actually be useful to add to bundled apps. The idea that media can be organized and managed within the app in projects is also a surprisingly absent feature in apps bundled with smart phones. "Flat" camera rolls are still common for storing phone images.

There are however a number of weaknesses of *HyperSite*. Some of these are relatively simple to fix. One of these fixes is that there should be more than rectangular bounding boxes available for users to select and apply on images and high definition video. Circular and arbitrary polygonal hyper regions should also be supported. A more serious limitation is the performance of the hyper region pinning on high definition video which is sluggish and not as responsive as it should be when users are specifying its image location and dimensions. It is likely that this feature will need to be substantially redesigned both in terms of its coding and also in terms of its interactivity; usability testing will be needed for this feature. Elements of the


**Fig. 9** Media management 2: (**a**) Move selected operation and (**b**) Delete operation

design can be extended – an example of this is the stitching together of a bracket of images to form a photographic virtual reality. Of course, these should support hyper regions as well. Some features could be added relatively easily. For example, a potentially useful feature is modifying *HyperSite*'s existing bracket capture mode as the basis for implementing a slow motion feature to accelerate slow-moving processes on playback. Another limitation that might need to be rethought particularly if team-based analysis is to be encouraged is that the coding is performed on the device on which the application runs and on the media that has been collected on that device. What if the coding can be done not only on the device used to collect it but on other *HyperSite* instances on other devices, using cloud-based technologies? The coding practice would look a little similar to a crowd tagging application like Sound Cloud. As a design prototype, *HyperSite* is very useful. But where does field functionality stop and desktop functionality begin? Is the functionality of full qualitative analysis systems needed in the field?

## 4.2 Institutional Responses to App Development

Universities are particularly slow to adapt to changing educational technologies. There are also some well-worn paths that educators will walk down when developing apps to address teaching and learning concerns. One of the most frequent is to get students to build them. This is likely to be a problem if the work is nontrivial. Often students have little or no business knowledge; they are likely to think you should pay them while they are still learning the technologies they need to implement your app. They will often under deliver on features and deliver them late. They may even arbitrarily decide that an agreed feature should occur in subsequent version of the app! Institutions need to assist in supporting the development of app building cultures. Many of them do by setting up programs where students can build apps and develop these kinds of skills. These programs may work within, or alongside, established university courses. Some examples of the latter are *Hackagong* that promotes a coding and maker culture at the University of Wollongong (2014a). Similarly, the *Univative* and *iUniVative* programs (see University of Wollongong 2014b, c) allow for students to develop entrepreneurial skills in multidisciplinary groups working on projects of interest to industries and organizations. These kinds of programs and events are extremely useful in developing a local culture of innovation and, when they are mature, educationalists interested in the development and use of apps can benefit from them.

However, the experience of this project suggests that apps should be developed commercially using fixed price contracts, particularly when there is a degree of difficulty involved in developing them. Payments should only be made when particular agreed milestones are met. A detailed functional specification about what the app should do is something you need to provide but allow the developers to think up how to go about implementing these features. Good open-source and commercial applications, for example Indigo Studio (Infragistics 2014), are now available that allow users/educationalists to develop storyboards and create vacuous app prototypes that follow the guidelines for the chosen mobile platforms in terms of user interface and user experience (see Firtman 2010 for a current list of them). That prototype can become a clear specification of what the educationalist needs. These environments are becoming increasingly easier to use and so the line between educationalist and developer is quickly blurring or perhaps more accurately users can contribute more directly in developing a clearer vision of the kinds of apps they may wish to have and use.

### 4.3 Shifting the Boundaries: Students as Researchers; Industry as Partners

While developing applications is becoming easier, what the use of educational apps can do in the right kind of institutional environment is nothing short of remarkable. The use of apps in the Operations discipline holds the promise of providing a strategy for blended learning that is very powerful. Operations students are not only completing workplace based assignments but they are adding to a growing repository of media for use in the institution. By undertaking their real-world assessments, students are contributing to a broad multimedia survey of work practices and workplaces that covers a wide range of industries. This media repository also provides the opportunity for comparative and longitudinal studies to be conducted. This repository is also useful for researchers as a source of examples in publications. The repository is also useful for teachers seeking case materials for use in their classes. More detailed follow-up studies can be conducted by researchers that also contribute to this media repository. Negotiating with industries and companies for assess to students and researchers, establishes connections that benefit disciplines in the future. The development of relatively sophisticated bespoke apps running on smart phones for the purposes of creating educational case studies converts our industries and companies into our educational and research partners.

## 5 Cross-References

► Design Considerations for Mobile Learning
► Development of Mobile Application for Higher Education: Introduction

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# Cross-Country University Collaboration Barriers and Solutions

# 35

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## Contents



**Abstract**

University collaboration generates enormous benefits. However, the majority of these collaboration outcomes are far from satisfaction. Previous literature focused on the number of coauthored publications as a measurement of successful collaboration. However, new student enrollment, increase of knowledge share, and global influences for both partners are also important for global collaborations. China has been the major source of both undergraduate and postgraduate overseas students for many universities. Many Australian and New Zealand universities have Chinese universities as their international strategic partners. But the differences between Australian and Chinese policies, structures, and cultures have been barriers in these collaborations. The majority of intercountry university collaborations, which took great amounts of time and efforts, did not generate expected results. The chief barriers are discussed in this chapter. To save transaction costs in seeking for suitable collaborators and increase the success rate in current

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collaborations, it is important to identify the key issues in university collaboration between Australia, New Zealand, and China. This study collected empirical cases from observation of more than 10 years of university collaborations and face-to-face interviews with three pioneer Chinese universities. Universities between Australia/New Zealand and China have many differences, and some of them are barriers for cross-country university collaborations. Mobile technology can help solve most of the communication problems and reduce misunderstanding between communication. The possible solutions are also discussed in the end of this chapter. The results shed a light on future cross-country university collaborations for universities and educational institutions.

## 1 Introduction

University collaboration generates enormous benefits, such as coauthored publications (McCombs 2010; Qiu and McDougall 2013); the sharing of knowledge or data (McCombs 2010; Kennedy et al. 2013; Keengwe 2013); the generation of new ideas, tools, and other intellectual properties (Fernández-López et al. 2013; Collins and Hammond 1997; Coad and Teruel 2013); and greater efficiency (Hwang and Chang 2011; Butoi et al. 2013). Intercountry collaboration has also been one of the major sources of international student enrollment for some Australian universities (Park 2013). These outcomes are also influenced by different factors, such as trust, cultural difference, location distance, shared goals, and mutual benefits (Fernández-López et al. 2013; Hwang and Chang 2011; Coad and Teruel 2013) and are also associated with high costs and risks (McCombs 2010; Fernández-López et al. 2013). Furthermore, students are different today (▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning"). They seek information and opportunities online instead of following the paths which were prepared by universities. They have more choices and know how to design their education better. Previous literature focused on the number of coauthored publications as a measurement of successful collaboration. However, new student enrollment is another benefit generated from university collaborations (Park 2013). China has been the major source of both undergraduate and postgraduate overseas students for many universities (Balaram 2010). Many Australian universities have Chinese universities as their strategic collaborators.

The majority of cross-country university collaborations, which took great amounts of time and efforts, did not generate expected results (Park 2013). It should be argued that the motives and risks for university collaborations are also different between Australian and Chinese universities, which may explain the high failure rate. Therefore, to save transaction costs in seeking for suitable collaborators and increase the success rate in current collaborations, it is important to identify the differences of university collaboration in Australia and China. This study identified the differences and barriers between Australian and Chinese university collaboration and proposed potential solutions by adopting mobile technology in cross-country communication and teaching. This chapter focuses on Australian, New Zealand, and Chinese universities' collaborations.

## 2 Literature Review

The literature on cross-country university collaborations is plentiful (Sana et al. 2013; Qiu and McDougall 2013; Cheon et al. 2012; Hsu et al. 2013; Liaw et al. 2010). The types of collaboration are diverse from research (McCombs 2010; Collins and Hammond 1997; Dabbagh and Dass 2013) to teaching (Sana et al. 2013; Reich and Daccord 2008; Liaw et al. 2010). China has a different higher education structure and background (Zhang et al. 2009; Su et al. 2009; Balaram 2010). The targeting benefits are usually more political than academic in China. Cross-country university collaborations between Western universities and Chinese universities are usually required to go through an official interface of each university instead of through individuals or research centers. Many cross-country university collaborations with Chinese universities failed to reach their expectation because of the misunderstanding of the different educational and managerial system. Adopting only the number of coauthored publication as a measurement of successful university collaboration does not suit the situation in China. China has special expectation on international educational collaborations (MEPRC 2003). Chinese universities take other benefits (such as political benefits and visiting trips) as more important outcomes from university collaborations. The regulations published by the Chinese government (MEPRC 2003) and relationships between universities and different government departments are important for university collaborations and the source of support or grants from the government of China.

The Chinese universities and Australian universities have many differences in international university collaborations in terms of types and barriers. This study adopted both qualitative observations and face-to-face interviews with high-level managers in different departments in universities. A qualitative case study approach will be adopted to identify current collaboration types, barriers, and key determinants for Chinese universities' collaborations with international partners. Interviews with the international officers, deans of faculties, and directors of research centers will be conducted in three Chinese universities. An observation on Australian and New Zealand universities' collaboration is also adopted in this study. Both authors have been involved in different level of university collaborations as the key contact person between universities. The results will provide suggestions for both Chinese universities and Australian/New Zealand universities on their global collaboration strategies and current collaborations with each other.

## 3 Case Study

Universities collaborate with global partners on various types of activities and programs, such as international conferences, visiting meetings, workshops and seminars, undergraduate and postgraduate exchange projects, and teaching and research collaborations. Most of the Chinese universities seek supplementary educational resources, good experience, and bilingual educators through international collaborations. They have been urged to connect with the global education

**Table 1** Interviewed universities and agents for international university collaboration

| Studied universities | Types of collaboration | Collaborating partners |
|---|---|---|
| ***University of Science and Technology of China: Professor Wang Rongsen*** | Guest professor, visiting professor, 3 + 1 + 1 student undergraduate + postgraduate programs, visiting research fellow, joint education for PhD, Microsoft-sponsored mobility study project, CSS scholarship, research collaboration | America, Australia, the UK, Canada, Japan, Hong Kong, Taiwan, and Switzerland |
| ***Beijing Information Science and Technology University: Professors Ge Xinquan and Li Chen*** | Visiting research fellow, teachers training program, 3 + 1 or 2 + 2 undergraduate student program | America, Australia, Japan, and Ireland |
| ***East China Jiao Tong University: VP Shi Huanping*** | 2 + 2 undergraduate student program, 1 + 1 postgraduate, international conference, visiting trips | America, the UK, Taiwan, and Russia |

Source: Interview from this study

level and quality. China has announced the global university collaboration policy for years. However, there are some problems with the implementation of the policy in practice. This study focused on the types, barriers, and key determinants for successful cross-country university collaboration between Australia/New Zealand and China. This study is an international collaboration study on three Chinese universities and Australian/New Zealand universities. To study the barriers for international university collaborations, three Chinese universities were interviewed for a case study. University presidents, deans, heads of schools, international officers, professors, and managers are interviewed to understand the different opinions and expectations from different departments in universities. The interviewed universities are listed in Table 1.

## 3.1 East China Jiaotong University (Rank 240 in China)

The East China Jiaotong University (ECJTU) was established in 1971. It is located in Nanchang, Jiang Xi Province, China. ECJTU has 17 faculties and 60 undergraduate majors. It has more than 22, 000 students and 1, 600 staffs now. It also provides master's and PhD degrees.

ECJTU had collaboration with many international universities, such as universities from America, the UK, and Russia. ECJTU has a good relationship with the transportation department rather than the local government (due to the history of this university). The interviews were conducted with the vice president, Professor Shi Huanping; associate dean of economics and management faculty, Professor Han Shizhuan; associate dean of international faculty, Professor Zhou Liping; dean of international faculty and international officer of ECJTU, Professor Fan Yong; and Professor Shang Yong and Professor Tang Bin from the international faculty in ECJTU. The different views and visions provide better answers to the research questions in this study.

As the Chinese government required 4 % of GDP to be invested into higher education, ECJTU got four million RMB on lab and infrastructure projects. One third of the staff in transportation system was from the university. The faculty of Economics and Management in ECJTU has ten undergraduate majors with about 500 undergraduate students and 200 postgraduate students.

ECJTU had many collaborating projects with international universities. The types of collaboration include 2 + 2 undergraduate student program with the UK (approved by the educational department from the government), 1 + 1 postgraduate with the USA (high expectation from students), international conference on transportation, and visiting Taiwan University. ECJTU also planned for international collaboration on postgraduate studies. However, the high tuition fees and global reputation of the partner universities became barriers for enrollment. They took openness, action, and sharing as the key determinants for successful university collaboration. In terms of seeking for international partners, the research ranking, reputation of the vice-chancellor of partner university, and research centers are regarded as important selective factors.

## 3.2 University of Science and Technology of China (Rank 4 in China)

The University of Science and Technology of China (USTC) was established in 1958 in Beijing, China, and was chaired by Mr. Moruo Guo. It moved to Hefei, AnHui Province, in 1970. USTC has 15 faculties and 30 majors and master's and PhD degrees. It has about 15, 500 students and 1, 572 staffs now. Ranked as the top four university in China, USTC is similar to high-ranking universities in Western countries.

USTC had collaboration with universities from America, Australia, the UK, Canada, Japan, Hong Kong, Taiwan, and Switzerland. Professor Wang Rongsen, Professor Lu Wei, and Professor Jin Hong accepted the interview of this study. The average publication on journals is seven per person per year in the economics school in USTC. They have a very good understanding on the structure and process of foreign universities. Most teachers and students have experience of foreign study or research. The English level of professors and researchers is very good.

USTC collaborates with international universities on different projects, including guest professor, visiting professor, 3 + 1 + 1 student undergraduate and postgraduate programs (with Taiwan and American universities), visiting research fellow, joint education for PhD, international-enterprise-sponsored study project, students' scholarship, and research collaboration.

USTC also had many visiting professors from other universities. The medical insurance during visiting was a problem. They require the coverage from the partner universities. If the visiting professor is over 60, the Chinese government now requires health report and insurance. Technically, academic visitors over

65 are not allowed to visit China for a long stay now. The understanding of the medical service in China is another problem facing the foreign visitors.

USTC believes the contact person is vital for successful university collaboration. The quality of visiting researchers is important but hard to identify. USTC usually sends invitation to the dean of faculty or head of school in their partner university and asks them to recommend visitors.

### 3.3 Beijing Information Science and Technology University (Rank 370 in China)

Beijing Information Science & Technology University (BISTU) was formed in 2008 by the combination of two institutions: Beijing Institute of Machinery (BIM) and Beijing Information Technology Institute (BITI, which was the 2nd branch school of Peking University in 1978). It has approximately 15,000 students. It has 11 faculties now. The dean of commerce, Professor Ge Xinquan; dean of information management, Professor Li Chen; associate dean of arts, Professor He Shensi; vice president, Professor Xu Xiaoge; and previous international officer, Professor Fan Yutao participated in the interviews of this study.

BISTU had collaboration with universities from America, Australia, Japan, and Ireland. The types of collaboration include visiting research fellow, teachers training program, and 3 + 1 and 2 + 2 undergraduate student program. BISTU had many projects sponsored by the Chinese government and Beijing local government. The policy change in China affected the international collaboration. All programs and visits need to be approved now. The Australian policy change on master's programs (2 years now) also influenced collaboration. The master's collaboration has been stopped since then.

The interviewees in BISTU also agreed that the contact person is vital for international collaboration. Sometimes, when the contact person left, the collaboration between two universities was closed. Language communication is also a barrier for research collaboration. Communication is vital for international collaboration.

## 4 Barriers Between Chinese and Australian/New Zealand Universities

The purpose of global educational collaboration is to utilize different resources and advantages, and high-quality human resources with global educational background to implement higher quality education. It can also increase and enhance the teaching quality of both sides and allow the Chinese universities or institutions to learn from their global partners. To facilitate the global educational collaboration, the Chinese government published the "Chinese-Foreign Cooperation in Running Schools Regulation" (CFCRS regulation) in 2003 (MEPRC 2003). The higher education in China has experienced reform during the past three decades.

**Table 2** Barriers for international university collaborations

| Major barriers | Risks |
|---|---|
| Policy and structural differences | Student exchange and visiting staff |
| Different expectations | Cannot reach an agreement or expectation |
| Cultural differences | Misunderstanding |
| Communication barriers | Misunderstanding and delay |

Source: Observation from this study

But there are still some barriers toward the international university collaboration between Chinese universities and Western universities.

Based on more than 10-year observation on China and New Zealand/Australian university collaborations, there are some barriers for university collaborations between Chinese universities and foreign universities. China and Australia/New Zealand have very different economic histories, structures, and performances. The foreign collaboration regulation published by the Chinese government also indicated the different expectations in global collaboration (MEPRC 2003). The major barriers are summarized in the following table and explained in detail in the sections below (Table 2).

## 4.1 Policy and Structural Difference

The first barrier toward international university collaboration among Australian, New Zealand, and Chinese universities is the policy and structural difference. The strict governance and investigation on foreign universities and educational institutions influenced the initiative of global educational collaboration. The CFCRS regulation limited the foreign partners to universities or colleges only. But these collaborations usually include foreign enrollment, visa application, management of students' accommodation, evaluation on teaching materials from both sides, and teaching collaborations. Some students even enrolled in courses in different universities or faculties. Furthermore, the different legal systems, regulations, and policies in different countries influenced peoples' thinking, behavior, and custom. To increase efficiency and quality of services, the foreign universities usually contracted some services to educational agents to sign contracts or negotiate collaboration with Chinese partners. They only follow the agreement to provide teaching services, which is not allowed by the CFCRS regulation.

Chinese universities are regarded as state-owned institutions, which are governed by government departments and regulations. The advantages for such centralized system include plenty of funds and resource supports from the government, separated functions and regions in planned development, resource relocation with higher-level management that needs change, and quality assurance from province or central government level. However, there are some disadvantages for this system, including limitation of the international collaborations and visitors, limitation of differential development and enrollment, enlargement of the quality inequity by allocating too much resources to top universities, and delay of approvals due to bureaucracy.

Some policy changes may influence international university collaboration too. For example, as mentioned in the case study in the section above, BISTU has to stop their master's collaboration with Australian partners due to the 2-year requirement for master's degree in Australia. USTC also stopped their invitation for senior researchers over 65 years old due to the new regulation by the Chinese government.

Universities are regarded as not-for-profit in China. The expectation on foreign collaboration is that collaboration should be not for profit too. However, this is not very attractive among Australian and New Zealand universities. This difference brought a problem for international collaboration.

The Australian government also required the collaborating universities to have formal representative agent in China. Australian universities rely on agents to enroll new students and provide visa, insurance, and consultation services. They pay commission fees to these agents for new enrolled students too. However, the number of approved agents in China is very limited due to the strict investigation and supervision in China. Many small agents have to collaborate with the approved agents by paying them "rental fees" for adopting their names. The quality of services provided by these agents varies dramatically. This kind of collaboration lowered the average quality of service provided to Chinese students. The international educational agents are regarded as "dirty words" in the Chinese market now. In a global collaboration, Chinese universities usually avoid any agent's name appearing in agreement or activities.

Another barrier toward international university collaboration is the structural difference in Australia/New Zealand and China. International university collaboration or program must go through a special department – International Office in Chinese universities. The office is usually managed by a professor with international experience or educational background. They plan the visiting trip for all staff or teachers, send invitation to other partners, enroll and manage foreign teachers, sign agreements with international partners, and monitor the international projects. Any international project or visit must be approved by the international office. Therefore, the personal relationship with the managing professor in the international office is vital for any international collaboration. If the person in charge of the international office changed (e.g., retired), the collaboration would be totally different. In Australia and New Zealand, international office is also important in each university. However, the real collaboration is usually conducted by different faculties, schools, research centers, or individual researchers. Similar research interests, publications, and grant applications are usually the drives for collaboration between researchers. However, these kinds of collaboration are not regarded as formal collaboration in Chinese universities. The universities must sign an agreement on "university level" and then "faculty level" before any collaboration is formally conducted by individuals. The different structures are barriers for international collaboration.

## 4.2 Different Expectations

The second barrier for international collaboration is different expectations. Universities, like firms, usually look for higher-ranking partners in global collaboration. However, collaboration with similar-level partner can reach better results (Zhang 2012). Chinese universities usually took the ranks of partner universities and quantity of collaborating countries/universities as political achievement. The global reputation of visitors and government-supported grants are also important results expected by Chinese universities. However, in Australia and New Zealand, universities usually collaborate with Chinese universities for their international students. They expect to enroll more students through 2 + 2 or 3 + 1 undergraduate program or 1 + 1 postgraduate program. The different expectations prohibit the success results of international university collaborations.

On the other hand, the different evaluation of journals and publications is another barrier toward international collaboration. Australia has its own evaluation system on journal publications. Only level A or A* journal publications are encouraged by faculties and universities now. This excludes many Chinese journals in China, which are regarded as higher-ranking journals by Chinese universities. In China, many American journals are also ranked high by universities. Some level B or level C journals in Australia could be important publication journals in China. The different evaluation systems brought problems in international collaborations.

The professors in Chinese universities are very common. Sometimes, a professor is not necessary to be a PhD. Therefore, they expected the visitors or collaborators to be a professor too. In Australia and New Zealand, there are not many professors in each university, and they are usually busy with their research projects. The Chinese universities usually expect the visiting group that includes the vice-chancellor (top-level principal in a university), dean of collaborating faculty, and international officer. It is important to send the same level of managers to the meeting with visitors in China. However, this is usually difficult for Western universities.

## 4.3 Cultural Differences

Cultural differences are a big topic in any international collaboration. It is vital for global collaboration (Zhang 2012). Australia and New Zealand are deal-focused culture (Gesteland 2012) in which deal comes first. However, China is a relationship-focused culture (Gesteland 2012), which usually required the partner to be a friend to start any kind of collaboration. Contract is important in deal-oriented but not relationship-focused cultures. Any kind of written document or lawyer before the friendship establishment would be regarded as mistrust in China. Dining is very much a part of establishing business relationships in China. There are many hidden rules in Chinese dining, and the Australian government published an article “Doing Business in China” to help business understand these cultural differences (Austrade 2013). However, it should be argued that the general rules may not be suitable for different provinces or regions.

Chinese people usually use indirect language in negotiation to "save face." Expressive facial or body language and intense or firm eye contact in a meeting are not welcomed in China (Gesteland 2012). "Sincerely" means "say it as it is" in Australia but "say it indirectly to help others" in China. The schedule is made 1 year early in Australian universities but 1 week to 1 month early in China. But the expected responding time for email and message in China is usually within 1 day. All those important differences brought problems for international collaboration between Australian/New Zealand and Chinese universities.

Another important thing during collaboration is business gifts. The studied Australian university had been sending their Chinese partner clocks as gifts for 5 years, which is regarded as the end of life in China. In China, white chrysanthemum (or blue or yellow flowers) is only used in funerals in China. However, they are usually used as gift for newborn or wedding in Australia. Clock/watch (pronounced as end of life), comb or book (pronounced as lose), handkerchief, and cards written in red ink (means end of relationship) are not good gifts. A gift from the city or state where the Western university is located is usually a good gift in collaboration. To reach a successful international collaboration, whether for business or university, great emphasis should be put on cultural differences.

### 4.4 Communication Barriers

Communication barriers are also important for international university collaboration between Australian/New Zealand and Chinese universities. Firstly, Australia and China have two to three time differences due to the time zone differences (Government 2013). Secondly, the social media in China is very different from the other countries (▶ Chap. 25, "Mobile Education via Social Media: Case Study on WeChat"; Zhang 2012). Thirdly, the holidays are different in Australia and China, including school sessions and public holidays. The public holidays and cultural holidays in China includes January 1, New Year's Day; late January/February, Spring Festival and Chinese New Year; March 8, International Working Women's Day; April, Qingming Festival (in lunar calendar); May 1, Labor Day; May 4, Youth Day; May, Duanwu Festival (in lunar calendar); June 1, Children's Day; July 1, anniversary of the founding of the Communist Party of China; August 1, People's Liberation Army Day; and October 1–2, National Day. The different holidays greatly influenced communications between universities. Table 3 shows the different holidays in China and Australia in 2014.

As universities are usually very busy in the start of a semester (for orientation, selecting subjects, and changing tutorials in Australia) or end of a semester (for final exam, marking, and graduation), the best period for communication or visit in a year is from late May to early June or late October to early November. The delay of response not only brought barriers for collaboration but also brought some misunderstandings. The out-of-office auto-reply email from an Australian university is

**Table 3** Different holidays in China and Australia

| Month | China | Australia |
|---|---|---|
| Jan | Autumn Semester 1-5 New year | New year 1 Auz day 27 |
| Feb | Holiday (25 Jan – 9 Feb) | Recess |
| Mar | Spring Semester | Autumn Semester Labour day 3 |
| Apr | Qing Ming 4-6 | Easter 18-21 ANZAC 25 |
| May | Labor Day 1-7 | Autumn Semester |
| Jun | Duanwu (31 May –2 Jun) | Autumn Semester to 26 Jun |
| Jul | Holiday | Recess |
| Aug | Holiday | Spring Semester starts 28 Jul |
| Sep | Mid-Autumn 6-8 | Queens' birthday 29 |
| Oct | National Day 1-7 | Spring Semester |
| Nov | Autumn Semester | Spring Semester to 20 Nov |
| Dec | Autumn Semester | Holiday Christmas 25-30 |

Source: Observation from this study
The boxes show the suitable communication period for the Chinese university and its foreign partner in a year

regarded as a refused email for a visiting group in China, which caused the end of collaboration between both universities.

The Chinese universities will not respond to emails or telephone call during holidays (or 2–3 days near holidays) because staffs usually take annual leave before or after holidays. In Australia, the deputy officer will answer emails in place of the on-leave manager. However, if the manager in charge is not available, the deputy officer in China will not answer emails to avoid any mistake. Formal emails are not viewed often in China. The technical problems are very common in Chinese universities, and sometimes the emails cannot reach the expected person in time. All of these barriers threaten international university collaboration. One problem could cause the end of collaboration or years of delay. To solve those problems, some suggestions are introduced in the following section. Mobile technology and solutions could greatly enhance global collaboration for a better result.

## 4.5 Suggested Solutions

A good understanding on cultural and country difference is important for successful university or business collaboration across country. Showing respects to each other and following the rules and regulations in different countries are very important during global collaboration. A clear responsibility for each party in the global collaboration is also important. Chinese universities are usually responsible for enrollment and advertisement, teaching and management in China, assisting document accumulation for visa application for students, evaluation of students, management of students when they study abroad, and giving the graduation certifications. The third-party agents or representatives are responsible for visa application of students, services for students who study abroad, group visit and services from Chinese universities, communication between both universities, and problem solving. Australian or New Zealand universities are responsible for teaching abroad, evaluation and assessment of students abroad, management and evaluation, and graduation certifications abroad. The roles can be changed in certain cases. However, responsibilities are usually written in an agreement or contract clearly before the start of global collaboration. Financial problems and cost issues are usually the most common problems during global university collaboration. A transparent financial design and instant communication are always required during global collaboration between universities. The third party between both universities is usually important for communication and problem solving. They usually have very high trust level with both universities. The real problem solving is usually based on trust and good communication.

To collaborate with Chinese universities under current regulations and rules, it is important to create innovative collaboration models for a successful collaboration. As listed in Table 4 (some of them are already adopted and implemented by Chinese and foreign universities), there are usually many different collaboration models due to the real cases between universities. Some universities in this study have adopted many collaboration models with different universities at the same time. The selection of collaboration model is usually based on the real situation of each university, the requirements from the policy and rules in each country, the quality and numbers of expected students, and the negotiation between both universities in a given period.

There are also some suggestions for meetings and negotiations with Chinese partners: business professional attire should be worn when interacting with the Chinese universities, and it is better to have a Chinese business card with Chinese characters (not all professors can read English), exchange business card and gift with two hands, attend dining to establish personal connections, have small talks before a meeting, prepare a gift that is representative of your country or city, find the person who is in a position to make decisions, show respect to high status, not use red ink when writing, and try to avoid public holidays for business communications.

It is usually good to have a personal communication number instead of using the formal university email. Chinese people usually have QQ and WeChat as instant communication tools (► Chap. 25, "Mobile Education via Social Media: Case Study on WeChat"). WeChat is a free mobile application that can be downloaded from Apple Store or Google Play for free. It also has English version. Therefore, it is good to have this number or mobile phone number for communication. The voice message or message can be reserved in their mobile phone for a convenient time to be read.

Mobile technology can also assist teaching and research projects. An instant communication, interactive teaching, and multimedia contents can engage students better and reduce misunderstanding (► Chap. 2, "Characteristics of Mobile Teaching and Learning"). The examples of mobile teaching projects are introduced in other chapters (► Chaps. 2, "Characteristics of Mobile Teaching and Learning", ► 49, "Student Feedback in Mobile Teaching and Learning", ► 19, "Tutors in Pockets for Economics", and ► 25, "Mobile Education via Social Media: Case Study on WeChat").

**Table 4** Collaboration between Chinese and foreign universities under regulation

| | | |
|---|---|---|
| 1. Continuing education | a. Vocational to undergraduate degree | This is called “3 + 2” collaborating mode. Students need to finish 3-year vocational study in Chinese college and pass IELTS 6.0 to enroll into a 2-year course study in foreign university to get their bachelor degrees |
| | b. Vocational to postgraduate degree | This is called “3 + 3” collaborating mode. Students need to finish 3-year vocational study in Chinese college and pass IELTS 6.5 to enroll into a 3-year (including 1-year prepared class, 1-year master’s course, and 1-year master’s degree study) master’s degree study |
| | c. Undergraduate to postgraduate degree | This is called “4 + 2” collaborating mode. Students need to finish 4-year bachelor study and pass IELTS 6.5 to enroll into a 2-year (including 1-year master’s course and 1-year master’s degree study) master’s degree study |
| | d. Credit transfer for courses | This refers to the undergraduate or vocational students in Chinese universities who pass IELTS 6.0 and want to study abroad. Their Chinese course credit can be transferred into the foreign courses if they passed the evaluation of the foreign university |
| | e. Continuing study | All the previous collaborating modes have English language requirement (IELTS 6.0 for bachelor and 6.5 for master’s students) for new enrollment. If a student cannot get required IELTS score, he/she can also get conditional offer from foreign university. They can study a 3–12-month English course and pass IELTS test or similar test required by the university to continue his/her study there |
| 2. Student exchange | This collaborating mode is based on university visiting and investigation before they sign the formal “2 + 2” student exchange agreement. Both universities agree on each other’s course credit for their collaborating majors. Students need to finish 2-year undergraduate study in the Chinese university and then finish another 2-year study in foreign university to get degrees from both universities. This collaborating mode is usually based on matured majors in both universities and can be extended to other collaborating mode later | |
| 3. Based on real collaborating projects | a. English training for Chinese staff | |
| | b. Overseas teacher enrollment for Chinese university | |
| | c. Teachers’ training (groups) in foreign university | |
| | d. Foreign student enrollment for Chinese university | |
| | e. Chinese high-level managers group visiting service | |
| | f. Introducing foreign-teaching curriculum and measures | |
| 4. Hybrid overseas universities/ institutions | This collaborating mode is a new registered educational institute that belongs to a university approved by NZQA (New Zealand Qualifications Authority) and its Chinese partner. The hybrid institute is usually small but has special characteristics. It can enroll both Chinese and foreign students and increase the global reputation of Chinese partner. There are universities from Japan, Taiwan, and Mainland China which have opened their foreign college in New Zealand, for example, the Auckland Institute of Studies by Taiwan University and the Auckland College of Natural Medicine (for Chinese medical major and acupuncture major) by Liaoning Chinese Medical University. The university from Liaoning, China, arranges visiting from China to New Zealand as well as from New Zealand college to China | |

Source: Observation from this study

## 5 Future Directions

University collaborations are usually far from an expected success result between Australian/New Zealand and Chinese universities. The reasons include political differences, structural differences, different expectations, cultural differences, and communication barriers. This study suggests some collaborating modes and solutions for successful international university collaboration between Chinese and foreign universities.

To enhance the performance of international collaboration, mobile technology could be adopted in global university collaboration. It increased the response rate and efficiency in communications, reduced misunderstanding, and increased the performance for collaborating projects. It provides a supplemental method for face-to-face communication and greatly reduces the communicating cost in collaboration. It also brought new potential collaborating types for international university collaborations such as video teaching and interactive teaching.

In the future, mobile technology will bring new opportunities to university collaboration as well as the educational industry to provide more convenient learning materials and better learning experience and services to students and individuals. It is changing everyone's life and will change the way people learn and collaborate too.

## 6 Cross-References

► Characteristics of Mobile Teaching and Learning
► Mobile Education via Social Media: Case Study on WeChat
► Student Feedback in Mobile Teaching and Learning
► Tutors in Pockets for Economics

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# Designing Mathematical Tasks Within Mobile Learning Environments

# 36

Hea-Jin Lee and Jaime Kautz

## Contents



**Abstract**

Designing and implementing tasks for student mathematical learning has been well researched; however, the task design principles within mobile technology environments that promote students' mathematical learning have received limited consideration. This study shares a theoretical framework for designing and implementing cognitively demanding mathematical tasks for the use of mobile devices. The framework consists of three phases: Content and technological environment evaluation, Task design, and Task implementation. In the content and technological environment evaluation phase, teachers will define the lesson objective, technological environment, and types of investigations. This chapter provides a collection of ready-made resources for m-learning and m-learning implementation ideas that teachers can use during the second phase, Task design. The last phase in the model, Task implementation, involves defining rules, roles, and responsibilities, as well as anticipated social interactions and

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cognitive processes. This framework addresses different phases and variables for designing and implementing a mathematical task for m-learning. It can be adapted for other subject areas as it discusses general task design and implementation process. The ready-made resources for m-learning that are collected in this chapter can be found on the authors' websites, where they will be periodically updated.

## 1 Introduction

Mathematical tasks "convey messages about what mathematics is and what doing mathematics entails" (NCTM 1991, p. 24). They "influence learners by directing their attention to particular aspects of content and by specifying ways of processing information" and are "defined by the answers students are required to produce and the routes that can be used to obtain these answers" (Doyle 1983, p. 161). Mathematics educators and researchers define a task in various ways depending on the purpose of the study or the structure of the lesson. In this study, a task is defined to be anything that a teacher asks students to do to learn mathematics.

The use of manipulatives, or, tool-based learning tasks, to teach mathematics has a long history. Utilizing virtual manipulatives or electronic resources (technology-based learning tasks) has increased rapidly in recent years (Chan and Leung 2013; Chu et al. 2010). As mobile devices grow in popularity and become equipped with more features, many educators see tremendous promise in m-learning. Studies on m-learning report positive outcomes. They provide a rationale for implementing m-learning in the mathematics classroom to improve motivation, engagement, or performance (Kalloo and Mohan 2013; Mahamad et al. 2010).

Although the use of technology-based tasks plays an increasingly important role in mathematics education, the design of tasks within an m-learning environment has not been so thoroughly investigated. How do traditional task design principles apply to task design for technological environments, and how can a teacher's experience and knowledge of designing paper-and-pencil tasks be applied to the design of tasks or the development of a supportive m-learning environment? The primary goals of this chapter are: (1) to provide theoretical perspectives and guidelines toward the design of mathematical tasks for m-learning and (2) to share pre-made resources for m-learning that can be used for technology-based mathematical tasks.

## 2 Designing Mathematical Tasks for M-learning

Mobile devices are a part of our daily routine. They have dramatically changed human interaction. Yet the use of these devices in the classroom remains limited and is considered as a hindrance to school work. One of the major reasons m-learning does not flourish in the classroom is the lack of teaching and learning models that use mobile devices (White and Martin 2014). It is therefore obligatory to provide more mature theoretical and philosophical underpinnings for the field of m-learning with special attention to pedagogical, technical, and organizational aspects (Muyinda 2007).

## 2.1 Teaching and Learning Theories for M-learning

An m-learning setting can support various existing learning theories and learning and teaching activities (Muyinda 2007). For example, SMS messages can be used to lead to an action as a response (behaviorist theory) or enhance collaboration via conversations (collaborative theory) (Attewell 2005). Students' experiences with mobile devices are often richer than what teachers assume. The process of playing a game or performing an operation on a mobile device can have a profound effect on thinking and learning, one that may potentially serve educational purposes. Educators should reference such informal practices of a student when they apply "the basic constructivist tenet that students build new knowledge from their existing knowledge." (White and Martin 2014, p. 65). The merits of a mobile device are its anytime and anywhere features, which can help learners to construct their own knowledge and share it with their peers (constructivist theory) (Muyinda 2007). Spaced learning is also supported using micro time slots for anytime anywhere capability (Jones and Wallace 2007). Mobile devices also allow students to explore their environment and applications independently (Parsons 2010) and that, in turn, supports learning in various contexts (situated learning theory) (Attewell 2005; Muyinda 2007). For example, trigonometry, measurement, and geometry can be used to analyze the motion of a moving object that appears in a digital video. If the video is student-generated, then learning in context is achieved and this facilitates classroom discourse and reflection (Martin and Gourley-Delaney 2013).

Koole's framework (2009) for m-learning involves educational intersections among three aspects: the Device aspect considers the device features and capabilities; the Learner aspect refers to the learner's affective and cognitive domains; and the Social aspect refers to interaction among users. On the other hand, Tsai et al. (2005) proposed a course development model for m-learning that consists of six stages:

- *Stage 1* – analysis of the learners' needs and mobile situation
- *Stage 2* – integration of mobile technology–based instruction with a learning environment that uses digitized information
- *Stage 3* – design of mobile instructional strategies
- *Stage 4* – design and development of mobile learning content
- *Stage 5* – implementation of instructional activities
- *Stage 6* – evaluation of mobile learning effect

Both models address a larger issue than a task design steps for m-learning but tackles related issues that teachers have to go through daily. As stated in Koole's device aspect and Stage 1, the condition of devices and other technical situations must be checked, even if the teacher has a class set of mobile devices. Stages 2–5 are similar to the lesson plan steps and discussed in the learner aspect and the social aspect in Koole's model. Stage 6 can be considered as a post-lesson teacher reflection.

Designing a mathematical task is similar to developing a course but deals with detailed variables that might influence students' learning outcomes. In the task design model proposed by Henningsen and Stein (1997), the relationships among task related variables and students' learning outcomes are represented. A task is comprised of three phases: task as represented in the teaching materials, task as set up by the classroom teacher, and task as implemented by students in the classroom. This last task leads to learning outcomes. A teacher should set up a task presented in instructional materials by defining the features of a task and its cognitive demands. The way a task is set up is influenced by the teacher's goals, knowledge of subject, and familiarity with the students. Once a task is presented by the teacher, students engage in the task through cognitive process and enactment. Students' implementation of the task is influenced by classroom norms, task conditions, and the dispositions of students and teacher. Even though Henningsen and Stein's model does not address the technological aspect, their model provides an overall idea about how a task transforms a textbook passage or a set of instructional materials into a learning experience.

## 2.2 Mathematical Task Design and Implementation Framework for M-Learning

In order to implement mobile technology in the mathematical task design and implementation process, phases, and variables should be investigated in addition to those discussed in Henningsen and Stein's model. For example, the teacher's technology expertise, the technology available in the school, the role of technology in the lesson, student readiness, and the students' and teacher's roles and responsibilities.

Figure 1 depicts the issues to be defined and actions taken by a teacher incorporating technology into a mathematics lesson. The framework consists of six steps, not necessarily in chronological order, describing the natural flow of the technology-based task design and implementation process. The main feature of this framework is that it specifies the structure, components, and interrelationships of technology-based task design and implementation, with the aim of supporting a face-to-face lesson. Most components of the model influence each other, and teachers should understand the interrelationships among them. This framework can be used not only to design a task for m-learning but also to analyze its effectiveness.

### Defining the Lesson Objective

As in the design process of any lesson, the objectives of the lesson, mathematical concept to be taught, and the anticipated measureable student learning outcomes should be established and prioritized. The kinds of task, the types of mobile technology, and the level of cognitive demands are then determined based on the

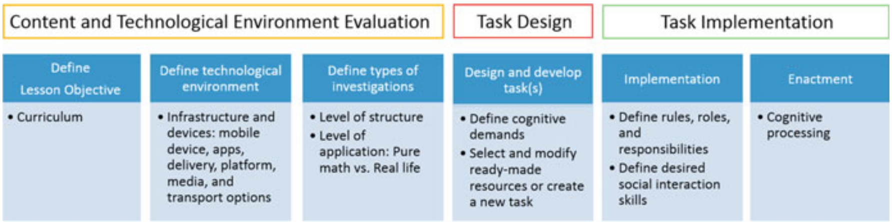


**Fig. 1** Frame work for m-learning task design and implementation

objectives of the lesson. Beside the goals, students' existing knowledge of the mathematics concept should be evaluated before moving on to the next step. Teachers can navigate through the standards and sample mathematics problems via the interactive apps, such as Common Core ConceptBANK™ or CommonCore MasteryConnect, available from Common Core.

## Defining the Technological Environment

Once the lesson objective is defined, social, technical, and human infrastructure need be evaluated before selecting the mobile technology and the level of technology adaptation. To make the lesson more effective, it is also critical to provide supportive technological environments, which requires a perspective different from the traditional mathematics classroom. Teachers should evaluate technology availability and supporting infrastructure including mobile devices, apps, delivery, platform, media, and transport options (Attewell 2005; Keramati et al. 2011).

Evaluating the m-learning readiness of the teacher and students is as important as the evaluation of technology readiness. As Shih et al. (2011) suggested, the effectiveness of the technology on the student learning should be investigated with regard to their backgrounds and personal features. Students do not all learn the same way and they may comprehend mobile technology at various levels. How ready and capable the teacher is to adapt mobile technology in teaching a mathematics lesson bears a large impact on student learning and technology effectiveness. On the other hand, the use of mobile technology and student expectations should be adapted also to the students' level of readiness.

For example, a technologically skilled teacher can demonstrate how to manipulate the Geogebra app and ask the students to "construct the centers of a triangle, showing the main points" as a task, and can expect results like those shown in Fig. 2.

A teacher who is a novice at Geogebra can use the app differently to teach the same concept, "the centers of a triangle." One who is technologically less competent might yet resort to the existing apps from GeoGebra Tube (www.geogebratube.org) or borrow from other Geogebra experts' websites. Using the existing apps, a teacher can still benefit from Geogebra as an interactive tool and integrate it into an inquiry-based task. The critical question teachers need to address is whether adopting a new technology is beneficial to the whole class or might it create some learning difficulties or unwanted pressure.

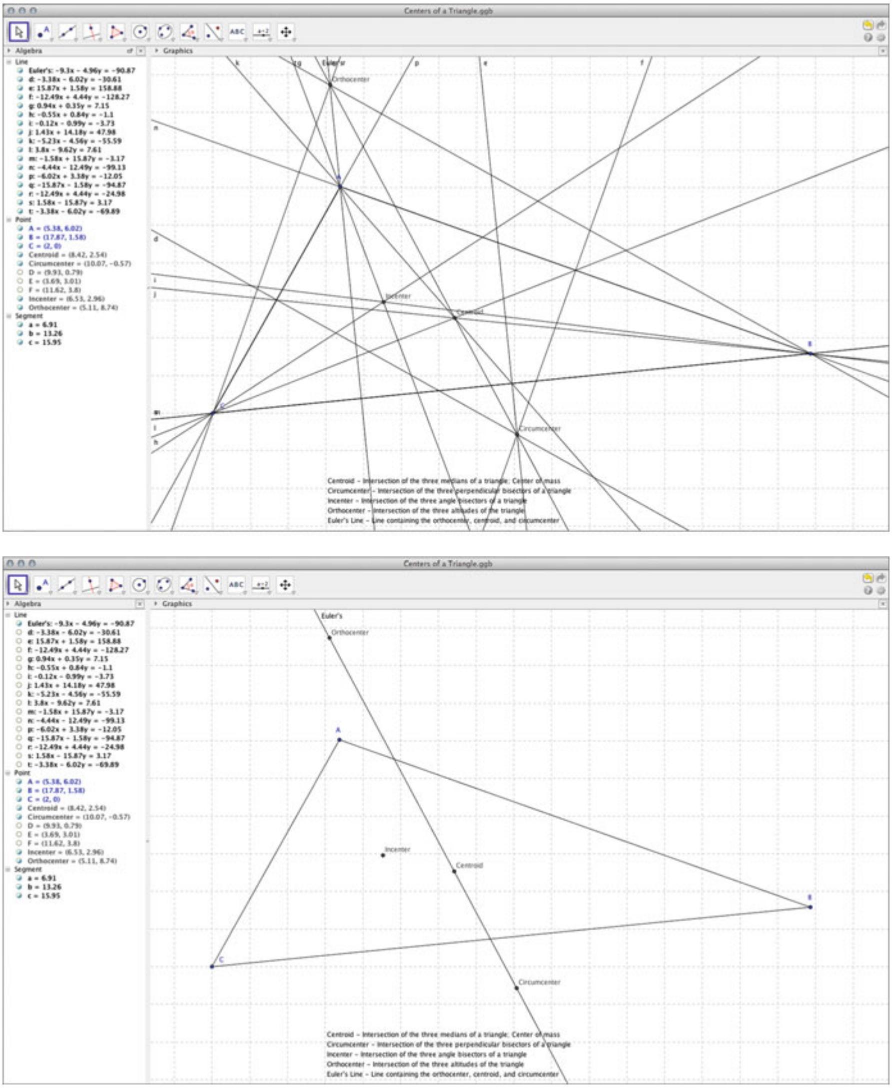


**Fig. 2** Sample GeoGebra construction of the centers of a triangle, viewing all or main points

## Deciding the Level of Structure

Mobile devices have drastically changed the way we live our lives, yet their use in teaching is still limited. They are used to replace traditional paper-and-pencil activities, drill and practice oriented games, calculators, or reading textbooks. Teachers should therefore seek novel ways that the functions of a mobile device can be used in the classroom context. One can use "the informal practice of *capturing and collecting* maps onto the STEM practice of collecting data, while *communicating and collaborating* maps onto scientific and mathematical discourse and argumentation" (White and Martin 2014, p. 64).

The types of investigation decide how a task will be presented to students and where the task will be implemented. One way of discerning the types of investigation is based on the degree of structure/guidance and the reality levels (Calleja 2013). The degrees of structure/guidance are: structured, semi-structured, or unstructured; the reality levels are: pure mathematics, semi-reality, or real-life. Pure mathematics is usually means working with numbers, equations, or theorems from geometry. Real-life investigation takes place in the actual setting such as measuring the frequencies of the sun's rays or the height of a building, whereas a semi-reality task is one that takes place in the classroom, where the data is collected and variables can be controlled.

The teacher should decide how much structure and field setting are needed to maximize the learning of the concept. A task that requires the solution of a complex problem is considered to be cognitively demanding. Tasks that are not cognitively demanding give less opportunity for the students to engage in high-level cognitive processes (Lin and Tsai 2013). The unstructured nature of investigation, whether in pure mathematics, semi-reality, or real-life contexts, is usually considered to make higher cognitive demands on a student, because it is presented as an "open-investigation."

## Developing the Task

The level of cognitive demands varies depending on the purpose of the lesson. For example, the introduction of a new concept, continuation or evolution of what was taught in the previous lesson, diagnostic/formative/summative assessment, or application will demand various levels of cognitive activity. In addition, anticipated cognitive processes can differ according to the capacity of the mobile device that is being used.

Mathematics teachers and the textbooks they use will often concentrate merely on mathematical content, ignoring the nature of the cognitive activity a task generates. Examples of such activities are: classifying, interpreting, comparing, evaluating, and creating. A mathematical task that involves doing mathematics or carrying out procedures that require connections demands a high level of cognitive activity, whereas a task involving memorization or procedures without connections exhibits a low level of cognitive effort (Stein et al. 2000). A cognitively demanding task will admit several possible paths towards a solution, emphasize the process that reaches a solution rather over the solution itself, and will usually be connected to real-world phenomena. Just as a quality mathematical task is characterized by accessibility, openness, novelty, and engagement, the tasks for m-learning should also be meaningful for students, encourage student intervention, involve learners in the mathematical solution process, and respond to a real-life situation.

Designers of m-learning need to be aware of the continuous technological change that is taking place, and the concomitant social organizational issues (Conole 2004; Graham 2004). Recent technological changes include: (1) a tremendous growing pace of electronic resources, including text, audio, video, and other multimedia (Tsakonas and Papatheodorou 2008); and (2) a shift from Web-based e-learning systems to the mobile platform (e.g., Chu et al. 2010). In this vein, Swan (2007) has reasoned that it is not just the content of the tasks that must be designed carefully, but also their physical appearance and the resources available for working on them. As our students increasingly rely on technology, mathematics educators need to pay more attention to the quality of technological resources available to students and of ways to implement these resources in the teaching of mathematics.

Teachers should investigate ready-made resources to find appropriate instructional technologies and tasks for m-learning. Instead of navigating randomly, teachers should refer to recommendations by trusted educational organizations that evaluate the effectiveness of ready-made instructional technologies and resources. Testimonials about instructional technologies by classroom teachers can also be helpful. In the next section, recommended ready-made resources are shared. Teachers should consider these ready-made resources as tools or means to improve student learning that may need to be modified for the particular content and context in which they are to be used. Some examples of implementing ready-made resources and instructional technologies are presented in the next section.

### Defining the Action

Educators recognize that significant learning can be achieved, and knowledge built, while engaging in collaborative activity and through social interaction with peers (Dillenbourg 1999). According to the Professional Standards for the Teaching of Mathematics (NCTM 1991), students should be encouraged to explore mathematical ideas for a sufficient time and respectfully discuss their ideas with one another. In order to achieve learning in a collaborative activity, students must encourage each other to ask questions, explain and justify their opinions, articulate their reasoning, and elaborate, and reflect upon their knowledge.

Studies have shown that mobile devices can be employed for collaborative group activities to promote student social interaction in the classroom (Patten et al. 2006; Tseng et al. 2005). The level of social interactions should be gauged not only according to the objective(s) of the lesson but also to the level of social interaction that the teacher feels is necessary and manageable. The teacher should think about the means of interaction, face-to-face or technological communication, and its purpose. Both teacher and students need to understand the impact that their behavior during the performance of the task will ultimately have on the learning outcomes. Ways to properly support social interaction, such as coordination, negotiation, and discussion, should be considered throughout the task design and implementation process.

Social interaction does not, however, occur spontaneously, simply by providing technologies. It needs to be nurtured and managed by providing ample physical spaces, assigning spaces, and gathering coherently around the classroom (Roschelle and Pea 2002). Zurita and Nussbaum (2004) report that the use of wireless networks in the classroom opened up many educational possibilities and that mobile devices advanced various components of collaborative learning. Grouping criteria have also been claimed to have an impact on mobile collaborative learning. Zurita et al. (2005) have identified three forms of collaborative scaffolding: technological, teacher, and social scaffolding. For collaborative learning, they suggest flexible grouping approaches, a preference criterion, or more structure to the activity.

Once the desired level of social interaction has been decided, the detailed process of implementing the technology-based task, which is different from a paper-and-pencil task, must be coordinated. The group members perform a variety of tasks (assignments), either individually or together. Engeström (2000) and Zurita and Nussbaum (2007) proposed a model of human activity and suggest teachers to ask if there are "any individual or group norms, rules and roles governing the performance of this activity?" and "who is responsible for what, when carrying out this activity and how they are organized?" Regardless of the grade level, students respond in a more responsible manner when the rules, roles, and responsibilities are clearly specified. These roles can differ according to the task and students' comfort level with the mobile devices.

### Enacting Teaching and Learning

In order to improve student learning outcomes, it is not only important for teachers to develop quality tasks but it is critical to understand ways to maintain high-level cognitive demands as the tasks are implemented in the classroom. It is often observed that the cognitive demand of a designed task is reduced during implementation. Some causes unsuccessful task implementation may be: students' desire for a reduction in task complexity (Doyle 1983); a tendency for the classroom-based work on tasks toward an emphasis on accuracy and speed (Doyle 1988); and a lack of alignment between tasks and students' prior knowledge, interests, and motivation (Bennett and Desforges 1988).

As Calleja (2013) concludes, "incorporating a range of resources may be crucial in minimizing the gap between the intended and the enacted activity and in engaging all students in cognitively demanding mathematical inquiry" (p. 171). As with any best practice, good teaching begins with well thought out planning and then applies continuous adjustment during teaching that is responsive to students' performance. Incorporating mobile technologies in a mathematics classroom effectively requires teachers' TPACK and their awareness of the devices and resources. For example, unplanned mobile technologies can be provided to keep students cognitively engaged during the lesson. It is also suggested that teachers use rich tasks and maintain cognitive demand by pressing students to generalize, justify, and to go beyond finding the solution of a problem (Knott et al. 2013). Also, teachers should keep in mind that the tasks they run: (1) replicate real-world events, (2) have various paths toward a solution, (3) provide a space for students to communicate their understanding of the concepts (Suzuki and Harnisch 1995), (4) challenge the students, and (5) are meaningful to students, in that they apply students' prior knowledge and cultural positioning to make connections between the students' community and home (Gay 2002).

## 3 Implementing M-learning

M-learning takes place both inside and outside the classroom through different platforms. Mobile devices, one such platform, allow students the opportunity to explore their environment independently and learn at their own time and pace (Parsons 2010) providing a platform in which teaching and learning can occur. Additionally, mobile devices allow for easy access to application and support spaced learning by using micro time slots (Jones and Wallace 2007). This learning can only occur when resources are made available to students on their mobile device. Often, the responsibility of finding such resources falls solely on the classroom teacher. The accessibility of ready-made resources help teachers to take advantage of dynamic mathematics environments and student access to mobile devices. The goal of this section is to present a collection of ready-made, conveniently accessible resources for teachers to immediately implement and reference in an m-learning environment. Furthermore, the implementation of the suggested mobile learning resources will be addressed, including a sample lesson that utilizes mobile devices and discussion around how a teacher might choose and organize resources for an engaging, m-learning experience.

### 3.1 Ready-Made Resources: Mobile Tools for Mathematics

As technology steadily progresses, so too does the number of m-learning resources. This ever-growing list can seem daunting to any educator in their search for mobile instructional materials. In an attempt to reduce the time and frustration associated with searching, filtering, and evaluating these m-learning technologies, a list of valuable resources has been compiled. These mobile resources range from general classroom supports to interactives focusing on specific mathematical content. Attewell (2005) proposed six areas such as development languages, device, delivery, media, transportation, and platform to distinguish options for mobile learning technologies. While the six categories might help technology personnel in assessing the m-learning resources and software, this chapter distinguishes the resources based on the target concept, need for internet access, and compatible devices in order to assist K-12 classroom teachers and teacher educators. There are five groups of resources, and each table includes the title of the m-learning resource, the m-learning resource's website, and a description of each resource. This includes information about the resource in addition to where a user can access it. Note that, when available, costs related to the resources are also provided.

The first group of mobile learning resources, as identified in Table 1, focuses on providing teachers access to tools that are general in nature. These resources are not limited to those in mathematics education nor are they age or grade specific, but rather these resources support instruction for teachers across all disciplines, age ranges, and ability. Included in this list are resources that support the use of tablets and interactive whiteboards in a classroom.

**Table 1** General m-Learning resources

| Resource | Description | Internet connection | Compatible devices |
|---|---|---|---|
| Cramberry https://cramberry.net/ | Cramberry offers students studying opportunities through the use of flash cards. Users can either make their own flashcards or choose from over a million in the app. Additionally, Cramberry assesses user progress and assigns flashcards to address the disparities | Required | Android iPad, iPhone iPod Touch Laptop Windows |
| Educreations Interactive Whiteboard http://www.educreations.com/ | Educreations Interactive Whiteboard is another resource teachers can use to produce online video lessons. The program provides opportunities record whiteboard experiences by recording voices and writing during the lesson. Examples are provided for multiple disciplines, including mathematics, on the webpage. The app can also be downloaded for free from iTunes | Required for initial download or if using browser-based program | iPad Laptop |
| Good Reader http://www.goodreader.com/ | Good reader is a fee-based tool that provides the option to download a document and write, edit, or take notes on it. For $6.99 in iTunes, users gain access to a top-rated, productivity app | Required for initial download | iPad iPhone iPod Touch |
| New Learning Institute http://newlearninginstitute.org/ | The New Learning Institute provides access to digital media programs that bridge classroom learning with real-world experience by preparing students for the demands of living and working in the twenty-first century | Required | Android iPad, iPhone iPod Touch Laptop Windows |
| Notability http://www.gingerlabs.com/ | Notability is a user-friendly app that allows for taking notes, recording speakers, or taping students. The app is available for download in the iTunes Apps store for $4.99 | Required for initial download | iPad iPhone iPod Touch |

(*continued*)

**Table 1** (continued)

| Resource | Description | Internet connection | Compatible devices |
|---|---|---|---|
| PaperPort Notes http://www.paperportnotes.com/ | PaperPort Notes provides users with multiple ways to create and share materials. Only available in iTunes as a free download, PaperPort Notes offers the options of typing, note-taking, and text-editing within documents, recording audio, and sharing such information | Required for initial download | iPad |
| ProjectMASH http://www.projectmash.org/ | ProjectMASH is a digital learning network that utilizes real-world problems as a mechanism for problem solving. Users can access samples in the "all experiences" section of the webpage | Required | Android, iPad, iPhone iPod Touch Laptop, Windows |
| Shared Notes for School and Work http://sundrynotes.com/ | Shared Notes is an app that offers users the option to write text, draw images, record audio, and share. Available in iTunes for $3.99 per download, this app also features math symbols that teachers can use with the whiteboard feature | Required for initial download | iPad iPhone iPod Touch |
| Show Me http://www.showme.com/ | ShowMe is a free app available in iTunes that allows users to easily narrate whiteboard tutorials and share them online. Sample narratives can be accessed at the website homepage | Required for initial download or if using browser-based program | Android, iPad, iPhone iPod Touch Laptop, Windows |

While the prior table addresses more general m-learning resources, it is imperative to present options geared specifically towards mathematics educators. Interactive geometry software, also known as dynamic geometry environments, is one tool that mathematics educators can use to support students as they build on geometric and spatial reasoning skills. These resources, as described in Table 2, provide users with the ability to construct, manipulate, and inquire about geometric figures in a digital environment. Not only does interactive geometry software bridge the gap from a traditional to modern look at geometry, but it also allows for an integrative approach to teaching algebra.

Just as geometry has its place in the mathematics curriculum, so does calculation. From the four basic arithmetical operations of addition, subtraction, multiplication, and division to multivariable calculus, technology has progressed in such a manner

**Table 2** Interactive geometry resources

| Resource | Description | Internet connection | Compatible devices |
|---|---|---|---|
| Cabri www.cabri.com/ | Cabri is a fee-based resource that allows students to explore geometric and algebraic constructs in a visual manner. Students can construct figures, create expressions, explore measurement, and connect geometry and algebra topics. Cabri offers various products including Cabri 3D, Cabri II Plus, and Cabri Jr | Required for initial download | Laptop |
| GeoGebra www.geogebra.org | GeoGebra is free, dynamic software that integrates geometry, algebra, statistics, and more advanced mathematical topics in one resource. Not only is it available for many platforms, but also is also available in multiple languages. Geogebra is available for online, desktop, and tablet use. Tablet users can download Geogebra at Google Play, iTunes, and the Windows store | Required for initial download or if using browser-based program | Android<br>iPad<br>Laptop<br>Windows |
| Geometer's Sketchpad www.keycurriculum.com/ | Similar to the previous two, Geometer's Sketchpad allows users to integrate mathematics topics through one package. Copyrighted by McGraw-Hill, Sketchpad offers both nonexpiring computer licenses and 1-year student licenses. Geometer's Sketchpad is for use on Windows and Mac operating systems, and available for download at iTunes titled Sketchpad Explorer | Required for initial download | iPad<br>Laptop |
| Quick Graph http://kzlabs.me/quick-graph/ | Quick Graph is a free app available in iTunes that offers users the opportunity to graph two- and three-dimensional objects in different systems and forms. This tool also provides users experience with the interactive motions of zooming, rotating, and translation | Required for initial download | iPad |

that students can complete these calculations entirely in a mobile learning environment. Table 3 offers a list of m-learning resources that concentrates on calculation functionality and extends into more complex resources that allow users to write mathematical code in an effort to solve multivariable integrals and beyond.

**Table 3** Calculation and programming resources for m-Learning in mathematics

| Resource | Description | Internet connection | Compatible devices |
|---|---|---|---|
| Calculator for iPad Free http://www.itwcalculator.com/ | Calculator for iPad is a free app, designed specifically for the iPad, which offers users both a four-function and scientific calculator | Required for initial download | iPad |
| Convert Units Free HD http://www.freetheapps.com/ | Convert Units Free HD allows users to instantly make conversions across different units. Although hundreds of unit conversions are made freely available within the app, this tool also offers users the option to customize their own conversions. Convert Units Free HD is available for free download in iTunes | Required for initial download | iPad<br>iPhone<br>iPod Touch |
| Equation Genius http://itunes.apple.com/us/app/equation-genius-math-equation/id372919594?mt=8 | At $2.99 per download in iTunes, Equation Genius helps support the development of student understanding of solving equations. Equations range from linear equations in one variable to systems of equations with three variables | Required for initial download | iPad<br>iPhone<br>iPod Touch |
| Free Graphing Calculator http://itunes.apple.com/us/app/free-graphing-calculator/id378009553?mt=8 | Free Graphing Calculator provides users with multiple functionalities on their Apple device. Not only does this app offer a scientific calculator with unit converter and access to scientific constants and formulas, but it also boasts interactive graphing capabilities and statistical programs. Free Graphing Calculator is available for download at iTunes | Required for initial download | iPad<br>iPhone<br>iPod Touch |
| Maple http://www.maplesoft.com/products/Maple/ | Maple is a mathematical computation program that supports in the visualization and solving of mathematical problems ranging from basic computations to college-level mathematics. Maple is available for desktop use on Windows, Mac OS, and Linux and freely available for download at iTunes | Required for initial download | iPad<br>Laptop |

(*continued*)

**Table 3** (continued)

| Resource | Description | Internet connection | Compatible devices |
|---|---|---|---|
| MyScript Calculator http://www.myscript.com/ | MyScript Calculator is a free, touch-screen technology that enables users to write numerical expressions in their own handwriting and translates the expression into text. The tool then performs the operation requested. MyScript Calculator can be obtained through iTunes and Google Play | Required for initial download | Android<br>iPad<br>iPhone<br>iPod Touch |
| Wolfram Alpha http://www.wolframalpha.com/ | Wolfram Alpha hosts a collection of resources that supports mathematics instruction. It not only features a fully integrated computation program (Mathematica), but also features course-specific apps and other content supports You can access these Wolfram Alpha tools through their homepage, iTunes, Google Play, the Nook store, and the Amazon App store. Apps range in price from free to $4.99 | Required for initial download | Android<br>iPad<br>iPhone<br>iPod Touch<br>Laptop<br>Nook |

In addition to the aforementioned mobile learning resources available for a mathematics classroom, more specific tools exist to aid the hands-on learning of mathematical content. For example, an educator may want their students to explore experimental and theoretical probabilities in a mobile learning environment. One available interactive utilizes a virtual spinner in which the user chooses the number of sectors on the spinner and the number of desired spins. The theoretical probability is displayed while the outcomes from the experimental events are tallied, allowing users to see the conceptual differences given the varying number of spins. This type of tool allows students to experience focused content in an interactive, mobile environment. A list of other such resources are provided in Table 4 along with collections of interactives and mathematics games that address specific mathematics content through a mobile medium.

The aforementioned categories are geared towards specific mathematics content, but there are many m-learning resources that support learning across varying mathematical topics. One such example is a clearinghouse of electronic, peer-reviewed, standards-based resources; a place where mathematics educators can seek out content related to the specific topic they wish to teach. Table 5 provides a list of such general mathematics resources available for a mobile learning

**Table 4** Interactive apps and games in mathematics

| Resource | Description | Internet connection | Compatible devices |
|---|---|---|---|
| Algebra Touch http://www.regularberry.com/algebra-touch | Available at iTunes and the Windows store for $2.99, Algebra Touch is an app designed to help review algebra concepts through interactive practice. Topics include order of operations, like terms, factoring, expressions, equations, and more. The full version is available for $2.99 per download | Required for initial download | iPad<br>iPhone<br>iPod Touch<br>Windows |
| Annenberg Learner – Math http://www.learner.org/interactives/?d[]=MATH | Annenberg Learner is a collection of web-based, interactives organized by discipline, grade band, audience, and required software. Not only do these resources provide learners mobile access to learning mathematics, but many of the interactives are embedded within full lesson plans | Required | Android<br>Laptop |
| Freudenthal Institute's Digital Mathematics Environment http://www.fisme.science.uu.nl/publicaties/subsets/rekenweb_en/ | Freudenthal Institute's Digital Mathematics Environment provides web-based access to hundreds of free, interactive mathematics games for students age 4–17. Games are filterable by discipline, age, type, and keyword | Required | Laptop |
| Funbrain http://www.funbrain.com/brain/MathBrain/MathBrain.html | Published by the Family Education Network, a part of Pearson, Funbrain offers interactive mathematics games for students in grades 1–8. Students can choose from the Math Arcade, Math Baseball, Tic Tack Toe Squares, and Connect the Dots. Funbrain games are freely available via their website | Required | Android<br>iPad<br>iPhone<br>iPod Touch<br>Laptop<br>Windows |
| Illuminations Interactives http://illuminations.nctm.org/Games-Puzzles.aspx | Designed by the National Council of Teachers of Mathematics (NCTM), Illuminations supports mathematics instruction. While there are lessons available, this site offers over 100 interactives | Required for initial download or if using browser-based program | Android<br>iPad<br>iPhone<br>iPod Touch<br>Laptop |

(*continued*)

**Table 4** (continued)

| Resource | Description | Internet connection | Compatible devices |
|---|---|---|---|
| | for pre-K-12 mathematics students. While all interactives are freely available on the web page, many are available for download at iTunes and Google Play, ranging from free to $14.99 per download | | |
| Itooch http://www.edupad.com/itooch/elementary-school-app/ | Ranging in price from free to $9.99, Itooch provides thousands of exercises to help students practice grades 1–8 mathematics. This app is available at iTunes, Google Play, and the Windows store | Required for initial download | Android<br>iPad<br>iPhone<br>iPod Touch<br>Windows |
| Math Evolve http://mathevolve.com/ | Available at iTunes, the Amazon App store, and Google Play, Math Evolve ranges in price from $.99 to $1.99. The apps offered by Math Evolve focus on the practice of math facts, number sense, and mental math. Free, trial versions are available for tablets and personal computers using Windows or Mac OS | Required for initial download | Android<br>iPad<br>iPhone<br>iPod Touch<br>Laptop<br>Nook |
| PBS Kids – Math Games http://pbskids.org/games/math/ | PBS Kids Math Games provides students with opportunities to learn mathematics while playing games with characters from popular PBS television shows. Hundreds of games, addressing a wide range of mathematical content, are provided online at no cost. Applets are available to download at a minimal fee through iTunes, the Amazon App store, the Samsung App store, Google Play, and the Nook Store | Required for initial download or if using browser-based program | Android<br>iPad<br>iPhone<br>iPod Touch<br>Laptop<br>Nook<br>Samsung |
| ShodorInteractivate http://www.shodor.org/interactivate/ | ShodorInteractivate features access to free mathematics activities, discussions, and lessons organized by subject, topic, audience, and resource type and focused on the exploration of mathematics. All materials on the webpage are | Required for initial download or if using browser-based program | iPad<br>iPhone<br>iPad Touch<br>Laptop |

(*continued*)

**Table 4** (continued)

| Resource | Description | Internet connection | Compatible devices |
|---|---|---|---|
| | freely available, while the app Math Flyer is available in iTunes for $.99 | | |
| touchyMath http://itunes.apple.com/us/app/touchymath/id388884486?mt=8 | Available for $1.99 in iTunes, touchyMath helps users practice with and solve different types of mathematical equations. This app also features a summary of user work in addition to guided practice problems | Required for initial download | iPad<br>iPhone<br>iPod Touch |

experience, many of which are collections of m-learning resources. While it is important to note that the audience of these mobile learning resources is teachers, they are just as accessible to learners.

## 3.2 Implementation of M-learning Resources

Although lists of viable resources may aid practitioners, it may be more helpful to see how these resources can be curated for use in a mathematics classroom. How do you identify, organize, and present m-learning resources in a way that engages students and fosters conceptual learning? And what issues arise as a result of using such technology? Answering these questions will help support education in a mobile learning environment.

Say a teacher is interested in teaching the centers of triangles as a precursor to the construction of inscribed circles of triangles. One may opt to start by searching for a lesson at the Ohio Resource Center (ORC), one of the mobile learning resources referenced in Table 5. In this instance, an educator could search the site based on a specific standard or search, for example, by the keyword in center. A list of resources that match the search criteria, whether by standard or keyword, appear and information about that resource is viewable as shown in Fig. 3. The provided information can be a useful reference for teachers as they plan their curriculum. For this example, the resource "Concurrent Events: An Exploration of the Points of Concurrency in a Triangle Using *Geometer's Sketchpad*" will be used (http://www.ohiorc.org/record/8911.aspx). Published by the National Security Agency, this lesson takes an extensive look at the centers of triangles using dynamic geometry environments. Although the lesson is accessible online, the pdf format leaves little to offer in a mobile environment and forces the instructor to take on the responsibility of shifting instruction to a mobile experience.

As explicitly directed in the instructional plan, students are to use Geometer's Sketchpad as a means for delivery of the suggested constructions. In addition to this software, Table 2 suggests some alternative resources that may be more readily

**Table 5** General mathematics resources for m-Learning

| Resource | Description | Internet connection | Compatible devices |
|---|---|---|---|
| Graph Paper https://itunes.apple.com/us/app/graph-paper/id592051544?mt=8 | For a price of $.99 per download at iTunes, Graph Paper is an app that offers a digital experience similar to using tangible graph paper | Required for initial download | iPad<br>iPhone<br>iPod Touch |
| iFormulae Free http://itunes.apple.com/us/app/iformulae/id367586887?mt=8 | iFormulae is a source for mathematic formulas and their application. Available for free download at the iTunes store, formulas are categorized by: area and perimeter, calculus integrals, calculus derivatives, equations of a line, midpoint formula, Pythagoras theorem, quadratic formula, rationalizing denominator, and surface area and volume | Required for initial download | iPad<br>iPhone<br>iPod Touch |
| Inside Mathematics http://www.insidemathematics.org/ | Inside Mathematics is a website that provides teachers access to tested lessons, videos of mathematical instruction, and tools and resources- including rich problems-to support mathematics teachers, coaches, and administrators. Additionally, Inside Mathematics has a professional learning community for mathematics teaching and learning | Required | Android<br>iPad<br>iPhone<br>iPod Touch<br>Laptop<br>Windows |
| Khan Academy https://www.khanacademy.org/ | Khan Academy is a collection of web-accessible, tutorial videos, developed to support learning mathematics, science, economics and finance, and other content for learners in grade K-12 and beyond. Additional materials to support learning are also available. Visit the Khan Academy website or download the free app at iTunes, Google Play, or the Amazon App store | Required for initial download or if using browser-based program | Android<br>iPad<br>iPhone<br>iPod Touch<br>Laptop |
| Math Ref Free http://happymaau.com/projects/math-ref/ | Math Ref Free is a free version of Math Ref, an app that includes a unit converter, hundreds of formulas, and examples. Both versions of the | | Android<br>iPad<br>iPhone<br>iPod Touch |

(*continued*)

**Table 5** (continued)

| Resource | Description | Internet connection | Compatible devices |
|---|---|---|---|
| | Math Ref app are available for download in iTunes, Google Play, and Amazon | | |
| Mathalicious http://www.mathalicious.com/ | Teachers and students have the opportunity to explore meaningful, real-world questions through a mathematical lens. For example, some questions addressed in these online lessons are: Do people with small feet pay too much for shoes? Do taller Olympic sprinters have an unfair advantage? How have video game consoles changed over time. . .and are we building the Matrix? Not only do these questions help engage and motivate students, but they are also aligned to the Common Core State Standards for Mathematics. Access to free lessons is limited | Required | Android<br>iPad<br>iPhone<br>iPod Touch<br>Laptop<br>Windows |
| Ohio Resource Center – Mathematics Educators http://ohiorc.org/for/math/ | The Ohio Resource Center, part of the Ohio State University's College of Education and Human Ecology offers teachers access to free, standards-based, peer-reviewed, web-based resources. These resources include such things as lesson, rich problems, and applets. Teachers can search for resources by standard, topic, keyword, or resource type. One popular feature is the Problem Corner, which offers users with hundreds of mathematical problems | Required | Android<br>iPad<br>iPhone<br>iPod Touch<br>Laptop<br>Windows |

available to students, such as Geogebra and QuickGraph, since they are both freely accessible. Screen shots, as provided in Fig. 2, allow readers to view the constructions required in Geogebra to make the centers of a triangle, including Euler's line. It should be noted that each of the vertices of the triangle are movable so that students can explore how the centers change given different types of triangles. But before a student fully engages in the complexities associated with learning new software, a teacher may want them to experience an interactive that focuses solely


**Fig. 3** Resource record from the Ohio Resource Center (2014)

on the content at hand. Available on the NCTM's Illumination Interactives site, "Half Angle" is an interactive tool that aids users in finding the in center of a triangle as displayed in Fig. 4 (http://illuminations.nctm.org/Activity.aspx?id=4149). While this addresses a subset of the lesson by examining only one of the centers of a triangle, it serves as another mechanism in which m-learning can occur. Another, more traditional option, focused on this topic stems from making

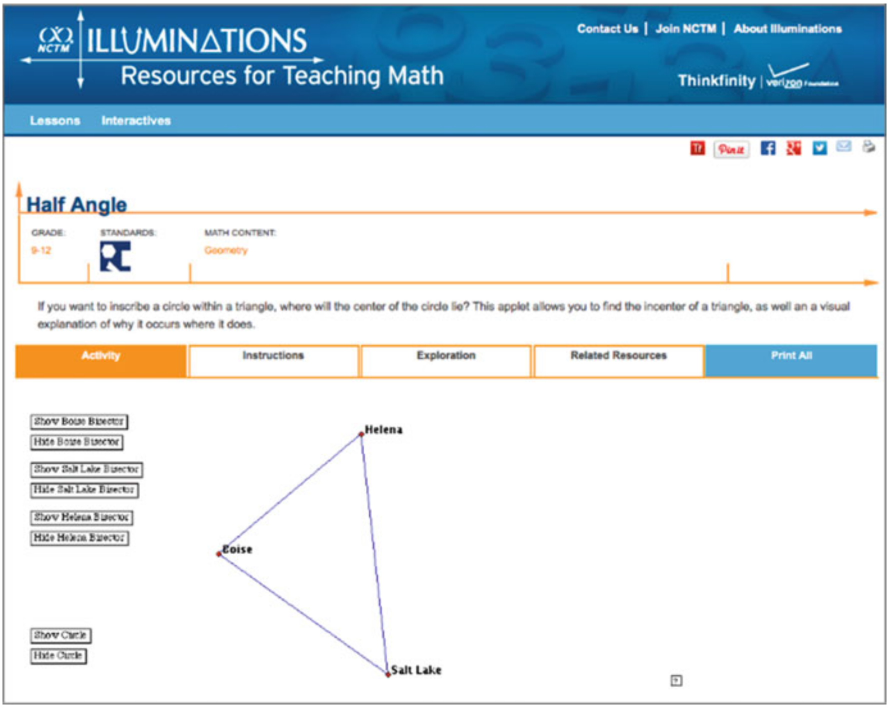


**Fig. 4** Screenshot of NCTM (2014) interactive, Half Angles

constructions using a compass and straightedge. Although this typically occurs utilizing paper and pencil, it can be accomplished in a mobile learning environment through the use of the Graph Paper app as described in Table 5, providing yet another way to bring m-learning into the mathematics classroom.

It is evident, as displayed in this example, that a single lesson can be supported through the use of multiple m-learning tools; however, the existence of issues in such implementation may hinder the mobile learning experience. Despite its usefulness, there are some key areas of using mobile technology in education that need to be addressed to help overcome obstructions in the learning environment. In the literature, two themes involving issues in the implementation of mobile technology continually arise: users and the technology. In this context, the term "users" refers to those who are consuming the mobile technology, while the term "technology" will focus on issues surrounding the devices and the associated software. Although these categories are broad in nature, some do possess overlapping qualities. In the following paragraphs, specific issues that fall within and across these two themes will be discussed.

The first type of issue that an educator utilizing mobile learning should be aware of surrounds the technology itself. One of the initial concerns around using mobile technologies lies with the infrastructure associated with using technology. Ng and Nicholas (2009) point out general concerns with the lack of support around infrastructure. Other issues including cost, access to electricity, and mobile coverage are things to consider when teaching in a mobile environment (Goundar 2011). In addition to infrastructure, hardware issues are likely to be of concern especially with the variety of personal devices in which students have access (Chen and Denoyelles 2013; Shuler 2009). This becomes even more important when thinking about the devices' durability, repairs, and the particular configurations of individuals' own devices, and how those will work in a mobile learning environment (Goundar 2011).

In addition to issues around mobile devices and the infrastructure are issues with the software. Memory and processing power, along with the appropriate software, are of major concern in an m-learning environment (Goundar 2011). For example, the Apple iPad does not support Adobe Flash, causing a major concern if students are asked to participate in something that requires that program. Other software issues that may arise are technical challenges, usability, and data privacy issues (Shuler 2009). Not only is the operation of software an issue, but so too is navigating the content that is provided on individual websites and apps. That is, some content are hard to access (Goundar 2011) and others may lack organization or relevance to the task at hand (Kushnir 2009). While all of these issues could cause major problems for an m-learning experience, it is also important to point out that the acknowledgement of and planning in accordance to the issues can help overcome the challenges and result in a successful learning opportunity.

The second category of issues surrounding mobile learning focuses on those using the mobile technology. The most prevalent issue in the literature lies with the experience, skills, and preparation of the user, whether it be the teacher or the student (Chen and Denoyelles 2013; Goundar 2011; Kushnir 2009). That is, the more experience and preparation the user comes with, the more successful the mobile learning experience.

Other factors that mobile learners face include multitasking and distractibility (Shuler 2009). While some may propose that students are engaged as a result of mobile technology, there is also the risk that they will be distracted by other mobile encounters leading to diminishing engagement. Additionally, research on m-learning resources and the problem of quality indicates the importance of the task, including task type and task difficulty (Kushnir 2009). Considerations should be made to help eliminate issues that interfere with mobile learning. Mobile learning tools may also present other issues as suggested by Shuler (2009), including difficulties monitoring student access and activity with inappropriate content, the negative impact on student writing as a result of slang and text lingo, the possibility of cheating, and the threat of cyberbullying, to name a few.

## 4 Future Directions

As Keough (2005) claims, m-learning might fail unless educators change the teaching and learning model, become more knowledgeable about the usage and function of mobile devices, adopt discoveries in cyberpsychology, and minimize the cultural differences that exist between government regulations and the use of mobile technology in the classroom. It would be ideal if teachers understood and were able to negotiate the relationships between technology, pedagogy, and content. However, not all teachers are prepared to have technological pedagogical content knowledge (TPACK) (Mishra and Koehler 2006) or have the time and knowledge to assess the tremendous amount of ever growing digital resources. Yet teachers are expected to integrate technology or web-based resources into their teaching of mathematics regardless of their readiness. Some state tests are even operated using a computer. Therefore, the need for guidelines to integrate technology into the teaching of mathematics is apparent.

Designing cognitively demanding mathematical tasks (with or without technology) is a complex process that requires knowledge of content and context, as well as an understanding of the form and representation of tasks (Namiki and Shimizu 2012). This study has proposed a model that teachers can use as a guideline to design and implement a mathematical task for m-learning. The chapter has also collected a list of ready-made resources that teachers can use to design a task for m-learning.

Since mobile devices have limited capacity for loading and storing problems, it is recommended to rationalize the use of mobile devices in teaching (Grasso and Roselli 2005). Specifically, teachers must consider the value and purpose of learning mathematics, the mechanisms by which different forms of learning take place, and empirical findings of "what appears to work" from teaching experiments.

As with any teaching method or pedagogical tool, there are advantages and disadvantages. It is up to the educator to try to identify both, make modifications to offset the disadvantages, and make the learning experience as fruitful as it can be. Similarly, mobile learning has both positive and negative aspects. It is the intent of this section not only to highlight the various issues that may arise along the way, but also to present a selection of m-learning resources that support instruction in a mathematics classroom. The hope is that the knowledge of both will support effective mathematics learning in a mobile environment.

## 5 Cross-References

▶ Characteristics of Mobile Teaching and Learning
▶ Design Considerations for Mobile Learning
▶ Designing a Mobile Applications Curriculum: Overview
▶ Mobile Learning: Critical Pedagogy to Education for All
▶ Mobile Learning and Engagement: Designing Effective Mobile Lessons
▶ Mobile Technologies for Teaching and Learning
▶ Student Feedback in Mobile Teaching and Learning
▶ Transforming Assessments into the Digital Domain

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# 37 iPad Program in K-12 Education: Pilot Year

Adelina Moura

## Contents




**Abstract**

Teaching and learning in a 1:1 environment supported by tablets is a very different experience, both for teachers and students, comparatively to the traditional teaching approach. More and more schools embrace the iPad as the latest tool to teach and to be used in class and at home. This chapter presents the outlines of one-to-one iPad program in an elementary school, a private school in the north of Portugal. This program is based on the use of the iPad as an instructional and learning tool. A brief history of the implementation pilot year of the program, which is in line with the pedagogical model of the institution, based on the Modern School Movement ideas, will be made. The institution's action plan includes three components: learning English, integration of mobile technology in teaching and learning process, and individualized teaching. It is intended to create technologically rich learning environments focusing on learning through projects, to engage and challenge students. Students have access to a mini iPad given by the institution to use at school and at home. Both teachers and



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parents enrolled in workshops to learn how to help students optimize the use of apps and the mobile device, in general, in and out of school. As this is an ongoing experience and research, only some preliminary data will be presented; in the future new data will be released.

## 1 Introduction

There is no doubt about the impact of technology on our lives. But what do people need to do to stay updated or be at the vanguard? In the society of information and knowledge, it is essential that all citizens use information and communications technologies (ICT) and digital media in both professional and personal life. The technologies have transformed the company from top to bottom (Livingstone 2012) and technological developments are creating new opportunities to learn anywhere and anytime.

The education sector has suffered in recent decades strong pressures for effective integration of digital technologies in educational practices, following its strong development and incorporation in different fields of society. Different organizations (OECD 2009; UNESCO 2013) emphasize the value that ICT can bring to the process of teaching and learning, especially mobile technologies. In the Google era, people have quick access to huge amounts of information and the teachers and students can enjoy and have this information available in the classroom through their mobile devices. With the advent of mobile technology, new learning opportunities are emerging in education, and they can be transformed into adequate resources to help improve the academic performance of students (Gliksman 2011; ► Chap. 2, "Characteristics of Mobile Teaching and Learning").

Mobile devices provide people with more flexible and accessible learning opportunities in different contexts. Learners are different today (► Chap. 4, "Design Considerations for Mobile Learning"), so curriculum design for mobile learning should be different. Students use their own technologies daily to socialize, organize, and learn informally, so schools should provide ways so that students continue to engage in formal and informal learning activities beyond the school (Johnson et al. 2014; Winters et al. 2013). The potential of mobile technologies is huge, such as to help learn more efficiently and creatively and to innovate and solve complex problems and to access a wide and updated level of knowledge (Kuuskorpi and González 2011; Johnson et al. 2014). Despite the interest and the potential of mobile learning, there is still a long way to go, and empirical studies to understand the benefits and challenges in educational success continue to be necessary.

But it is not enough to talk about the use of mobile technologies, it is necessary that there is also a significant change in learning spaces (OECD 2009), to implement learning environments that suit the needs of students and training requirements of working life (Kuuskorpi and González 2011).

The campaign "eSkills for Jobs 2014," released in Europe, aims to sensitize and raise awareness of the importance to improve the ICT applied to everyday life and the workplace. This initiative wants to raise the lack of qualified professionals in ICT and points to the urgent need to prepare future generations in the area of skills and digital tools, real problem solving, and critical and creative thinking.

In order to mitigate the warning signs on the reduced preparation of students of certain careers considered more competitive in the economy, such as Science, Technology, Engineering, and Mathematics (STEM), there emerged a “movement” of reflection and discussion on the need to introduce computational thinking in school, curriculum, and learning (Turvey et al. 2014). According to Berry (2013), the new national curriculum for computing, in the UK, gives schools an excellent opportunity to refresh the process of teaching and learning in this area of education and find new paths to innovate in education. More than ever, the school must prepare their students with new skills for new jobs and demands of a globalized and competitive society. In line with this, OECD (2009) believes that learning must extend beyond the simple use of the manual and enjoy digital resources to promote innovative learning, able to develop students’ necessary skills to the challenges of the twenty-first century.

However, technology cannot be seen isolated from other learning areas. It should become an effectively integrated element of the pedagogy of teachers and students in daily productivity. This point should be taken into account by all education actors, through an institutional and professional program sustainable and capable of promoting and facilitating students’ digital skill acquisition.

At this moment, when science, technology, and society are constantly changing, it is worth promoting in students the ability to learn new knowledge and acquisition of skills to meet new challenges. It is imperative that they understand the learning structures to be able to build knowledge needed to solve problems and use them in new situations. With technologies that students bring to school (BYOD), teachers are taking advantage of these tools to connect the curriculum to real-life issues (Johnson et al. 2014).

The enormous amount of information generated every day makes it impossible that it can be taught and learned in full. So the school’s mission is to equip students with the skills to research and analyze sources of credible and essential information now and in the future. But it is also crucial to prepare teachers with the skills to integrate digital tools and develop an innovative curriculum to help improve student’s learning and encourage them to learn throughout life (OECD 2013).

It is in this context that the term “learning how to learn” becomes meaningful within the educational program of the First College Braga, through the iPad integration program as a learning tool. For this particular educational institution, the construction of learning, learning how to learn, and raising passion for learning are its benchmark. It is not the means that determines the effectiveness of education, but the pedagogical strategies and the attitude of the student (Karsenti and Fievez 2013). Thus, the institution intends to explore through technology a wide range of techniques and interactions that are hard to accomplish with traditional tools, to involve more students in the educational process and in the pursuit of the objectives and curriculum goals.

It is also the aim of this institution to provide opportunities for students to become qualified academically for the responsible use of ICT, in particular, and to promote their educational success mediated by mobile technologies. To achieve academic and social success, the focus will be on promoting solid academic habits, the building of student's learning communities, attention and reflection on how technology can support the learning process, and leading students to understand that the most important is not the technology, but how can you use it to make the learning process more efficient, productive, and rewarding.

The educational project of the institution is built on the ideals of the Modern School Movement and its pedagogical model, focused on democratic training and social and moral development of students, ensuring their full participation in the management of the school curriculum. The school's action plan focuses on three key components, English learning, integration of mobile technologies in learning, and the individualization of the educational process. In this sense, the bet goes to the creation of integrated and technologically enriched learning environments, focusing on projects and problem solving to engage and challenge students. The development of skills in information technology is seen by the institution as a key element in preparing students for further study, life, and future career.

The iPad integration program in the educational practices of the college is based on a holistic integration, able to meet the rapid changes taking place in society and exploitation of the best educational processes for the acquisition of educational skills needed for the twenty-first century. In order to help parents, teachers, and students, a guide to operate the iPad integration program in the First College Braga was created. Taking into account their specific features, this guide can be adapted to other contexts and realities. In this text, a summary of the development of this program in the first months of the pilot year will be presented.

## 2 iPad Integration Program as a Learning Tool

The iPad integration program as a learning tool attached to educational and technological vision of the institution focused on a mixed learning environment that combines technology with other resources at the service of education and science. The access to a one-to-one (1:1) technology will allow students and teachers to choose from a variety of tools and the best moment to use them. Together, they decide the most effective way for students to create and share their work. The iPad will not always be in the tasks of the different moments during the class. There will be times when students will use the manuals or other available tools. Teachers and students will discover together what will be more suitable at each moment. It is intended that the lessons are connected to students' lives and the digital world they live in, because students have an effective tool to bring the real world into the classroom. The learning process will be personalized and self-directed, and teachers will have the opportunities to plan learning experiences that allow students to apply and extend skills and knowledge developed in the past.

## 2.1 Program Preparation

During the academic year 2013–2014, the school proceeded to the research about the investigation on the concept of mobile learning and about the studies on the use of the iPad in education, in order to outline the theoretical framework and the pedagogical structure of the program. So it was necessary to map out the conditions and needs to prepare the project plan, form the team, organize the supply of equipment, formalize the budget, and establish the program's development schedule and plan communication strategies and dissemination of the project.

Why mobile technology? Mobile technologies are shaping the lives of people in general and, in particular, of many young people around the world and should also be used in the classroom. This is because smartphones and tablets, as being private and personal technologies, as well offer real advantages as devices to support learning (Johnson et al. 2014; Moura 2014). One of the features of mobile devices is their ubiquitous power and flexibility of access to information. Studies' results show that students are more motivated and engaged in learning when they use these technologies (Gliksman 2011; Moura and Carvalho 2013; Woodill 2011), with an acknowledgment of the importance of technology in all areas of teaching and learning in general.

Several studies have demonstrated that school has tended to engage students in technology-enhanced learning environments (Karsenti and Fievez 2013), including through mobile technologies. But, as mentioned by MacCallum and Jeffrey (2010), there are several reasons for their still weak incorporation. For them, the resistance to the introduction of mobile devices, from teachers, should be understood by School Boards, to help them overcome barriers and provide training support. According to those authors, teachers have to be comfortable with mobile technology to integrate them and also to feel that they bring benefits to learning. In turn, students require continuous and sustainable opportunities to engage in educational activities, to build the ability to think critically, creatively, and innovatively when they use and create with technology.

Why a 1:1 program? Because each student has a mobile device, 24 h a day, 7 days a week (24/7), that can be linked to the teacher, colleagues, and even the experts, helping to create real opportunities to communicate and interact in real learning contexts. Learning becomes more focused on students; study materials can be tailored to meet the learning profile of each student and also the diversity of learning. Students can work at their own pace and according to their needs, building innovative and unique learning experiences.

Why the iPad? The iPad features make this mobile device a learning tool to be used in the classroom. This device is always ready for use, but should not be confused and used as a laptop (Gliksman 2011). In a study by Henderson and Yeow (2012), the teachers interviewed felt that the iPad has features and design that make it a useful tool for use in education. The size, portability, and absence of peripheral make it usable inside and outside the classroom. According to Karsenti and Fievez (2013), the iPad was chosen by more than 75 % of the world market of education and it is considered one of the most advanced technologies. Also because this mobile device supports a large number of applications designed specifically for it.

In the case of a personal device, the student can learn anywhere and at any time according to the program managed and led by the teachers. The profusion of applications and the access to information on a wide range of topics allow students to learn about the planned materials and develop the areas that interest them the most. The student can access it when it is more convenient for him/her about general or educational information, through text, sound, images, and interaction with peers. The information is presented through rich multimedia capabilities and various techniques of data visualization. The student can also take notes and create documents or various resources that can be saved in folders and accessed in any context. The familiarization and instantaneously of iPad use means more use of class time to learn, solve problems, and produce content.

The touch screen interface facilitates the use and handling of the device. The battery life is big which means that the iPad can be used throughout the school day. It is lightweight and portable, easily transported in the school bag. The iPad is seen as intuitive, with little need for technical support device. But as stated by Henderson and Yeow (2012), without a good learning environment, good management, and mentoring, the device's potential may not be tapped. That is why this program has established a management, maintenance and security plan, and rules for choosing the appropriate applications to class needs. Given these characteristics and qualities, and toward democratization and universal access to technology, the school provides each student a Mini iPad Air 16 GM at his/her enrollment.

## 2.2 Adoption of Institutional Policies

The school year began with a meeting with all parties participating in the program, to provide information about the project and reflect on the most sensitive points. The responsibilities of each and the established protocols relating to the policies of the appropriate use of technology inside and outside the classroom were explained. Parents and students were provided with information on safety aspects and mobile literacy. It was established a shared responsibility among students, parents, and the institution in iPad program. Parents signed the guide of school policies for the use of technologies and the Internet inside and outside the institution.

The supply to all students of the same mobile devices with Internet access aims to provide equal opportunities to all. Thus, rules of conduct of responsible use of the devices listed in the program guide were established. The entrusted equipment intended solely for educational use and both student and parents or guardian shall be fully responsible for the iPad. The observation of the general rules of use, the safety regulations, and the terms of responsibility avoid the decision to confiscate the device and limit access to content considered unsuitable to the principles that guide the usage policies set by the school and the document program guide.

Targeted sanctions have been established for forgetting iPad cases, dead battery, and loss and lack of protective cover. When a student fails to attend, the institution should undertake the delivery device.

## 2.3 m-Safety

Security has been safeguarded through registration of all devices, with the student's name, year, class, and the iPad serial number. A single e-mail was created for all devices, provided to teachers. Students were informed of the occurrence of regular remote surveillance to search history, to oversee the proper use of the Internet, in and out of school. To prevent misuse of apps, students have not got free access to the iTunes store. Installing apps is done remotely at the request of teachers of different subjects. The use of social networks is done with teacher's permission. Security in accommodation of equipment is of students' responsibility and the device can't leave the classroom during breaks. In class, focused activities were carried out in e-security and mobile literacy to prepare students for a proper use of the equipment.

## 2.4 Access and Use of the Internet

Internet use is ruled by school policy and the contract that students and parents must sign for the appropriate use of the device in class. Proper use of the Internet within the school system is controlled by a filtering system. Any inappropriate use of the Internet is unacceptable and it is subject to disciplinary action, with the possibility of exclusion of the student of this program.

Students have access to Web 2.0 applications to implement new educational opportunities. Within the college, it is possible to access websites, wikis, podcasts, blogs, and other tools that can support students in their learning and allow them to be also content producers.

## 2.5 Technical Support and Maintenance Care

The school has a technical support for the iPad program. Students have the technical support from the teacher in the classroom. The early months of program development were essential to test the potential of the computer network of the institution and make the respective adjustments. After a period of some disruption of the network, it has come up to a period of stabilization.

Each student must maintain and care for his/her iPad. The device should come to school every day fully charged. Only exceptionally it will be possible to load in school. The cover is mandatory and it is parents' responsibility. The guidelines for customizing the iPad are provided by the teacher in the classroom.

Students use the iPad at school in all subjects and also take the device home. This covers all classes and learning situations in different contexts. The college does not provide assistance or Internet connection at home, these are family's responsibility.

## 3 Training Workshop for Teachers

Any technology incorporation program in the classroom must take into account the key role that the teacher has in its development. Therefore, teacher's training and the empowerments to use technology resources are essential, which may ensure some level of action. There is a general belief that the more technological skills, the greater methodological range. It is essential that the teacher integrates and puts him/herself in the center of educational change with technology.

One of the concerns in this program is the training of teachers. Different studies (Karsenti and Fievez 2013) point to the preparation of teachers for effective and capable use of mobile technologies such as the weak point of many projects of this nature. In this sense, a training workshop for teachers was prepared (named "Integration of mobile technologies in educational practices") with 25 h of classroom work and 25 h of autonomous work, divided into five sessions, the first being more theoretical and the second essentially practice. Even in the case of an initial/intermediate level training to acquire skills in using the iPad as a learning tool, the purpose of this workshop is to equip participants both with the technological and instrumental point of view as well as methodological.

The first session started with the concept of mobile learningcontextualization, followed by the presentation of studies in the area and the approach of the main theories of learning for the mobile age. Thereafter, teachers explored learning environments mediated by mobile technologies, in order to understand how these technologies can be used as teaching and learning tools.

The second session began with the exploitation of iPad basic navigation commands, configuration, and native apps (Pages, Numbers, Keynote), and then teachers discovered how they can flipped classroom and personalize learning by creating a website (Weebly, Wix, Webnode) and a blog (Blogger, WordPress) using editors optimized for mobile devices. Finally, teachers explored two audiences' response systems (GoSoapBox, Kahoot).

In the third session, some tools for communication, interaction, and collaborative writing were presented. Teachers were asked to present a pedagogical project to integrate mobile technologies in learning practices based on productivity suites such as Google Drive, OneDrive, or Zoho.

In the fourth session, teachers explored some productivity apps to create flashcards (StudyBlue), videos (Educreations, ShowMe, and Animoto), audio files (QuickVoice), and podcasts (Audioboom, Podomatic). Teachers also learned about WebQuest, a great way of observing students' thoughts and imagination in a motivated and meaningful learning process.

In the last session, the teachers presented their pedagogical projects, showing examples of how to integrate iPad and several apps in the curriculum of the respective subject. A website was created (http://tableteducacao.weebly.com/) with a variety of materials to support the development of this training workshop and teachers' projects can be seen here.

## 4 Integration of the iPad in Learning Practices

During the early months of the program development, the main objective was to explore different ways to use the iPad, supporting teachers and students in the transition to the use of e-manual instead of paper manual. The option for e-textbook and educational resources from Escola Virtual (http://www.escolavirtual.pt/), a platform to help the study, had to do with the quality and variety of resources made available by the company, as well as technical and training support provided in the program's start-up phase.

At the beginning of the school year 2014–2015, teachers and students downloaded for their devices the app EV e-Manuais, launched by the Escola Virtual platform, to be able to have off-line access to all digital manuals of the respective year, at school and at home. Along with this app, the Air iPad installed a set of free Apple applications that are being also used by students and teachers (Pages, Keynote, GarageBand, iMovie, Draw, Mathletics, Calculator ++, iBook). Teachers have access to an iPad per classroom, provided by the school. The first apps incorporated in the iPad to support learning were the e-textbooks and the resources of the Escola Virtual platform. Some other apps were introduced as the teachers were more comfortable to use them. In general teachers have adapted well to this iPad integration program in the classroom.

### 4.1 Technological Profile of Teachers

The data presented below has been collected before the start of the program and helped to prepare teacher training workshop. An online survey was answered by 16 teachers, 47 % male and 53 % female, aged between 30 and 50 years, of whom 47 % have between 10 and 20 years of experience. Most teachers (73 %) have attended some training on the use of technology in the classroom. Only 24 % of teachers said to have had prior experience working with tablets (iPad), lasting less than one year. The majority (86 %) of teachers said to have an average degree of familiarity with the technologies. All respondents say they understand the importance of digital technologies in educational practices. Only 24 % of respondents say they have had previous experience of working with the iPad.

When teachers were asked about the iPad functions or services they would like to learn how to use, as presented in Table 1, the vast majority of them feel the need to know how to optimize the device usage.

The desire to learn how to manage the schedule; take notes during a meeting; synchronize tasks between the iPad and the computer; share files; communicate via Skype or other communication application; share pictures, videos, and other

**Table 1** iPad functions or services teachers would like to learn how to use

| Question | Scale | Participants ($n = 16$) | |
|---|---|---|---|
| *What iPad functions or services would you like to learn how to use?* | | f | % |
| Managing the calendar | Yes<br>No<br>Already know | 12<br>1<br>3 | 75<br>6<br>19 |
| Taking notes in a meeting | Yes<br>No<br>Already know | 11<br>2<br>3 | 69<br>12<br>19 |
| Synchronize tasks between the iPad and the computer | Yes<br>No<br>Already know | 15<br>1<br>0 | 94<br>6<br>0 |
| Share files | Yes<br>No<br>Already know | 14<br>0<br>2 | 88<br>0<br>12 |
| Communicate via Skype or other communication application | Yes<br>No<br>Already know | 9<br>2<br>5 | 56<br>12<br>32 |
| Share pictures, videos, and other multimedia resources | Yes<br>No<br>Already know | 12<br>1<br>3 | 75<br>6<br>19 |
| Download multimedia resources | Yes<br>No<br>Already know | 13<br>0<br>3 | 81<br>0<br>19 |
| Find apps for students with special educational needs | Yes<br>No<br>Already know | 16<br>0<br>0 | 100<br>0<br>0 |

Source: Data collected for this study

multimedia resources; and download multimedia resources was remarked by most teachers. The categories of applications with more interest for teachers are educational games, productivity apps such as to create e-books, apps to communicate, and apps to integrate in education in general. The teachers' interest in knowing apps to develop motor and cognitive skills of children with special educational needs is also observed.

## 4.2 Preliminary Results

At the end of the first part of the program, some data through online anonymous questionnaire to know the teachers and students' perceptions about their experience with iPads was collected. In the midterm evaluation program, some students and teachers will be interviewed to know how they used the iPad in and out of the classroom. Some students' parents will be also interviewed to know about using the iPad out of school.

Teachers of all subjects are using the iPad regularly in their teaching, not only the e-manual but also other applications (audience response system, podcasts, videos, audio, conceptual maps, presentations, and others). Teachers who have iPad themselves feel more comfortable in using it in class than those without, as revealed by some teachers during the training sessions.

### Resources for Integrating Tablets into Classroom

After the first six months, it was asked to teachers involved in the project that made an assessment of the program development. The following paragraphs are comments from some teachers collected online.

According to the teacher of the first cycle: "The iPad has been used in most cases as a research tool (biographies, animal footprints of the story "A yellow dog and several of her friends", images of objects and places). The app EV e-Manuais has been more used by the student of the 4th year. The access to the Escola Virtual portal has been explored with all students, encouraging them to consult the "communities" menu at home to follow the work in the classroom. The student of 4th year already knew the Escola Virtual project so she explores it very well as well as its functionalities. Apps were installed, some of them according to the work done in the classroom (stories, mental calculation, water cycle, and graphics). Students explored these apps at school and at home and learned how to send emails."

The teacher of Sciences, Physics, and Chemistry said: "Istarted the iPad program leaving the 5th year students (2nd cycle) develop technological learning, such as to send and receive email, to use the text tools and calculation. At this point, students began to understand that the iPad is a working tool and not just fun.With the iPad the research of curricular contents is made available in an instant.Thus, students are more motivated and learn more."

In the English course, as stated by the teacher, "Students used the iPad in almost every class, not only because of the e-book but also to research contents, and make recordings. The biggest problem so far was some difficulty in accessing e-books, which has meanwhile been solved."

The history teacher reported that "When the difficulties in accessing the e-manual where overcome, students began to realize the potential of research time and have begun to demonstrate motivation in learning new content, but sometimes students try to go to other web pages. From time to time they access the Escola Virtual portal to view some educational resources, but it consumes a lot of time, when Internet access is slow." The greatest difficulty to this teacher is not having her own iPad to be able to exploit its potential outside the classroom.

According to the teacher of Portuguese language "were installed some apps, to integrate in the curriculum. With the iPad, students researched information on the Web; consulted online dictionary in reading classes to learn the meaning of difficult words; answered quizzes (Kahoot, GoSoapbox) on grammar issues and literary education, surveys and open questions; published their ideas on Padlet; resolved online tests (Google Form; SurveyMonkey); read literary works; created conceptual maps (SimpleMind+); made collaborative clouds words (Word Clouds); participated in discussion chats (TodaysMeet); created videos (Animoto); tookpictures to illustrate the work (Pages); wrote short stories (Story Buddy2); accessed to the e-mail to receive and send messages and work; wrote texts (Notes; Caderno), made

**Table 2** Apps and activities realized by students

| iPad apps | Activities |
|---|---|
| Pages | It is used as a word processor to make writing assignments inside and outside the classroom, for example, for illustration of a legend |
| Notes | With this app, students took notes in class, created the iDictionary, and organized study activities |
| iBook | Students stored e-books to read inside and outside the classroom |
| Keynote | Students created their own presentations about, for example, the history of Halloween |
| Idea Sketch | Teachers and students created conceptual maps |
| AnswerGarden | This app helped in brainstorm activities to find the name of the project |
| Educreations/ ShowMe | Students created video of their homework |
| StudyBlue | Students created flashcards for autonomous learning |
| Kahoot | Teachers created quizzes for learning vocabulary, grammar, and literary education |
| Word Clouds | It was used by students and teachers to make word clouds on the topic under study |
| QuickVoice | Students recorded their reading, then listened to it, and evaluate it |
| EV e-Manuais | With this app teachers and students accessed to the e-manual that replaces the manual on paper, it lets student highlight parts of the text |

Source: Data collected for this study

comments; created time lines (Timeline); took notes (Notes); wrote notes in documents (Mobile Noter); created QR codes with messages, slogans, etc. The iPad has also served to explore different subjects, to consult the dictionary, make screenshots of texts or images, and to send documents via Bluetooth. The apps for writing with correction suggestions are suitable for writing practices inside and outside the classroom, making the studentmore independent and autonomous. The more they use the iPadthe more comfortable with the tools they are and it becomes easier to use them, optimizing the time spent using technology."

In Table 2, a summary of iPad apps used by teachers and the corresponding activities that students made inside and outside the classroom is presented.

Installing applications is the responsibility of each teacher and it follows a careful choice, always bearing in mind the quality and the need of the app. The indication of the applications to be installed on the iPad, throughout the school year, is the responsibility of the institution and can be changed at any time. School decision is to start using free apps and then paid which have to obey the criteria, price/quality/need. Apps that do not require registration are privileged because it makes the process more user-friendly and fast.

## Teachers' Perception on the Use of the iPad in the Classroom

The main focus of the program in this pilot year was to explore how the iPads were integrated and familiarized. It was important to know their impact on the approaches and motivations of teachers. Table 3 focused on how teachers perceive the use of iPad for learning.

**Table 3** Teachers' perception on the use of the iPad in the classroom

| Items | Scale | Participants ($n$ = 11) | |
|---|---|---|---|
| | | f | % |
| Teachers were properly trained to use the iPad in class | Strongly agree<br>Agree<br>Disagree<br>Strongly disagree | 3<br>8<br>0<br>0 | 27<br>73<br>0<br>0 |
| Teachers are prepared to efficiently integrate the iPad as a learning tool | Strongly agree<br>Agree<br>Disagree<br>Strongly disagree | 2<br>8<br>1<br>0 | 18<br>73<br>9<br>0 |
| Students get more involved in class when using the iPad than without it | Strongly agree<br>Agree<br>Disagree<br>Strongly disagree | 3<br>8<br>0<br>0 | 27<br>73<br>0<br>0 |
| Using the iPad makes lessons more interesting | Strongly agree<br>Agree<br>Disagree<br>Strongly disagree | 8<br>3<br>0<br>0 | 73<br>27<br>0<br>0 |
| Using the iPad helps achieving the class objectives | Strongly agree<br>Agree<br>Disagree<br>Strongly disagree | 8<br>3<br>0<br>0 | 73<br>27<br>0<br>0 |
| It is easy to use the iPad | Strongly agree<br>Agree<br>Disagree<br>Strongly disagree | 6<br>4<br>1<br>0 | 55<br>36<br>9<br>0 |

Source: Data collected for this study

The teachers' perception about iPad use in the classroom is very positive. All of the teachers consider that they had adequate training to use the iPad in the classroom, they feel prepared to efficiently integrate the iPad as a learning tool, they think students engage more in class when they use the iPad rather than when it is not used, and they say that using the iPad makes lessons more interesting and helps to achieve the objectives of the class and the iPad is easy to use.

All teachers mentioned that they would recommend the use of the iPad in the classroom to other colleagues, because, as it was mentioned by two teachers, "It's a good tool, with an almost unlimited number of resources for the classroom." "It allows performing various activities that were not possible without the iPad. It allows to motivate students and to change the methodology of the class in accordance with the educational objectives."

When teachers were asked “What can you do with the iPad that you couldn’t do before,” they said:

- “Teacher can lead the student to discover by learning at the moment the topic is being studied and not after.”
- “Allows you to display resources to students at any time during the lesson without having to book a computer room.”
- “Allows to improvise more easily. Contents are more appealing.”
- “Allows students to construct knowledge.”

The main problems reported by teachers were:

- “When students were not yet adapted to the methodology, they used the iPad as a distraction.”
- “Lack of knowledge of applications for their subject.”
- “Inability to show what you see on iPad for the whole class, because of lack of projector in the room.”
- “Improving the sign of the Internet connection.”
- “Update of iPads.”

### Students’ Perception on Using the iPad in the Classroom

Students also completed an online questionnaire in order to obtain some knowledge about their perception regarding the use of the iPad in the classroom, as showed in Table 4. Five students answered the survey, a student of the 4th year, three students of the 5th year, and a student of the 7th grade.

As teachers, the students’ perception on the iPad use is also very positive. All students consider that using the iPad in the classroom motivates them to learn. The vast majority of students (80 %) agree or strongly agree that the textbooks on the iPad make them consult the manuals more and it is easier to write on the iPad than on paper. It was important to know if students think the iPad is a distracting tool; only one student considered that he/she was more distracted with the iPad. All students say they are very happy to use the iPad to study at school and at home.

## 5 Future Directions

It is not the iPad itself that motivates the student or improves his/her performance, what should be taken into account is the way it is used. Good management of the classroom is important for the success of such a program. The teacher should circulate among the students, controlling and helping to overcome difficulties in the activities, and whenever necessary ask students to turn off the device and draw their attention for what the teacher is saying.

The data collected in the first months of the iPad integration program as a learning tool will allow a better understanding of the benefits and challenges that this project presents to all participants. But the most important is that teachers have

**Table 4** Students' perception on using the iPad in the classroom

| Items | Scale | Participants ($n = 5$) f | % |
|---|---|---|---|
| Using the iPad in the classroom motivates students to learn | Strongly agree<br>Agree<br>Disagree<br>Strongly disagree | 5<br>0<br>0<br>0 | 100<br>0<br>0<br>0 |
| Now with the manuals on the iPad, students consult them more at home | Strongly agree<br>Agree<br>Disagree<br>Strongly disagree | 1<br>3<br>1<br>0 | 20<br>60<br>20<br>0 |
| It is easier to write on the iPad than on paper | Strongly agree<br>Agree<br>Disagree<br>Strongly disagree | 1<br>3<br>1<br>0 | 20<br>60<br>20<br>0 |
| With the iPad students are more distracted | Strongly agree<br>Agree<br>Disagree<br>Strongly disagree | 0<br>1<br>3<br>1 | 0<br>20<br>60<br>20 |

Source: Data collected for this study

a consistent, accurate view of how mobile technologies such as the iPad can help educational institutions to perform their educational mission. Mobile technologies are appropriate tools to help teachers to develop the educational process, instructing, socializing, and classifying students. Despite the many challenges that technologies like the iPad place in each class that it is used, it also opens numerous opportunities. The benefits outweigh the failures that are always there when working with technology.

With this program it was intended to find new teaching models to enhance the most of the technology that teachers and students have at their reach, enabling to obtain a quality education that is innovative, multicultural, and democratic. Although the program is in its beginnings, there are some aspects that raise some concern, including budgetary, security, and management of devices. As the number of users increases, the risk of damage of equipment and installation and purchase of apps will have to be solved in a larger scale. The emergence of technical, pedagogical, or management problems is to be expected by the institution in the future and it should already prepare their overcoming.

This project is moving toward its second phase in which it intends to begin to integrate more apps that allow students to be content producers, through the use of a simple and fast document sharing platform like Google Drive, allowing to create in the students and in the teachers a widespread routine use of technology. Teachers report that they would like to receive more training and resources to learn more, take more time to create resources, and participate in communities of practice to share experiences and ideas. The first steps of this program show that the iPad when properly used as an educational tool can play an important role in the process of teaching and learning.

## 6 Cross-References

▶ Characteristics of Mobile Teaching and Learning
▶ Design Considerations for Mobile Learning

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# Health Guidance of Children's Psychological Development

38

Fan (Linda) Liu

## Contents



**Abstract**

Since the twentieth century, science and information technology have developed rapidly. This has impacted families' and children's lives. This chapter describes the development of children's psychological and cultural health to ensure the improvement of children's physical and psychological well-being. Technology and high technology mobile devices have advantages and disadvantages in early childhood education. Teachers should balance the use of these devices and technologies in teaching.

## 1 Introduction

When a baby is born, the parents and child will live together, sharing the child's happiness and pain as the baby grows. Parents give their love willingly, and they hope their baby will be smart, lively, and lovely. They also hope that the baby will

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**Table 1** Children's stages of growth and development

| Age | Stage |
|---|---|
| 0–18 months | Infant |
| 18–36 months | Toddler |
| 3–5 years | Preschooler |
| 7 years + | School age |

Source: Kearns (2010)

excel and grow up to be intelligent and wise. Children's stages of growth and development are listed in Table 1.

# 2 Stages and Development

## 2.1 Infants and Toddlers

A child's development includes physical and psychological development. Psychological development is based on physical development, and each influences the other (Yu 1993).

### Physical Development

In terms of physical development, an infant can rise to a sitting and standing position and can pick up small objects with a fine pincer grasp (Yu 1993). From the perspective of brain and nervous system development, in early infancy, the brain cells increase in size and there is rapid growth of nerve fibers to form complex links between one another. From the sensory development perspective, a baby can focus, gaze at shiny objects, and sometimes can adjust his or her position to see objects. Their visual memory is good. A baby's eyes can only see light before beginning to hear sound or feel touch. Later they become interested in their new environment, seeing, hearing, smelling, tasting, and touching. As babies grow, they learn and respond immediately to their names, and they gradually recognize their mother and father, sounds and voices, and other people (Johnson and Puplumpu 2008).

### Brain Development

Mothers should ensure that healthy conditions exist in the womb. When babies are born, they have their first contact with their new environment. A variety of stimuli (light, sound, temperature, food, etc.) affect brain development. The brain increases in size and function. The cerebral cortex develops rapidly, the shape and size of the cells change, and the cortex area increases (Yu 1993). Gradually, the nerve fiber sheath marrow increases in length, reaching deep into the various layers of the cortex and forming complex neural connections. When the nerve cells excite nerve fiber conduction, development of the lower part of the cerebral cortex and bone marrow improves.

From birth, infants have the instinct to breast-feed, and they know hunger and fullness (that is, the development of the oral manifestations of hunger, the experience of taste, and the bloating sensation of fullness). Babies also excrete feces and urine (this is a visceral function).

After 3 months, babies begin to learn to sit with their backs straight and to kick vigorously, with their legs alternating or occasionally together. They can also wave their arms and bring their hands together. At about 3 months, babies can smile and chuckle with their parents and can cry loudly to express a need. They also began to learn to turn over in bed.

Around 6 months, babies love to explore objects with their hands and their mouths. Sometimes they will grasp a foot with their hands. At 9 months, babies enjoy exploring and start to crawl or move about by shuffling or scooting on their bottoms (this is the development of limb function). At this age, babies can call to their mother and father (this is a developmental language feature).

Babies begin to learn to walk when they reach about 1 year old. The baby expands the limits of activity with this development of sensory and physical ability. They begin seeing more things, listening to more sounds, and contacting with more objects (the sense of touch features in development). Language develops into conversation, with increasing intonation, although there are very few recognizable words. This not only improves the ability to live but also increases psychological ability and meets the requirements of actions and activities. As the sun goes down, the parent will turn off the lights and put the baby to bed. In the morning, when the baby wakes up, the parent will dress the infant and wash his or her face. Next, the parent will show the infant how to use a spoon and bowl to meet the need of hunger. After lunch, the infant will play with toys to meet the need of children to play.

The baby depends on the parent's leadership for their education and learning and development of human life functions and psychological function. Parents are the education guides for most of a baby's activities in the home.

The promotion of early childhood psychological health development is discussed in the following sections.

### Promotion of Brain Development

Brain development is important in the development of intelligence (Yu 1993). During this period, it is essential to provide adequate nutrition to supply the needs of both physical and psychological activity. Physical exercise is an important means to promote blood flow to assist brain development. Parents should create a spacious area so the infant has freedom to move about. Suggested activities include visiting a park to see flowers, trees, and animals, playing games, drawing, and reading books.

### Training the Child to Develop Hygienic Habits

Some children learn to be independent and are able to follow the parents' example, learning quickly and meeting their own hygiene needs. To encourage children to develop good habits, parents should let children wash their own hands and faces, brush their teeth, get dressed, comb their hair, and feed themselves. Many parents do not realize how important it is for the child to learn these life skills. They are so fond of their children, especially when they are small, that they insist on doing everything for them instead of training the children to do it for themselves. Children in kindergarten can take care of life habits, and parents are advised to give children opportunities to develop self-confidence through practicing life skills.

#### Cultivation of Good Behavior and Character

Some infants, as they develop self-reliance, may become too confident and self-assured. They do not want their parents' help, insisting, "I can do it myself!" and will not cooperate with the parents. This phenomenon is called the first period of resistance. Parents should encourage their child to develop a good personality and good behavior. Thus, communication is important, and parents should explain what is right and what is wrong.

#### Language Development

Infants are curious and may ask many questions: "Why?" "What is this?" Parents should be patient, as this activity increases the child's knowledge and teaches them to speak.

### 2.2 Early Childhood

During this period, a child's physical and psychological development is continuous and rapid. The physical and physiological characteristics of preschool children (3–5 years) are discussed below.

#### Physical Development

During this period, the children grow very fast in terms of height and weight.

#### Brain Development

After 3 years, a child's brain develops quickly. The weight of the brain gradually increases and brain cell volume increases. There is rapid growth of nerve fibers and an increase in branching. Complex linkages are formed and nerve fiber function continues to improve. The brain liaison bone sheath of nerve fibers substantially completes the rapid development of nerve conduction.

At this stage, as children enter preschool, they should be psychologically prepared. Parents can help by explaining to their child the benefits of attending preschool and describing the fun of participating in games and activities with other children. This orientation process should occur over a minimum period of 2 or 4 weeks. On the first visit to the school, the parents can stay with the child to become familiar with the setting and the routines. The child can be shown the colorful preschool room, with tables and chairs, blackboards, and pictures and the playground and play equipment. Children can be encouraged to meet the teachers, staff, and other children. If these processes are neglected, children can experience fear when they are separated from their parents and resist going to preschool again. Even when parents have prepared a child, the child will still sometimes experience difficulties adjusting. Then it is important for the preschool teachers and staff to recognize and address this situation.

### Cognitive Function

Cognitive function involves knowing and understanding a concept, for example, the difference between inside and outside activities. As this function develops, children can answer questions like: “What do you see?” “What is this like?” “What do you hear?” “What do you want to do?” “What do you need?”

### Emotional Function

Participating in different kinds of activities can be satisfying or unsatisfying, and may make a child happy or unhappy, willing or unwilling, laugh or cry, or be angry or calm. The psychological results can be rebelliousness and jealousy or harmony and happiness.

### Behavioral Performance

Parents and teachers should be aware of how behavioral performance can be influenced by psychology. How do children think? A child can choose to do or not do, to complete a task or not to complete a task, to learn or refuse to learn, to participate in group activities or individual activities, to complete or fail to complete.

### Social Life

To develop healthy social skills, children should learn to play and to live together happily and to understand the social rules of their culture. When, for example, children take food from other children, refuse to participate in group activities, quarrel with other children, or refuse to share toys, the parents and childcare center staff should cooperate to address these problems.

### Performance and Changes in Children’s Psychological Attitude

Psychological fear can be caused by a child’s insecurity. A child’s initial development is in the mother’s womb. After birth, the child is at home with his or her parents and feels secure there. This feeling of security is important in a child’s life. When children go outside the home accompanied by their parents, they have a carefree attitude because they feel secure. When children go to preschool with teachers and staff who are strangers, they do not know what to expect. Parents can help by encouraging their children to play with others and participate in various social activities, such as playgroups, to develop the ability to mix well with other children. Teachers should also provide guidance and help children to participate in a variety of learning games and other preschool activities. Thus, children will develop feelings of security rather insecurity, which will gradually eliminate their fear.

Although there are many games, balls, storybooks, and toys available at preschool, these distractions do not guarantee that a child will feel secure, especially after parents leave. If children have not been prepared for separation from the parent, they will find it very difficult to suddenly be left at preschool. In this situation, the staff at the childcare center should play a role in settling the children, comforting them to make them feel secure and safe.

### Psychological Loneliness

Some children prefer to play alone, ignore other children, and refuse to participate or talk with other children. They may lack facial expression and display no obvious attachment when parents leave. Loneliness can cause disorders in a child's performance. The teacher can try to arrange for such children to play with others to strengthen ties, guiding them to participate actively in many different activities.

### Psychological Rebelliousness

Some children may display infantile emotions and bad behavior. When this is accepted by the child's family as normal, it influences a child's behavior. Preschool teachers can help children by correcting bad behavior and promoting good behavior in democratic education. Parents and preschool staff should teach children what is right and what is wrong to help them develop character and maintain good behavior.

### Psychological Maladaptive

Children who don't understand their new environment may feel uncomfortable when entering preschool. For example, if they don't know where the bathroom is or where they will sleep. Preschool teachers can help the child to adapt quickly to preschool by teaching about the lifestyle in the new environment, which includes going to the bathroom, washing hands before eating, where to sleep, and where to play.

### Psychological Depression

Some children can have difficulty separating from their parent at the beginning. Usually, parents are very busy and want to put their children in preschool quickly. Yet some children cannot yet speak and are unable to adjust to the new environment. For example, if a child wants a drink and doesn't know how to communicate, this may cause misunderstanding and conflict. The child may cry because of frustration and anxiety. This situation can cause a psychological disorder. It is strongly suggested that parents teach children simple language at home. Parents should encourage their child to communicate with staff and other children before the child enters preschool. This helps promote the development and growth of the child's psychological health.

## 2.3 Problems in Early Childhood

Some common problems of early childhood are discussed in the following sections.

### Finger Sucking

Newborn babies suck, swallow, and grasp. This a physiological response when babies feel hungry. When a baby's lips hit something, the baby starts sucking reflexively. Even when a baby is asleep, he or she may spontaneously put a hand over his or her mouth and begin sucking. This is a conditioned reflex and will gradually disappear as the baby grows up.

For babies who have reached 1 year of age and still have a sucking habit, it is strongly recommended that parents help the child to stop this sucking habit. Following are some suggestions:

- To meet infants' and young children's emotional and psychological needs, breastfeeding is suggested every time the baby is hungry. Use of a milk pacifier should be limited. It is better to feed slowly to make the baby comfortable and enjoy the feeding time, which satisfies the desire of sucking reflexes (a psychological need).
- Feeding and cuddling is good for meeting babies' emotional needs.
- After feeding and sleeping time, parents can give toys to babies to play with to keep them busy playing and distract them from the sucking habit.

### Feeding Problems

Some children have difficulty eating. They can develop eating disorders, where they do not eat properly or vomit after eating. This may be caused by a poor physiological function. Sometimes it is necessary to feed slowly and teach them to eat slowly. Every infant is different; some infants learn new things quickly and some do not.

### Children with Strong Self-Will

Parents sometimes complain about children who are naughty, rebellious, and say "no" to almost everything. And, of course, parents want obedient children who are easier to handle. Some children are of the active resistance type and are very stubborn, often saying, "No, I quit, I am not going to do it!" Other children are negative confrontational, and they sulk and complain.

When faced with unreasonable demands by children, parents should guide them to the right behavior. When parents can't accommodate unreasonable demands by infants, parents should cooperate to answer the requirements of infants and young children. For wayward children, the following practices are recommended:

(a) Transfer target or storytelling
(b) Cooling method
(c) Comparative guide
(d) A no-hitting approach

### Managing Bed-Wetting

It is common for children to wet the bed in a childcare center during sleep time. Enuresis usually is caused by psychological or other factors, including a family history or genetic factors, bladder function, or anxiety.

Options for solving this problem include

(a) Adjusting the eating and drinking schedule.
(b) Establishing a reasonable lifestyle and routine.
(c) Not letting children get too excited before sleep time.
(d) Not punishing children before sleep time
(e) Reminding the children to go to the toilet.

### Pay Attention to Children's Curiosity

Children grow every day and they become curious about their surroundings. They imagine the nature of the world and ask many questions, such as, "What is this?" "Can rain drown trees?" When children listen to stories, they can imagine the characters in those stories. When children listen to the music, they can follow the rhythm of the music. Imaginary play is very important. These psychological activities are part of almost all kinds of activities, and learning activities, music, and painting are conducive to the development of intelligence and psychological development.

## Cultivate the Preschool Child's Psychological Health

### Organize Games and Activities

The majority of children spend most of their time playing and play is a major form of social interaction and development and learning. Playing games helps children develop friendships and emotions, teaches focus and concentration, and promotes learning and physical exercise.

In individual play, there is no peer socialization but children cultivate concentration and development of their intellect and imagination. A child playing with building blocks may make a house, a tree, and a road, and use cars to go on the roads. If you ask the child why small cars go slow, the reply may be that when the small cars travel over the bridge too fast, the cars might get into an accident and fall off the bridge. In this case, this child is thinking and trying to find the answers.

Sometimes when several children play together there is no organization or common game; rather, each child has their own idea and they are happy to play alongside one another. In cooperative play, each child plays a different role in the group. In preschool, some play is under the guidance of the teacher in organized group activities with certain rules for the game. The children must comply with the rules of the game. Cooperative play can cultivate the spirit of collaboration with peers and teach respect for other children. Sharing ideas and interacting with other children improves children's ability to understand and fosters children's psychological development.

**Fig. 1** A student playing iPad in preschool (Source: from this study)

### Establish Good Family Relationships

Children need parental love and kindness to make them feel safe. Even subtle changes in a parent's feelings may affect a young child's psychological development. Thus, family harmony, mutual love, mutual respect, and mutual understanding are indispensable for a child's psychological health. For example, parents who are angry and impatient may make a child timid.

## 3 Modern Science and Technology in Early Education

Many parents use the smartphones, iPads, and computers and allow their children to use technologies. Parents want their children to know and learn these technologies at an early age. They want their children to become more intelligent and more skilled. Figure 1 shows a student (5 years old) playing with an iPad in preschool.

Children's use of computers, mobile phones, and tablets such as iPads has both pros and cons (Johnson 2010). For example, children can use computers to learn drawing, music, reading, and many other subjects. The negative aspects of children's computer use include potential problems with eyesight, social interaction, and health. Excess screen time can put the brain's nerve center in a highly excited state, producing abnormally high levels adrenaline. Parents should always supervise children in using computers and mobile phones.

Early education should be tailored to children's interests, and children must be able to understand the content. Age-appropriate pictures and toys will promote psychological development and the more children can understand, the more they are interested in learning.

## 4 Future Directions

Early childhood education has two parts. One is the education in the family, which is important because the family is a child's first community. It determines a child's living habits, emotional health, culture, worldview, and ethics. If the family provides a proper education and good examples, the child will have good morals and character. If a family lacks education and knowledge, the child may have a more difficult time.

The other part is preschool education, which is a part of social education. It is a systematic and scientific method of education, where there are steps and educational methods combining individual and collective learning. A preschool teaching program is based on the psychological development of children. In addition to teaching good health and life habits, it focuses on the development of intellect, morals, and social skills. Children learning to communicate, to share, and to understand the relationship between the self and the collective in group activities. They learn through play and experience the fun and happiness of childhood.

The psychological and physical development of children begins at birth, and each child has self-learning capabilities and capacity, which are the result of human brain function and conditioned reflex. To succeed, children need a good environment, comprehensive training, educational care, patient teachers and staff, and the cooperation of parents to acquire the abilities of life skills (eating, sleeping, toileting), knowledge (painting, singing, dancing, playing), observing the natural environment (sun, air, water, flowers, grass, trees), and understanding the social environment (nursery room, sleeping room, dinner room, bathroom) and playground activities (slippery slides, springboard, seesaw, balls), as well as the way children interact with others socially (politeness, cooperation).

Technology can be beneficial for children's psychological health development (► Chap. 2, "Characteristics of Mobile Teaching and Learning"), however, it also has disadvantages for early childhood development. Teachers should balance the use of tablets and smartphones during early childhood education.

## 5 Cross-References

► Characteristics of Mobile Teaching and Learning

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# Mobile Teachers: Becoming Professional Mobile Educators in the Marketization of Education

39

Athena Vongalis-Macrow and Ruth Arber

## Contents



**Abstract**

The movement of educators, from local systems into international education systems, underscores an increasingly important development in the internationalization of education. The chapter explores the experiences of educators creating mobile careers in education by working outside their local education systems. Drawing on Urry's (2004) concept of mobility, this chapter explores the mobile professionalism of teachers working outside their local and national education systems. The chapter aims to theorize the concept of mobility as it applies to teaching professionals as they shape their professional and private spaces to construct mobile professional identities, knowledge, and practices. The chapter will explore case studies of eight mobile educators with an aim to capture their mobility trajectories. These trajectories will be critically discussed as a way to explore both the motivations that drive educators to become mobile and the meanings that shape their knowledge and practices as they negotiate successive international contexts. Shaped by the vastitudes of cultural and

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gendered identifications and variegated agency, mobility has differentiated consequences for teacher professional identities, career trajectories, and professional practices. The mobility of educators presents challenges for teacher education what counts as their professional knowledge in the "disorganized capitalism" of international education.

## 1 Introduction

In the early twenty-first century, schools and higher education institutions have been transformed by technological innovation and global interconnectivity (▶ Chaps. 2, "Characteristics of Mobile Teaching and Learning", and ▶ 19, "Tutors in Pockets for Economics"). The mobility of educators across international education systems underpins the cultural and educational flows which integrate local and global interconnections. The mobility of educators has consequences for the ways in which educational theories and practices can be understood in globalized education systems that vie for educators and educational expertise.

Within a growing international teaching marketplace (Bryan 2007), Australian teachers and practitioners are in demand and can be found working worldwide in international school contexts, as language teachers, subject specialist, and administrators (Townsend and Bates 2007). The demand for locally trained Australian educators is particularly evident from recruitment agencies and companies seeking to headhunt locally trained teachers to develop international educational expertise, as well as seeking those teachers with international experience and international knowledge (Widegren and Doherty 2010). The growing international demand and movement of teachers has consequences for the teaching profession and how, as mobile educators, these educators sustain their knowledge and practices within a changing landscape of differentiated education systems.

The movement of teachers, from local systems into international education systems, underscores an increasingly important development in the internationalization of schooling, governance, curriculum and assessment, and also teachers and teacher professionalism (Arber and Blackmore 2007–2011). The internationalization of the teaching profession and the mobility and increasing cosmopolitanism of labor, ideas, and finances generally point to a growing trend for teachers to become more mobile and join the mobile international workforce (Rizvi 2009; Rizvi and Lingard 2010). However, the international demand and movement of teachers has occurred without much critical review. The movement of teachers from a local system to international systems has repercussions on local notions and practices of professionalism, professional development, standards and regulations, and professional identities (Blackmore 2010). Teachers' mobility, and its consequences for teacher professionalism and identity, is an area requiring more comprehensive research.

This chapter examines the concept of mobility Calhoun (2002) as it relates to the movement of local educators into international teaching contexts. Drawing on Urry's concept of mobility (Urry 2004, 2007), the chapter will critically discuss case study research of mobile teachers as a way to explore both the motivations that drive Australian teachers to teach in locations outside of Australia and the meanings that shape their knowledge and practices as they negotiate successive international contexts and create a "mobile life" (Urry 2002).

## 2 Background: Mobility and Educators

The term mobility refers to "movement driven social science in which movement, potential movement and blocked movement are all conceptualized as constitutive of and constituted within economic, social and political relations" (Urry 2007, p. 43). As distinct from social science that unpacks the social context within a specific space, movement-driven analyses focus on transition space, which is constituted within the social space or context, in addition to the paths and transitions from one context to the next (Kevin et al. 2006; Urry 2000a, b). Rather than each context being the focal point of analysis, the transition space or the "in-betweenness" (Urry 2007, p. 39) is of interest. It is within the expanding markets of international education that mobile educators negotiate their mobile life. These negotiations are varied depending on the professional and their motivations; however, the demand for teachers in expanding markets is a key driver of teacher mobility. Some engage in mobile life as a condition of the practices of consumerism (Rizvi 2010), which shape and are shaped by social institutions, cultural practices and the sense of identity (Rizvi 2010).

Professional identities are interactive in that they are acquired, performed, and mediated within the everyday of diverse institutional, cultural, and ideological contexts. In addition, the transformative effects of digital change and a globally networked society and their consequences for institutional contexts and day-to-day lives put pressure on the ways professional identities themselves are negotiated (Rizvi 2010; 2011). The move to adapt some practices, to reform others, and to negotiate the harmonies and turbulences of everyday work spaces impacts on the acquisition and development of professional skills and knowledge. According to Urry (2007), "mobility systems are based on increasingly expert forms of knowledge" (p. 53); if this is the case, then as the education profession becomes more mobile, the assumption is that new expert forms of knowledge will emerge as a result of mobility. Part of the development of the mobility expertise is reconfiguring of professional identity, professionalism, and professional practice as these aspects of an educator's work are developed within a mobile context. Mobile educators are experiencing change in how they develop their careers and their work, and this professional change is being shaped by the different economic, social, and political relations that, in turn, shape international education systems creating demand for particular knowledge and practices.

A mobile life provides opportunities for mobile professionals to shape their own patterns of mobility. This is more so for educators because the education profession has yet to develop international benchmarks that regulate teachers' professionalism. While organizations like the World Bank have sought to set up international standards for assessing teacher quality (Vongalis-Macrow 2012), these are recommendations attached to development conditions of borrowing nations. Teaching qualifications are recognized internationally and international teaching training, such as International Baccalaureate teacher training programs; however, beyond the qualification, there is no regulatory body or group who oversees the quality of teachers' practices internationally. From this perspective, the negotiation of teachers' careers trajectories and practices are mostly negotiated by the individual teacher and the host context.

## 3 Researching Mobility of Educators: Mobility and Methodology

Exploring the trajectories of mobility of eight teachers teaching within the international education system as they shape new identities and new practices requires a depth of conceptualization and theorization (D'Andrea et al. 2011). One of the criticisms of mobility research is that it lacks depth, for example, as subjects traverse borders and locality, they recode and update their understandings, identities, and practices (D' Andrea et al.); therefore a methodological challenge is to capture their recoding and changes in understanding (Büscher et al. 2011). In order to overcome a methodological gap, the methodology draws on two specific analyses. Identity will be theorized conceptually by drawing on the narrational practices of the participants to explore notions of identity. The narrational practices evoke the mobile teachers' sensemaking in describing the contingent and practical domains of experience in relation to their everyday life and professional-cultural experience. A social cultural analysis of teachers' narrational practices examines the interactions of professionals and how these find and create meaning in relation to others. These encounters shape their professional identity. The mobile teacher agent "in situ" negotiates his or her identity, and the everyday practices of the experiential everyday as it is constituted within the unequally empowered, turbulent institutional, and normative contexts of the local which underpins the processes of transculturalism (Rizvi 2010; Elliott and Urry 2010; Vertivec 2001). These changes and the personal and social knowledge and activities which shape and are shaped by them describe the complex interrelation between the spaces and places in which the mobile teacher sites their overseas teaching lives.

The critical discussion of professional skills and knowledge will take a more specific analysis which focuses on the teacher's agency, specifically on the actions that shape capacity. As embodied agents, teachers negotiate their professionalism within an already structured social and professional world (Bourdieu 2007). The examination of mobile teachers' agency can demonstrate what particular skills and knowledge are valuable in negotiating their professionalism within international contexts. A focus on teachers' agency provides a framework for exploring the ways that professional knowledge and skills of educators are performed and in demand. Emirbayer and Mische (1998) define agency as "the capacity of actors to critically shape their own responsiveness to problematic situations" (p. 971). Drawing on agency theory (Archer 1995, 1996; Nash 2001; Vongalis-Macrow 2004, 2007), professional practices evidenced through agential actions can be examined in order to clarify the actions and activities of mobile educators, which are negotiated in order to ascertain which ideas, knowledge, and practices are relevant to the transnational exchange.

## 4 Research Design

The research involved developing a detailed questionnaire in order to generate essential knowledge about teacher mobility. This was followed up by in-depth interviews with the research participants. The questionnaire consisted of 36 questions seeking biographical and demographic information and then contained a series of open-ended questions in which the participants were asked to provide details about their local cultural context, the school, school operations, their students, their role, and questions outlining their experiences. The questions contained items which explored how each teacher understands the teaching contexts in which they work in terms of students and pedagogies and of codes of conduct, professional practice, ethics, skills and knowledge, how teachers understand their professional identity as they negotiate those contexts, and how teachers understand the impact of their experiences in terms of their future work as educators both inside and outside of Australia.

The questionnaire was administered to eight Australian teachers currently teaching overseas. The participants were also interviewed about their experiences, and these interviews formed a narrative of the participants' mobile teaching experiences. The interviews delve deeper into their teaching experiences and practices while being mobile. The participants were able to narrate their story, responding to open-ended and semi-structured questions about their experiences and how these influenced their teaching and notions of identity. The interviews were transcribed and formed the basis of narrative analysis of educators' beliefs and ideas to construct notions of a mobile professional identity.

In order to capture mobility trajectories of a group of educators, the research specifically focuses on the differentiated tracks of the educators as they pass through particular stages in constructing their mobile career and how they shape and create the "in-betweenness" (Urry 2007, p. 39). The stages are:

- **Impetus:** motivating factors to undertake mobility. The professional makes decisions about their personal and professional life and whether mobility enhances their personal and/or professional goals.
- **Recruitment:** engagement with occupation possibilities. The professional becomes mobile dependent on skills and knowledge that are in demand. Teachers need to have particular skills and qualifications to enable mobility.
- **Professionalism while mobile:** constructing professional identity and practices while mobile.
- **Future mobility:** future prospects and how mobility is reimagined as a condition of future work.

The mobile life of educators, captured through the four stages, provides a structure for examining the mobility as a process of movement inclusive of the potential for movement, in this case the impetus to become mobile. The stage also includes potential for blocked movement, such as the recruitment process, as this stage is also a factor in whether mobility is enabled or disabled. The analysis of professionalism will unpack what happens to the educational expertise while educators are mobile and how professional identity is reshaped. This analysis will critically analyze the narrational practices of the respondents to investigate professional identity, and drawing on agency theory as defined by Archer (2004, 2007), the analysis will also critically discuss how educators draw on and use their professional skills and knowledge while mobile.

## 5 Results

The table outlines the basic demographic information of the eight participants in this study (Table 1).

Eight participants were teaching in seven countries inclusive of the UAE, Indonesia, Taiwan, China, Hong Kong, and Thailand. The participants ranged in age from late 20s to 70 years. Only four of the teachers had preservice teaching qualifications; all the participants had undergone some kind of teacher education particularly in English as a foreign or second language. Three of the participants were teaching English at universities, attended mostly by local students, and two of the universities are private. Two participants also taught other subjects, including Math, Science, and ICT at primary schools. One of these schools is attended by mostly local students and the other school is a dual-language school attended by both local and international students. One participant taught only Mathematics at an international school in Asia after teaching for a year in London. Three of the teacher participants have also another position apart from teaching. One respondent is head of International Affairs and Scholarship Program at a university, while the others

**Table 1** Participants

| Name | Gender | Age | Location | Professional position |
|---|---|---|---|---|
| 1 | M | 71 | Jakarta, Indonesia | Head of intern, affairs and scholarship program |
| 2 | M | 36 | Thailand | Assistant principal, international school |
| 3 | M | 39 | Hong Kong | Primary teacher |
| 4 | M | 28 | Banda Aceh, Indonesia | English Language Center |
| 5 | F | 42 | Xian, China | English second language teacher |
| 6 | M | 37 | Taipei, Taiwan | Aquatics program director |
| 7 | F | 36 | United Arab Emirates | Senior curriculum specialist in English |
| 8 | F | 51 | Abu Dhabi, UAE | Head of faculty, primary school |

Source: Vongalis-Macrow, Arber (2013)

**Table 2** Reasons for mobility

| Participant mobility | Reasons |
|---|---|
| 2 | Other business to teaching |
| 3 | Travel |
| 3 | Teaching |

include an assistant principal in an international school and a head of faculty for primary level at a government school.

Two remaining participants did no teaching work. Although accepted to teach, one respondent prefers to work as an English Curriculum Specialist at the local government department with responsibility to give advice to teachers from KG to G12 at government schools for various subjects, including English, Mathematics, and Science. After teaching overseas for many years, another participant holds position as a director, whose role is to oversee swimming pools, aquatics and water safety curriculum, and programs for all students from kindergarten to G10 at an American school in Asia. The local students attending this school mostly have international associations, for example, one parent has foreign passport and high education aspiration of going to the USA for their degree.

### 5.1 Impetus: Motivation for Movement

The motivation to teach overseas and begin mobility is varied between professional and personal reasons. Two of the participants were motivated by other professional opportunities which they transferred to teaching out of need and desire. For one participant, their business opportunities fell through and teaching was a fallback. Another, once a chef used to mobility as part of the professional expectations transferred this expectation onto teaching. For three participants, mobility was motivated by personal desire to experience different cultures and locations. Two participants were motivated for professional reasons, to seek more opportunities within the teaching profession (Table 2).

Motivation for mobility is also tied to the perceived benefits of mobility as distinct from remaining local. The professional benefits among the participants are highlighted more than the lifestyle benefits. For example, the professional benefits included flexibility in working conditions; greater experience with colleagues, students, and communities of different culture; greater financial rewards; and greater professional opportunities. Only two of the participants emphasized lifestyle benefits such as new cultural experiences. It appears that initial motivation for mobility is consolidated by professional benefits once mobile.

### 5.2 Recruitment

As students were sampled from a master's level education course, all have similar education background, mostly in TESOL as a second degree. However, not all of them have teaching experience before teaching overseas and only four teachers had teaching qualifications accepted within the Australian school sector. Three participants applied their teaching job overseas only using TESOL and online TEFL certificates; two of them had never taught in Australia. Among six participants who have teaching experience both at schools and TAFE sectors in Australia, only four who actually work as a teacher/ teaching professionals as their first job overseas. One participant was a business man and another was a chef when they moved overseas. The teachers found their placement through the use of the Internet, social contacts, and letters of introduction. The "rites of passage" to obtain employment differed strongly and may have reflected the different standards applied within different countries and different kinds of educational institutions.

Both teachers in Indonesia said that they applied, one through a friend, and were then given the position. Teachers going to China and Thailand were interviewed. Those teaching in the Emirates and in Hong Kong and Taiwan sent through an official resume and went through an intensive interview process of two or three interviews before being accepted for their position. The recruitment process can vary depending on the site for mobility; however, the professional skills and experience of the teachers were key in their mobility capacity.

### 5.3 Professional Practice: Narrational Analysis of Professional Identity

Although the sample was small, gender was consistently identified as an influential factor shaping the scope and value of the mobile experience and the development of mobile professional identities. Affirming the work of Pavlenko and Piller (2008), women described cultural and language constraints as influential in shaping the quality of their mobile experiences, differently to men. In particular, women described the ways that cultural and structural mechanisms impinged on their day-to-day lives and had different consequences for the development of their careers and professional identities, living differently to men.

When asked about the ways that they understood their cultural identity, for instance, men described themselves as agents whose cultural identity was chosen and malleable. Participant three understood his identity as becoming increasingly fluid explaining that now his identity gets often confusing especially the longer he stays away from his home. He stated that he felt detached from his home even though he had experience moving locations when he was younger. He questioned the location of home.

The survey showed a difference between the ways the men and the woman were satisfied in their teaching context. Men regularly reiterated that they were excited in their work and in their community location. The male participants were more likely to describe the idyllic nature of their location, citing cultural difference, the beauty of the location, the language, and the relative lower cost of living as key factors in their satisfaction. The women also cited similar factors; however, they also included the personal nature of their experience as it offered self-discovery in new cultural contexts. Women reflected that the experience would make them more appreciative of their friends and homes. Nevertheless, while all of the women, bar one, were satisfied in their present teaching location, they described that they were often lonely missing family and friends, feeling a sense of isolation. They did not always understand how things work and found different notions of politeness and the emphasis on specific dress difficult. However, this sense of identity restriction was mitigated by statements which essentially valued the opportunity to do something worthwhile and make a difference.

Men and women answered questions about the challenges and opportunities they faced in relation to language and culture differently. Male participants based in Asia commented on the opportunity to learn, especially cultural learning and language learning. They highlighted experiences of cultural festivals and traditions such as weddings and cultural celebrations as indicators of more deeply experienced cultural differences in how local people interacted. They singled out respect and tolerance as operational values in social relationships and suggested that these values contributed to feelings of safety and security within the local contexts. Participant three noted that despite not being fully cognizant of the cultural norms, his attitude to embrace the differences was fostered by the opportunities to participate in the learning and in the understanding of the different culture. He commented that the context can be challenging to foreigners if they do not embrace both the language and culture of living abroad.

The women had quite different concerns. Participant five in China regretted that she did not learn more Chinese language – although she had always been fascinated by China. However, the cultural differences were more difficult to overcome and the cultural gap too wide. The participant was more intent on maintaining her identity outside her professional role. It could be argued that her professionalism drove her mobility, and despite personal issues in adapting to the host culture, her main motive to remain a mobile teacher overcame any cultural concerns.

In the UAE, participant seven saw the prospect of being exposed to new cultures, languages, and religions as a great opportunity. Still she was challenged by the multifaceted nature of culture and the realization that an Australian way of doing things was not the only way. She was more open to her cultural identity being more influenced by her experiences. She became aware of the keen differences in culture between the UAE and her Western values. Participant eight also found that culture framed her world in new ways, but she was more open to tackling challenges and taking personal responsibility for understanding and working with very different social and cultural values.

Whereas the men argued that community participation was a matter of becoming more involved with the community, participant eight understood that the successful development of her professional identity demanded that she showed consideration for the norms and structures which defined her work context. The behaviors exhibited to ensure professional success in the UAE included listening to colleagues, seeking advice, joining committees, and ensuring that in all negotiations, she remained calm and respectful.

Participants two, three, and six agreed that they had developed professionally through their overseas work. They discussed their aspirations for leadership as a professional goal. Participant six described how his focus as a teacher and his professional identity had changed since he had left Australia. The supportive school community in Asian international schools, he explained, had made him feel challenged and important and allowed him to grow professionally. Being a mobile teacher had presented more professional learning opportunities that he believed these had improved the quality of his teaching. Participant two concurred, also commenting that he had grown professionally through the opportunity to develop his teaching and leadership skills within schools. Despite a lack of teaching qualifications, participants one and four revealed their mobility aspirations. Participant one saw his future as involved with student exchange and double degree program as well as enjoying traveling and meeting new people. His aspiration is to continue his professional growth and be integral to providing education for his prospective students. Participant four had similar future plans to develop his professionalism and continue teaching. Generally, all the male participants indicated that the experience of being a mobile teacher had enabled them to develop professionally and for some, to pursue ongoing career goals within a mobile career.

All of the women wrote at length about the ways that they felt changed by the experience – and these changes took quite different forms to the men. Participant five, who did not have preservice teaching qualifications, had recently returned to Australia and was trying to find work teaching English to tertiary students. Participant five felt empowered by the new professional knowledge; however, as a specialist English teacher in educational markets that draw significant numbers of foreign teachers teaching English, she felt disappointed that her specialization was not considered higher status. She commented that English teaching was associated with a backpacker and tourist teaching.

She was disappointed that her overseas experience did not seem useful as she looked for work in Australia; however, the experience of mobility remained with her and she indicated a return to mobile teaching in the future. It appears that participant five's professional identity was more representative of her in the international context rather than in Australia. Despite a disruption to personal identity, the role of the professional identity became the main conduit in shaping mobility and future employment. In other words, the individual is able to put aside personal responses to culture and change in order to progress and grow their professional capacity.

Participant seven also indicated a future for her as a mobile teacher. The participant stated that teaching in a new context initially challenged her identity as a great teacher and had implications for how she felt professionally. Rather than accepting a professional setback, she continued to feel optimistic about the opportunities of mobility. She stated that her present work, as a curriculum advisor within the UAE, would provide an avenue for further work in educational development and would like to explore the work of NGOs and international organizations in the area. The challenge to her professional identity, nevertheless, opened up new career and professional opportunities for the participant. Rather than accepting that her professional identity is that of a classroom teacher, in her new context, she sought ways to build on her professional capacity and credibility.

Unlike the men who agreed that they had consolidated their professional identities in their overseas work, participant seven found that she had to build more skills and in doing so understood the work of teaching as not being perfect and certain, but she understood her professionalism as uncertain and responsive to contextual and cultural challenges of working within a different education system. She had to become more familiar with different ways of having professional conversations and dialogues, thus being more mindful of subtle cultural differences in the way professionals interact and participate in exchanges. She particularly noted the need to be aware of the cultural norms that needed to drive exchanges. As a Westerner living in an Islamic culture, she noted that arrogance of a Western teacher had no place in the context and in the profession. She noted values such as tolerance and patience as critical cultural learnings.

Within that frame, she negotiated a strong and very successful professional identity. Participant seven was being considered to take up a vice principal position of the next academic year. Her aspiration was to do a Doctorate in education with a focus on education reform and business opportunities in the UAE. Like the men, she felt that overseas experience had prepared her well for a number of high-powered positions, and with her knowledge, she considered herself highly marketable in international education. Her future aims were to remain mobile and seek employment in an emeriti teaching university.

The way in which women (and men) negotiated the surrounding context was different. The mobile teacher agent "in situ" negotiates identity, and the everyday practices of the experiential everyday within the unequally empowered, the multidimensional, and contradictory processes (Rizvi 2010; Elliott and Urry 2010; Vertivec 2001). In creating a professional identity within new international contexts, the professional is managing economic, cultural, ideological, and technological flows that are part of the new mobilities (Urry 2007). In fact, participants five and seven had negotiated very successful career paths in ways which both paid attention to and moved beyond the contextual factors which framed and mediated their professional development. When asked to speak about their everyday lives as teachers in localities different from those in which they were trained, men described the development of their professional identities differently than did the women. Men described the normative and structural contexts of their day-to-day experience as assessable after appropriate learning and their professional identities as matters of confidence and choice. Women described the ways the material and unequally empowered nature of the surrounding cultural and social context impacted on their everyday lives.

### 5.4 Professional Practice: Agentic Analysis of Professional Knowledge and Skills

The mobile professional teacher negotiates their professionalism in an already structured work and professional context (Bourdieu 1997, 2007). How teachers negotiate their professional experience is evidenced by the particular skills and knowledge that they draw upon in the transnational exchange. The identification of professional skills and knowledge that arise out of mobility can be identified and clarified through an analysis of the educators' agency. By examining the conditions of agency, especially focusing on how and when agency is enacted, actions relevant to the navigation of mobile professionalism can be identified. The focus on agency (Archer 2004) helps to make visible the phenomena of mobility because how people exert their agency (Biesta and Tedder 2006) is by engaging specific professional skills and knowledge that facilitate mobility.

Regarding the impetus to become mobile, the personal autonomy of how each teacher moves into their current place of employment varied. The majority of the participants, six out of the eight participants, were seeking mobility for professional reasons. The impetus for mobility is for professional reasons reflecting strategic choices. Urry (2003) refers to the roaming talent that characterizes mobile professionals. In addition, the participants expanded on their strategies. For example, participant five identified that a motivator for choosing a career as an English teacher was that it was a marketable professional option that would enable her to teach overseas. All but one of the examples indicated a desire for greater responsibility and leadership in their teaching career. In other words, their actions were guided by the teachers seeking more professional opportunity in their teaching career. Their international postings were stepping stones to furthering teachers' careers and become marketable in international education.

The professional impetus for mobility suggests that it is not only the experience in itself that the teachers sought, but they attributed a value to the experience in terms of its contribution to career progression. Rather than roaming talent, which suggests that the emphasis is on the roaming or mobile experience, our cases rationalized their mobility in terms of career progression and enhancement. Participant one provides a general example of career mobility. As a teacher, he had aspirations for leadership and stated that he would remain mobile to purse his career goals. Similarly, participant three stated that he would continue his mobility and move into middle management. Participant three states that he will also remain mobile in pursuit of teaching experiences in different contexts.

Regarding professional knowledge and practice, the participants were asked to explain the qualities of a "good" teacher that may be in demand to work overseas. In addition, they were asked how the qualities of a "good" teacher could be demonstrated. Participants all identified teacher performance measures as measures of quality. Specifically, seven of the eight participants identified that teaching performance, as evaluated by students, is a critical negotiating indicator. Therefore, qualities of a good teacher included practices that focused on student learning and student outcomes. How each participant underwent evaluation of their skills and knowledge varied. In some cases, the evaluation included a range of stakeholders: students, teachers, heads of departments, and human resources. At the very least, all participants were expected to have their teaching skills and knowledge evaluated as part of their employment. The participants indicated that being able to demonstrate good teaching was tied to performance bonuses, contract negotiation, staff rating, and a reflection of dedication.

Critical professional knowledge for mobile educators includes the capacity to undergo evaluation and assessment of their teaching performance. Student achievement was identified as a key indicator of teaching by three of the participants. They understood that performance appraisal was evidenced from the students' results, and they believed that this indicator for teaching standards was professionally sound.

All the participants had theoretical expertise in outlining key conceptual, practice, and context knowledge that underpins "good" teaching, and the necessity to demonstrate and be evaluated on performance is a key factor in mobile professionalism. Urry (2007) suggests that mobility evokes expert forms of knowledge, and the research suggests that being able to demonstrate "good" teaching, largely through student achievement outcomes, is a necessary performative skill among mobile teachers in order to confirm their talent and value and negotiate their value and marketability. The notion of performance tied to salary is controversial in many national systems; however, this notion is depoliticized for the mobile educator, and instead it is a point of negotiation tied to remuneration, opportunity, and professionalism.

The mobile teachers in this study mediated their professionalism through regulations set by the school or educational context in which they are working. For example, when asked about Codes of Conduct, which are standardized in national teacher registration and are implemented to frame the conduct of the professionals, each participant referred to local codes of conduct either determined by the school or by the broader cultural context. For example, in some contexts such as Aceh, Sharia law framed the code of conduct. However, in other contexts, schools had a very detailed code of conduct such as working days, times, extra duties, preparation expectations, classroom management, professional dress, supervision, and teacher discipline procedures. The varied nature of how teachers shape their code of conduct to suit the context means that they are required to be adaptive in order to meet the obligations that shape their teaching and their employment conditions. This requires a developed self-reflexivity, "to direct attention and intervention toward their own patterns of response" (Emirbayer and Mische 1998). A developed self-reflexivity sensitive to the subtle and overt cues that are crucial for professional and private adaptation in diverse cultural contexts is a new knowledge specific to mobile teaching professionals.

## 5.5 Ongoing Mobility

The respondents had mixed feelings about returning to Australia. The main concern is that they were unsure about their recognition of their international experience. They express a concern about how their mobility is represented. One participant noted that they felt more mature professionally and as such believed that they were a better teacher; however, she was uncertain about her prospects. The return to Australia nevertheless remained as a possibility for all of participants. The main motivation was to keep their teacher registration current in their local contexts.

However, it appears that upon returning to Australia, the negotiated identity and new knowledge gained from the mobile experiences would be undervalued in Australia. However, participants noted that despite more multicultural understandings in their native countries, they were not ready to forgo the cultural diversity offered by being mobile. The participants allude to notions of multiculturalism in order to imagine an educational space in which their cultural knowledge and professional knowledge can become of their local professional identity. It appears that while the rhetoric about international teaching and globalization of education have consolidated in educational theorizing, the practices of teacher mobility demonstrate that teaching is still a largely localized professional construct. However, as the teaching market place continues to grow with the increasing demand of education in middle-income and developing nations, the mobility of teachers will become a growing phenomenon, and local constructions of professionalism will need to reappraise the value of mobile professionals and their attractiveness to not only international contexts but also to local contexts.

## 6 Future Directions

The growing phenomenon of teachers becoming more mobile is in response to a greater demand from international education markets. However, becoming mobile and creating a mobile life mean that educators are negotiating their professional skills within varied economic, social, and political contexts (Urry 2007). The study of educators' mobility draws on a distinct form of social analysis that not only unpacks what happens to educators once they are working within different contexts but also focuses on their transition space or the act of movement from one workplace to another. Mobility is not a process open to all educational professionals as there are transition points in the mobility process. In order to become mobile, professional educators need to reshape and reconfigure to overcome how they create their professional identity and professional practices so they are adaptable to new contexts. Their identity and practices remain fluid as they move between and in international work spaces.

This exploratory research interrogated the mobility experiences of Australian teaching professionals as they reflected on their professional experiences working outside of Australia. The examination of teacher experiences in situ suggested that their professional trajectories could be tracked in terms of five points of mobility, each of which captures a point of boundedness that requires the mobile teacher to review their professionalism within a context (Warf and Arias 2009). Negotiating their professionalism means that they adapt to the normative and structural terms and conditions of working in different social and cultural contexts. The cultural and social norms which construct cultural and, in particular, gendered identities impacted differently on women than they did for men. Although the sample was limited, we contend gender influences the way that educators formulate their professional identities and develop their career trajectory. For some teachers, the mobile experience was empowering, whereas others found the experience challenged their career trajectory and their professional identities. These differences warrant further and more extensive examination. The understanding that social and cultural features of different contexts are important but that they are negotiated differently is an important one for teacher education as more teachers seek mobile careers.

The mobile career creates capacity for personal autonomy for mobile teachers. In accepting the challenges of negotiating the value and potential of their professional knowledge in the "disorganized capitalism" of international education, what emerges are expectations of demonstrating the performative skills of teaching. Teachers' professionalism depends on demonstrating teaching capacity and having their performances undergo evaluation as indicative of their professional capacity and value. This performative aspect of teaching privileges teaching practices that are linked to student learning outcomes. This indicates that professionalism is being rescripted away from perhaps a more critical professionalism, where teachers have a greater influence of their pedagogical practices and curriculum creations. Mobile teachers tend toward a more performative professionalism.

Overall, the study showed the gendered influences on mobility, the variegated disruptions to professional and personal identity, the performativity of professionalism, and the under-recognition of mobility as a career trajectory. As the juggernaut of international education continues to grow, the research serves as a reminder that teachers must be cognizant of the social and cultural circumstances in which they might teach and be provided with the skills and knowledge to work with them and to understand the ways that these are changed, impacted differently, and negotiated in situ and in process.

## 7 Cross-References

► Characteristics of Mobile Teaching and Learning
► Tutors in Pockets for Economics

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# Mobile Technologies for Teaching and Learning

# 40

Rajiv Ramnath and Ajay Kuriakose

## Contents



**Abstract**

Mobile information technologies can unshackle students from desks and classrooms and allow them to learn on the go. They can explore and consume information, record their learning, and collaborate with mentors and with each other at any time and in any place. Further, because the mobile device knows user location and identity, learning can be location and situation based as well as personalized to the user. In this chapter, we describe current mobile computing technologies and their use in teaching and learning. We project how mobile technologies will evolve in the future and examine – using the various theories and processes of learning as a lens – how the growing affordances of these technologies will impact student learning and education in the future.

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## 1 Introduction: How Mobile Technologies Can Support the Teaching and Learning

Fischer and Scharff (1998) suggest that "New technologies and learning theories must together serve as catalysts for fundamentally rethinking what learning, working, and collaborating can be and should be in the next century." This idea is the foundation for this chapter. Thus, this chapter will discuss a selection of the seminal learning theories, styles, taxonomies, and processes. It then presents the main mobile technologies in vogue and describes how they are currently being used in teaching and learning. Finally, it will project these technologies into the future and examine, through the lens of the learning theory presented, how the capabilities and affordances of mobile technologies can enrich education and improve learning outcomes.

## 2 Applying a Theory-Supported Approach to Mobile Learning

Before discussing how mobile technologies may effectively help learners, it is important to understand how learners learn, how they are taught, and how teaching and learning is assessed. To that end, some of the foundational elements in the theory of learning will first be covered. This will be followed by an explanation of and a discussion on how mobile technologies may help, using learning theory, teaching methods and learning processes as the framework for discussion.

### 2.1 Types of Learning and Learners and the Cognitive Processes of Learning

Learning has been broadly classified as follows:

- Task-conscious or acquisition learning (Rogers 2003): Acquisition learning is seen as going on all the time. It is "concrete, immediate and confined to a specific activity; it is not concerned with general principles." Here, while the learners may not be conscious of learning, they are aware of the specific task in hand. For example, project-based courses, internships, and professional practice itself contribute to this kind of learning.
- Learning-conscious or formalized learning (Rogers 2003): Formalized learning is "educative learning" rather than the accumulation of experience. There is a consciousness of learning, with the intent that formalized knowledge makes learning more conscious in order to enhance and accelerate it.

Considerable research in education has also focused on categorizing the types of *learners* – from conceptual learners, who prefer to learn using abstractions, to hands-on learners, who prefer to learn by doing. One commonly referenced body of work is Kolb's Learning Style Inventory (LSI) (Kolb 1984). In this model, learners are categorized using two axes, namely, the active experimentation-reflective observation axis and the abstract conceptualization-concrete experience axis. Learners are placed in one of four quadrants, as follows:

- *Convergers,* who believe in active experimentation as well as abstract conceptualization. For example, convergers may first think about things and then try out their ideas to see if they work in the real world or they could do the reverse, which is, experiment first and then generalize their experience into concepts. Convergers like to understand *how* things work. Convergers typically prefer to work by themselves, thinking carefully and acting independently. Computer-based learning tends to be effective with them.
- *Accommodators* learn by active experimentation and through direct interaction and concrete experiences. Accommodators do rather than think and like to ask "what if?" and "why not?" rather than "how?" Unlike assimilators (see below), they are likely to reject approaches to learning that are routine. Accommodators prefer to learn by themselves than with other people and like hands-on and practical learning rather than lectures.
- *Divergers* (reflective observation-concrete experience). Divergers take experiences as well as instruction and extrapolate and generalize their learning in multiple directions. Divergers like to ask "why?" Divergers enjoy participating and working with others. While they like interactions with others, they like these to be calm and conversational and fret over conflicts.
- *Assimilators* learn by reflective observation and abstract conceptualization. Assimilators think rather than act. They ask "what is there I can know?" They prefer lectures for learning, with demonstrations where possible, and will respect the knowledge of experts. They will also learn through conversation that takes a logical and thoughtful approach. The best way to teach an assimilator is with lectures and reading material that start with high-level concepts and then work through the details.

Note that Kolb's model of learner types is considered useful as a description of learning types; however, its use to analyze situations and provide solutions is unproven (Hunsaker 1981).

An important aspect of all learning is "metacognition," i.e., the process of reflecting on and directing one's own thinking. When trying to develop students' reflective and metacognitive skills, making students' thinking visible to both their teachers and themselves is very important. Metacognition is the basis for two types of generalized learning, as follows:

- Double-loop learning (Argyris and Schön 1978): This form of learning involves the detection and correction of error. In single-loop learning, the response when something goes wrong is to look for another strategy that will address and work within the existing governing variables. In other words, given or chosen goals, values, plans, and rules are operationalized and made more efficient rather than questioned. An alternative response is to question the governing variables themselves. This is double-loop learning. Such learning may then lead to an alteration in the governing variables and, thus, a shift in the way in which strategies and consequences are framed.

- Reflective practice (Schon 1983, 1987): Reflective practice is a specialization and refinement of double-loop learning. The capacity to reflect on action so as to engage in a process of *continuous learning* is one of the defining characteristics of professional practice. The cultivation of the capacity to reflect *in* action (while doing something) and *on* action (after completion of the action) has become an important feature of professional training programs in many disciplines, and its encouragement is seen as a particularly important aspect of educating the beginning professional.

## 2.2 Enabling Effective Learning

According to *How People Learn* (*HPL*) (Bransford et al. 2000), environments that best promote learning have all four of the interdependent characteristics described below:

1. They are *learner* centered. These learner-centered environments are those that pay careful attention to the knowledge, skills, attitudes, and beliefs that learners bring to the educational setting. New knowledge is built on existing knowledge so teachers need to uncover any incomplete understandings, false beliefs, and naïve concepts that students may have.
2. They are *knowledge* centered: Knowledge-centered environments present knowledge in a well-organized manner, so as to support understanding and adaptive expertise building. Teachers have clear learning goals that capture exactly what knowledge students will be gaining and how they can use that knowledge. There is also emphasis put on developing a strong foundational structure of basic concepts on which to build further learning.
3. They are *assessment* centered: Assessment-centered environments provide frequent formal and informal opportunities for feedback focused on understanding and encourage and reward meaningful learning. In addition to grades on tests and essays that serve as *summative* assessments that occur at the end of projects, *formative* assessments provide students with opportunities to revise and improve the quality of their thinking and understanding.
4. They are *community* centered: Community-centered environments allow people to learn from one another, by collaboration, as well as by conflict.

The HPL framework also has several recommendations for enabling effective learning, as follows:

- Make thinking visible, of both students and experts. Thus, have students engage in activities that make visible the processes of their thinking, rather than merely

the conclusions of their thinking. Model expert thinking so as to make explicit the strategies and techniques that are implicit in expert thinking.
- Benchmark the knowledge level of students. The knowledge (and misconceptions) that students enter the class with will affect their learning.
- Use contrasting cases as examples. Two examples whose differences highlight a particular point or set of points can illustrate particular points very effectively. Experts are more likely than novices to see the contrast between two complex cases with many similarities. It is best, therefore, to start with simpler cases before moving to complexity as understanding deepens.

## 2.3 Assessing Teaching and Learning

As the HPL framework recommends, assessment is a key aspect of an effective learning environment. The most well-known framework for assessment is Bloom's taxonomy. The revised and updated version of this taxonomy is (Anderson et al. 2001), which categorizes the levels of learning as the following:

- Remembering, that is, can the student recall or remember the information taught in (say) a class? Assessments for this level involve asking the learner to memorize and then define, duplicate, list, or even simply recall or repeat what was taught.
- Understanding, that is, assessing that the student can explain ideas or concepts. Here, the learner is asked to classify, describe, discuss, explain, identify, translate, or paraphrase what was taught.
- Applying, that is, assessing that the student can use the information. Here, the learner is asked to choose, employ, and demonstrate the use of the learning.
- Analyzing and evaluating, that is, can the student distinguish between the different parts by appraising, comparing and contrasting, examining, and critiquing the information taught, or can the learner justify a stand or decision?
- Creating, that is, assessing that the student can create a new information product or point of view.

While Bloom's taxonomy is intended to assess learning, Kirkpatrick's four levels of training (The Kirkpatrick Model) are an orthogonal set of levels primarily used for assessing knowledge delivery (i.e., the teaching or training). These four levels are as follows:

- Level 1: Reaction: To what degree participants reacted favorably to the training
- Level 2: Learning: To what degree trainees acquired the intended knowledge and skills from their participation in a training event
- Level 3: Behavior: To what degree trainees could apply on the job what they learned during training
- Level 4: Results: To what degree the appropriate outcomes (such as revenue growth, improved quality) occurred as a result of the training event

In a sense, Bloom's taxonomy is aimed at summative assessments (i.e., assessing the learner) as opposed to formative assessments (i.e., assessing the teaching or training), which is the target of Kirkpatrick's four levels.

## 2.4 Teaching Techniques

Terrell (2005) has a simple categorization for activities that can be incorporated into a learning system: auditory, which includes listening and speaking; visual, which includes seeing and reading; and kinesthetic, which incorporates "doing" in the teaching and learning process. The use of a hybrid of activities within a mobile learning system is exemplified in (Tan and Liu 2004), where words are learned through matching with pictures (kinesthetic plus visual), having the tool read out words (auditory), and so on.

The "places" in which learning occurs is also a key characteristic of a learning system. Traditional lecture-based teaching typically takes place through lectures, interactions, and assessments in a specific room. Online systems remove constraints of location and distance. Thus, lectures are delivered as streaming videos, assignments may be submitted via email, and discussions may take place through online forums, such as chat rooms, or wikis. Massive open online courses (MOOCs) are highly scaled up examples of online education systems. Hybrid systems consisting of place-based and online components deliver what is typically termed as blended learning (Meejaleurn et al. 2010). A (now) common example of blended education is done through what is known as a "flipped" or "inverted" classroom (Lage et al. 2000; Herold 2012). The flipped classroom is widely regarded as an excellent approach to exploit the affordances of online technologies to actively engage students and improve learning. Traditional lectures are moved to online videos with class meetings being devoted to discussion and application of new ideas. The expectation is that this will help improve student achievement of course outcomes.

The granularity of learning (and teaching) has also been the subject of educational research. A learning object (Wiley 2000; Gerard 1967) is "a collection of content items, practice items, and assessment items that are combined based on a single learning objective." The main idea behind learning objects is to break educational content into small chunks that can be reused in various learning environments.

## 2.5 Learners and Technology

Marc Prensky (2001) makes the claim that learners today are "digital natives" who "think and process informationfundamentally differently" because of the way they use technology in their daily lives, texting constantly to stay in touch, holding parallel conversations, used to playing deeply immersive games, rather than reading, and skilled at integrating information quickly, rather than synthesizing it deeply. His claim (that has considerable anecdotal support but, truth be told, insufficient experimental validation) is that learners today must be taught differently, in ways that take advantage of their multitasking, nonlinear skills.

## 2.6 Implications for Applying Mobile Technology to Learning

The above theory and practice has significant implications on how mobile technology can be used in teaching and learning, as follows:

- Support for task-conscious and learning-conscious learning: To begin with, mobile devices can support formalized, learning-conscious methods of teaching by presenting learning objects, or even just reading material, and streaming or podcasted audio and video lectures. Mobile devices can also support a wide and nuanced range of acquisition or task-based learning.
- Personalization: Because smartphones and tablets are personal devices, they can be programmed to identify, store, and apply intimate knowledge about the user. This knowledge can be used to personalize presentation of knowledge to the learning type that the user most closely matches. A digital native can in fact use today's devices to access knowledge in chunks, in parallel by multitasking, and through Trojan horse means, such as games.
- Support for single- and double-loop learning, reflection, metacognition, and learner visibility: Data can be collected at a very fine-grain level (selections, navigations, data entry, time of entry and exit, etc.) by the smart device as the user is consuming educative material or practicing what he has been taught. This data can be mined and analyzed to provide detailed feedback to the user, so he can better apply what he has been taught (i.e., mobile technology can assist in single-loop learning). Further, mobile devices can be programmed to identify lack of convergence toward a solution, compare one user's process with another's, perhaps someone who is an expert, and offer suggestions that will direct the user toward double-loop learning as well. Active reflection can be facilitated by the device prompting the user to think aloud, to answer questions to probes that assess her engagement as well as quizzes or tests that assess his learning and make his problem-solving process visible.
- Creating rich learning environments: A smart device is a conduit to a learner's learning environment. As mentioned above, this environment can be made learner centered through personalization, where the mobile device is collecting the data that enables this personalization. A smart mobile device can be programmed both to do explicit assessment (by presenting the learner with surveys and tests), as well as implicit or behind-the-scenes assessment, simply by observing the interactions between the user and the learning material. Finally, the mobile device serves as a means of connecting the learner with her learning community.
- Assessment: Nuanced assessment that measures the learner's level in accordance with Bloom's taxonomy or the quality of the program with respect to Kirkpatrick's four levels may be done through explicit popup surveys and tests

or by implicit behind-the-scenes data analysis, with the mobile device serving as the data collection device.
- Support for auditory, visual, and kinesthetic models: The audio, video, and touch capabilities of the mobile device directly support these modalities, as well as hybrids of these modalities.

Certainly other electronic and physical means (such as paper forms) may be and, in fact, have been used to achieve the above as well! However, mobile technology allows the learner to acquire knowledge through various modalities and practice this knowledge while collaborating with others free from the tethers of time and location.

In the next section, then, we will describe current mobile technologies and how they are currently being used to enable rich learning.

## 3 The Current State of Mobile Teaching and Learning Technologies and Applications

This section presents the current state of the computing technologies used in mobile teaching and learning applications and systems. This section then describes a selection of the teaching and learning applications and systems themselves. Both applications that have been built for research, as well as commercial applications, are presented.

### 3.1 Technologies

Types of devices: Mobile computing devices used for teaching and learning range from smartphones to tablets to laptops to specialized devices. Most devices fall into following categories:

- iOS devices from Apple that include the various versions of the iPhone, the iPad, and the iPad mini. iOS devices have a share of approximately 41 % of the US market (and approximately 15 % of the global market) (Forbes 2014).
- Devices powered by the Android operating system from Google that make up roughly 50 % of the US market (and about 85 % of the global market) (http://www.businessinsider.com/iphone-v-android-market-share-2014-5). These include smartphones and tablets from a variety of manufacturers, such as Samsung, Google, and HTC, as well as the Kindle Fire from Amazon (which is primarily an e-book reader but which can also run apps).
- Specialized devices such as the Amazon Kindle and the Sony and Nook e-readers.

Most of the general-purpose devices (i.e., outside of the specialized devices) have high-density displays. Thus, all mobile devices can present documents (text and PDF are the common formats supported), and most can support high-density video presentation. Rich interactive graphics can also be displayed (such as games). All can run special-purpose "apps."

Device capabilities: Apps on mobile devices can make use of a powerful set of built-in device capabilities. These include

- Display and graphics: The presentation capabilities mentioned above but also rich interactive graphics capabilities through touchscreens.
- Storage: The ability to store increasingly large amounts of data – now up to multiple gigabytes (GB) for the more expensive and powerful devices (such as the Samsung Galaxy tablet, which has internal storage of up to 16GB), with storage cards available that can store up to 128GB. Data can be stored as files as well in relational databases (such as SQLite [SQLite] that can run on the device).
- Computation: The newer mobile devices are high-powered computing devices with multicore processors that can do complex mathematical calculations and render rich high-quality graphics in real time.
- Sensing: These smart mobile devices come with a range of sensors that can sense magnetic fields, sound, light, and acceleration. A new sensor that is now found on many Android and iOS smartphones is a near field communication (or NFC) sensor. Together with the camera and audio recording capabilities, sensors are very useful in creating active learning educational applications in which the device is used for data collection in the field of physical phenomena.
- Location sensing: Location sensing allows the smart device to not just know its GPS location but also its location hierarchy (e,g., which country it is in and within that, which state, which city, which street address, and so on).
- Communication: A core feature of almost all mobile devices is the ability to communicate via the Internet through which apps can access information on the Web as well as send and receive emails and text messages, as well as communicate with each other. Devices also typically have a built-in *short-range* communications capability via a technology known as Bluetooth. This allows the device to connect to nearby devices such as displays and audio and video servers (like iTunes Plus that can stream content from the device to an audio system or the television).
- Interactivity: Most recent smartphones and tablets allow users to interact with them using touch (which works like mouse clicks) and gestures. With the advent of Siri™ and Google speech recognition technology in Android devices, speech recognition is now a mainstream and (almost) reliable capability; hence users can interact with applications with their voice.
- Built-in applications and app stores: Mobile devices come "factory installed" with several apps, such as a Web browser, a messaging app, a telephony app, a contacts app, and audio and video playback and recording apps. Thus, for example, an app that teaches biology can have an experimental component where the learner is expected to go out in the field and take pictures of various plants and upload them as part of an assignment. A useful feature is that the services that these apps provide *are callable from other apps*. Thus, if a learning

application needs to email results to a teacher for evaluation, it can simply use the built-in email app to send the email.

The apps on a device are not predetermined and fixed. New apps can also be downloaded and installed from the appropriate “app store.” Thus, Android apps can be downloaded from the Google Play store and iOS apps from the Apple Store.

Software technologies: A large variety of software technologies are used to build applications and systems for mobile devices, as follows:

- The standard set of Web technologies such as HTML, Cascading Style Sheets (CSS), and JavaScript can be used to build Web-based apps for mobile devices. The advantage of building Web applications is that they are cheaper to build (because of the availability of programmers familiar with Web applications) and easy to install (because no installation is needed!). Note that a Web app is driven by a software component on a server, which may be written in a scripting language (such as PHP or Python) or in Java™ or .NET™. Such a server component will also typically use a commercial-quality relational database, such as mySQL™ or SQLServer™.
- Web applications have two disadvantages. They need to have constant and reliable access via the Internet to a server and (until recently) had limited capabilities with respect to a rich graphical user interface (or GUI). “Native” applications, which are essentially desktop applications that run on the mobile device, do not have the disadvantages Web applications have. Native applications for iOS devices (i.e., the iPhone or the iPad) are developed in Objective-C using a “framework” called the iOS Framework, on an interactive development environment (IDE) called Xcode. Applications for the Android platform are developed in Java using the Android Framework, on an IDE called Eclipse (a more usable IDE called Android Studio has recently been released by Google). Apps for the Windows phone are developed using a version of the .NET™ platform from Microsoft on an IDE called Visual Studio.
- Cross-platform technologies: Native applications that need to run on more than one platform (i.e., iOS and Android) have to have a version developed for each platform. However, there are technologies that allow developers to develop an app once using one programming language and then have it automatically adapted by the IDE for all the platforms. Such technologies are called “cross-platform” technologies and include Sencha™, Titanium™, RhoMobile™, and Xamarin™.
- Other relevant technologies: A mobile app may call upon data storage technologies to preserve user data or on data mining algorithms to extract insights from the data that the user is supplying. Data is typically stored on the device in files (which are often encrypted for security) or in relational databases (such as SQLite™) that run on the device itself (as opposed to on a server). Several open source data mining and machine learning technologies exist in open source (enabling free use), such as Weka™.

## 3.2 Software Development Methodologies

In addition to the technologies used for building mobile apps, it is also important to briefly describe "best-practice" methodologies (or the engineering processes) used to develop these apps and systems. When developing apps for teaching and learning, it is important to be able to rapidly evolve an app to meet the needs of an often diverse target population. The methodologies and techniques described below enable software developers to develop software in a flexible manner:

- Product line design: Product line design is an engineering design methodology used to develop a *set* of software-intensive systems that share a common, managed set of features. Typically, a *family* of systems is developed that satisfy the specific needs of a particular market segment or mission. These systems are developed from a common set of reusable assets in a prescribed way. Using product line design greatly increases the efficiency and reduces the cost of developing apps that are all targeted for a specific domain (such as STEM teaching and learning).
- Agile development: Agile development is a management practice and a set of programming techniques for software development that allows software to rapidly adapt to meet changing needs identified during its development cycle.

## 3.3 State of the Research and Commercial Products for Mobile Learning

In this section, the "state of the art" in mobile teaching and learning is described. This section begins by describing a selection of commercial products, followed by a selection of research projects in mobile teaching and learning.

### Commercial Mobile Teaching and Learning Products

There are several commercial teaching and learning products available commercially. A short list of products from Scholastic – well-known vendor of products – targeted at K-12 is shown below:

- Read 180 (http://read180.scholastic.com): This is a reading intervention program from Scholastic that has a set of curriculum, instruction, assessment, and professional development programming. Read 180 has recently been made available on the iPad. Targeted at the Common Core State Standards. In the reading area, it provides reading comprehension material – articles and stories, integrated with embedded questions. Read 180 also provides writing assignments, which come with scaffolding material (such as bullet points outlining a suggested flow and content).
- Math 180 (http://teacher.scholastic.com/products/math180): Math 180 is a mathematics intervention program to help students struggling with algebra.

Math 180 is organized into nine blocks of instruction, each of which not only presents a related set of algebraic concepts but also tries to present its mathematical theme in the context of application stories and potential careers.
- System 44 (http://system44.scholastic.com/): This is a reading program for reading-challenged readers in Grades 3-12+. It can be used as a standalone or as a supplement to Read 180. When combined with Read 180, System 44 is meant to bring students up to a level at which they can then use Read 180.
- Grolier Online (http://teacher.scholastic.com/products/grolier/): Unlike the three products above, Grolier Online is not targeted at a specific skill. Rather, it serves as a resource of information, designed to be usable for learners in grades 3 and higher. Resources include videos, links to world newspapers, and clickable maps that give detailed information about the places (including current events).

Most commercially available products (like the above) simply use the ability of mobile devices to present and interact with information using native apps. The other capabilities of mobile devices – such as sensing, location, personalization, etc. are not used. Commercial products will emerge that begin to use a richer set of mobile device capabilities. This prediction is further discussed in Sect. 4.

**State of the Research in Mobile Teaching and Learning**

As is to be expected, research in mobile teaching and learning has focused on answering research questions in mobile teaching and learning. Research has primarily looked at

- The efficacy of specific learning modules when delivered on a mobile device (Yan et al. 2012; Tan and Liu 2004).
- The adaption of students to mobile and online environments (Luo and Huang 2012) when they are asked to migrate away from the traditional classroom. In particular, (Terrell 2005) examines the effect of learning styles with respect to adapting to online and mobile instruction.
- The combination, or blending, of mobile learning with traditional classroom learning, such as in (Meejaleurn et al. 2010).

Note that most of the research is focused on applications that follow an acquisition of knowledge metaphor (AM). The participation (in activities) metaphor (PM) is so far mostly unexplored in the research, at least in any rich level. Incorporating rich activities in applications will be an area of deeper exploration in the future. To that end, some of the authors' own research in mobile teaching and learning is presented.

GeoGame: The GeoGame project is an ongoing collaboration between researchers in Geography, Physics Education, and Computer Science (and receives ongoing support from the National Science Foundation through an NSF-IIS Award #1320259).

The GeoGame project seeks to effect location-based learning (see Clough 2010) about the world through simulations built around online maps. Our first application


**Fig. 1** Game play in GeoGame – Green revolution

(see Fig. 1) developed via this project, *GeoGame–Green Revolution,* turns digital world maps, similar to Google Earth and Bing maps, into a game board where any place in the world can be experienced firsthand through game-like simulations. The online game combines satellite images, geographic information, and game play to give users a microexperience of what life is like in other places of the world. In the first 2 years of this project, the team has developed and tested a prototype game about the Green Revolution in India. The data collected from user studies in university geography classes will help the team and the learning technology community to understand

- What key components and functionality can help and guide others to develop similar learning technology
- How educators can naturally integrate an online social game activity into the classroom
- How a virtual microexperience can generate critical thinking and impact learning about a faraway place when the students can relate to what they experienced rather than what they have read

Our first results (Ahlqvist et al. 2013, 2014; Mikula et al. 2013) demonstrate that many students who play the game increase their understanding from simple explanations to an awareness of the complexity of agriculture in the developing world. Continued research will seek to determine how that awareness is developed and how the technology can be used to take the students one step further to formulate explanations of what happens in the game.

The technical innovations in GeoGame allow almost any type of board game to be played on top of a current or historic map of the world. In fact, the game can directly access and allow any known real-world information to affect the game play. Just imagine playing the popular game RISK with friends but in Google Earth on a current or historic map allowing real-world information on economy, population, and other conditions affect the game in real time; or playing Farmville in a village close by or in a faraway Indian village, planting, buying supplies, fertilizing, irrigating, trading goods, and so on. The intent is for learners to have a lot of fun while learning about real-world facts and complex human-environment interactions.

Vector Training Module: The Vector Training Module is an ongoing collaboration among researchers in Physics Education and Computer Science and Engineering. It is a Web- and tablet-based quiz application that presents learners with questions on vector algebra and allows them to answer using a touch-based interface. This project is aimed at removing mathematical misconceptions with respect to vectors from high school students and first-year students in the undergraduate program. The basic framework of the Vector Training Module can be extended to build quizzes on various topics (Fig. 2).

Edgeo: The Edgeo application is another touch- and gesture-based Microsoft Windows application geared toward high school students learning Geography. It is an application where teachers can present artifacts of geographic significance – such as the Three Gorges Dam, present slides that provide various details about that artifact, such as its dimensions, its capacity, its economic and social impact, and so on. Finally, instructors can then pose questions for discussion as well as quizzes for students to answer. Finally, the system provides analytics on how the students interacted with the system and how they performed (Fig. 3).

## 4 Future Directions

This section considers where mobile technologies will go and where they will take learners.

Mobile devices being used by learners still suffer from several limitations – of high cost (the newest iPhone 5s costs upward of several hundred dollars), unreliable Internet connections and connections with low bandwidth, and limitations in screen size, storage, and raw computing power. In addition, market penetration of capable devices is slow. While the newer devices are much improved, not everyone has the latest iPhone, iPad, or Android tablet. In particular, the market with the highest need for mobile learning are students from underperforming schools, nontraditional students, and students in areas with poor information technology infrastructure. But these are also the same learners who might not have the economic wherewithal to purchase the latest devices.

However, the cost of these powerful devices is also dropping, and it is likely that sufficient market penetration will be achieved in 5–10 years. Thus, it is our belief that emerging research and commercial products should assume the wide

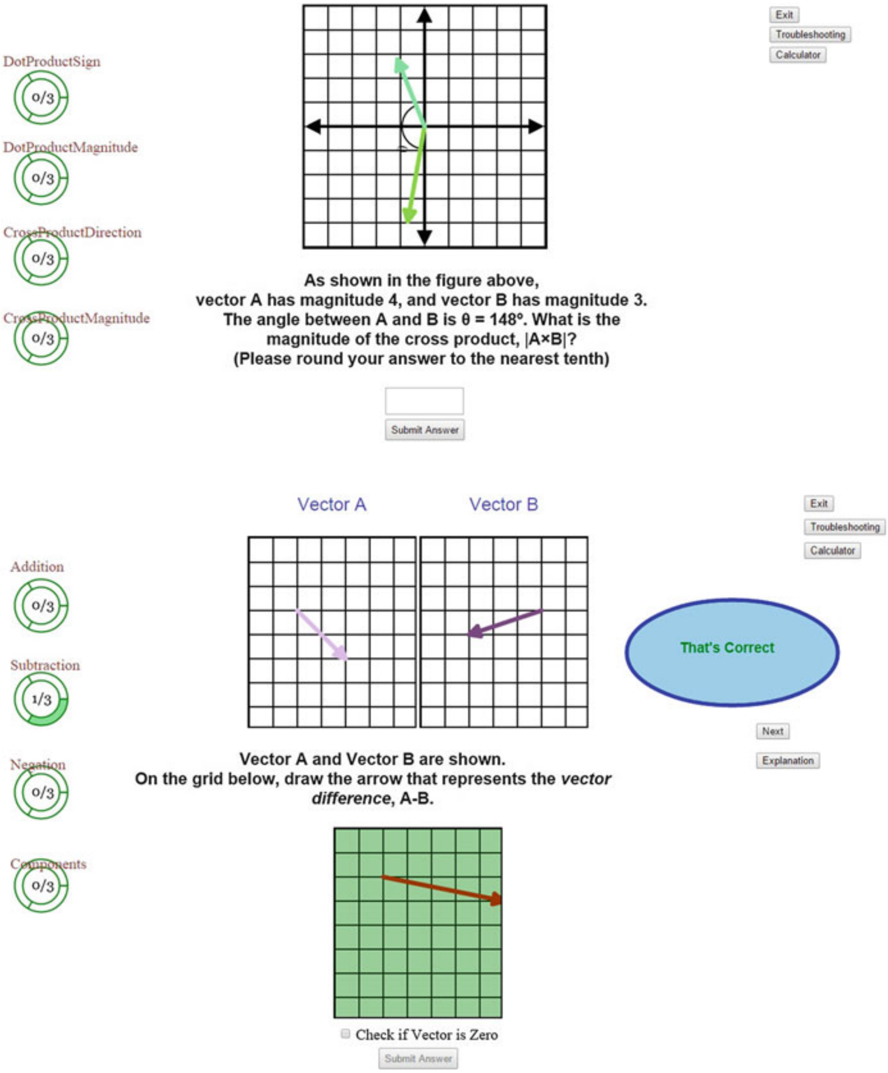


**Fig. 2** An example quiz question from the vector training module

availability to learners of powerful, well-connected devices. Given this, we now attempt to describe the future of mobile teaching and learning.

On demand learning: Technology will enable mobile learning to achieve its promise of on-demand, anytime-and-anywhere learning. Learners will be able to seamlessly start a lesson in school, continue the lesson on the bus, and complete the learning at home. Students will be able to initiate learning at any time and place as well. Finally, the location and context capabilities of the mobile device will make learning ubiquitous and embedded in the environment of the learner. Imagine

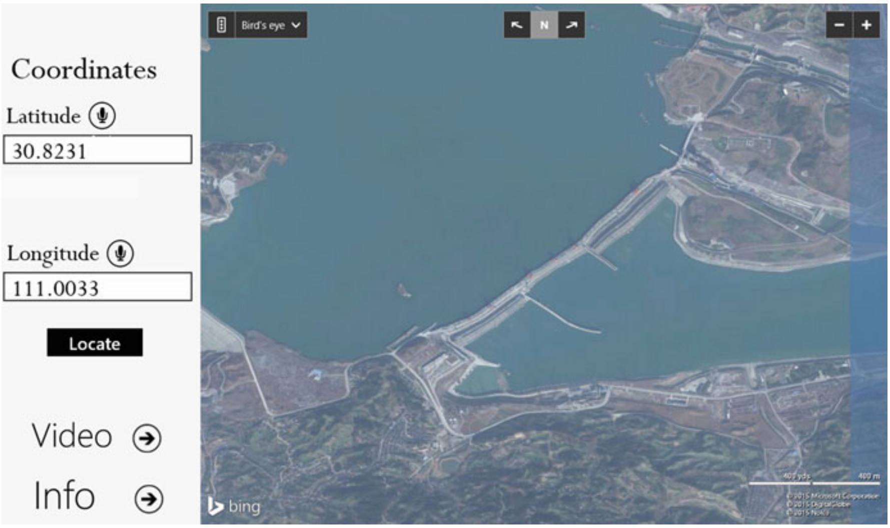


**Fig. 3** Interacting with Edgeo, a touch and gesture based Geography instruction application

simply driving by a state or federal park and being presented with rich, interactive information about its flora and fauna on your smartphone!

Personalization: Since the mobile device will become the locus of all interaction between the user and the outside world, the device will have a rich awareness of context and a *centralized* and hence holistic and deep knowledge of the learner. Thus, mobile learning will adapt to the learning style of the learner. If the learner is an assimilator, the device will teach in an information-centric manner. If the learner likes to learn by doing, the device will suggest activities.

Richer activity-based learning: Finally, the sensing capabilities of the device will be fully utilized in mobile learning. For example, learning modules will be able to teach about microweather patterns by having the learner measure wind velocity, identify the existence of eddies, and correlate wind patterns with the humidity and quality of the air around him or her.

A bright future lies ahead for mobile learning!

## 5 Cross-References

- ▶ Adoption of Mobile Technology in Higher Education: Introduction
- ▶ Designing Mathematical Tasks Within Mobile Learning Environments
- ▶ Moving with Mobiles – Using IT in the Classroom as Against Online: Comparative Reflection from South Australia
- ▶ Smart Lab Technologies

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# Using Mobile Technology in an Early Childhood Setting

# 41

Shelley Zipparo, Carley Robinson, and Rowanne Hazeldene

## Contents



**Abstract**

This chapter is based upon educator's experiences in using mobile technology in the early childhood setting. It will address the advantages and disadvantages of using mobile technology in the early years setting, along with how this aligns with current pedagogical practices in early childhood.

## 1 Introduction

As early childhood pedagogies evolve, placing greater importance on the acknowledgment of learning within sociocultural contexts (Department of Education Employment and Workplace Relations (DEEWR), 2009, Belonging Being and Becoming), the use of mobile technologies as educational tools within our preschool has, in turn, progressed also. The inclusion of two ipad mini to teacher resources has afforded children and educators the opportunity to enhance learning, using methods many of our children are accustomed to within their own homes.

The preschool used as the case study in this report is a 22 place early learning environment that benefits from the knowledge and experience of eight educators, holding qualifications that range from Bachelor of Early Childhood Education to

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Diploma in Children's Services and trainees working toward achieving a certificate III in children's services. All educators contribute to the preschool curriculum, deriving content from children's interests, ideas, and questions. The children and their families reflect a vast range of familial structures, such as socioeconomic status, employment and education levels, culture, and religious beliefs and customs. The dynamics of such differences is considered to be one of the preschool's greatest assets and achievements.

While the concept of creating an educational curriculum, originating from the ideas of 2–5-year-olds, that presents opportunities for children to learn and develop life skills (while also representing key learning areas such as literacy, math, and science in concrete experiences, guided by the five learning outcomes of the Early Years Learning Framework for Australia) (DEEWR 2009) may seem daunting, educators have relished this challenge, discovering and embracing pedagogies that best serve current educational philosophies. Mobile technology is considered a means of providing the children with reliable, current information, accessed without delay, provoking critical thinking in young children.

The use of mobile technology creates technological experiences within our setting that are more economical than previous options. The advantages of using ipad mini over installing computer technology for children were overriding and were dominated by the ease of use for our students. The smaller size of these devices makes them easier for children to physically manipulate, and the visual touch screen prompts provide greater possibility for children to navigate the device independently. Increasingly, they are providing children with access to current technology, such as the Internet, email, YouTube, games of an educational standard, and eBooks. Children have quickly become accustomed to this convenient means of researching their questions, sharing information with peers, or keeping in touch with their friends as they travel around the world.

Access to this technology has created opportunities to explore the world beyond the preschool community, opening doors to authentic information that was previously very difficult or time consuming to retrieve. Expanding the communities of our young students far beyond physical horizons promotes cultural diversity, a quality that is reflected within the Early Years Learning Framework (DEEWR 2009, pp. 25–29) and highly esteemed within their school. Intentional teaching allows educators to use pedagogies that utilize mobile technology to "...plan experiences and provide resources that broaden children's perspectives and encourage appreciation of diversity" (DEEWR 2009. p. 27). Within our increasingly globalized world, this is imperative as "Issues such as climate change and food security extend beyond national borders and require countries to work together to solve these problems in new and innovative ways" (Pickles 2012, p. 9).

Vygotsky's theory of children's learning and development forms the basis of many pedagogical practices in early childhood education, specifically theories regarding learning that is scaffolded by more knowledgeable others (MKO) (Vygotsky, cited in, Mcleod 2007). The iPads promote this pedagogical model among the children, when interests, ideas, and issues arise during their everyday play and learning. Children who have an extensive understanding of iPad software and “apps” become the MKO, promoting positive connections, collaboration of ideas, and support of their peers and even at times their educators, as knowledge and ability are expanded, when they demonstrate the effective use of this technology. Educators can further scaffold learning, using the same technology children will commonly be exposed to in their future formal school career and as digital citizens in the long-term future. In direct contrast to those children who find themselves to be an MKO, educators also find great benefit with the use of mobile technology to children who have little to no experience with this type of software at all. Utilizing the iPad at preschool helps to provide equality in accessibility to digital technologies for all children, regardless of their background.

Experiences with the iPads are small fragments of time, no longer than 5–10 min on average. Using timers has allowed children to know and prepare for time limits, engaging in turn taking and successful sharing, which is considered a valuable lifelong skill to master among peers (DEEWR 2009, p. 28). On other occasions, educators use the iPads with groups of children and also as a means of daily documentation. This usage is not set to a schedule but rather a spasmodic system, whereby the educators may determine when the use of mobile technology may be more beneficial than other forms of research, investigation, exploration, or experimentation.

Family opinions regarding the use of mobile technology were surveyed, with results confirming all agree that educational apps and research are considered appropriate use of iPads while in an early learning setting, complimenting more traditional educational experiences appropriate for preschool-age learners, such as unstructured play, reading books, and physical activities. Responses emphasized that iPad screen time was preferential to other screen times such as movies, and concerns were raised regarding the fine motor strength and dexterity of children as they mature, if technology experiences were paramount to customary fine motor experiences such as playing with Play-Doh and Lego and playing a musical instrument or hanging from bars.

For educators, it has meant that a multitude of resources are literally available immediately, affording greater ability to immediately respond to children’s interests and inquiries. Educators have also used mobile technology to document children’s learning during their active participation in experiences. This documentation consists of photographs, video footage, and written observation detailing events and experiences. Further, accident and illness records can be completed using mobile technology devices, allowing educators to remain with the children while completing this task. Data is then easily accessed by families at their leisure, giving them “real-time” information regarding their child’s day at preschool and providing children and their families with instant feedback of their learning (Carr 2001).

However, as effective educators of the service, it is important to consciously consider not just advantages but also disadvantages to this mode of mobile teaching in the preschool. Integrating technology and early childhood education can be confronting on many levels, yet, regarding the use of iPads for research and educational games, this learning can be seen as an immediate link to information, building a society of people who have their needs met by technology and in an instantaneous manner. Also, the familiar and traditional role of the educator as being the MKO for the children is shifting (Makin et al. 2010) when considering games and apps the iPad offers in the preschool setting. Many times children of the service have assisted one or more educators to set up games they have chosen to play, as the educator has limited knowledge of how the game is operated. This indicates a need for educators to obtain professional development in the use of iPads with children, in order to use these in the most appropriate and educationally beneficial way for children. At this stage the availability of this professional development has been limited; however, it is anticipated that there will be an increase in this, as the use of mobile technology in early childhood services increases.

Cameron et al. (2003) (cited in Makin et al. 2010) argue that early learning is a sensory journey where young children need to explore and understand their world rather than use two-dimensional tools, which can then lead to today's dilemma of childhood obesity. Considering this, the educators of the service must be mindful of the amount of screen time children are participating in within our service. Get Up and Grow documents released by the Department of Health and Ageing (DoHA 2011) recommend children aged 2–5 years engage in less than 1 h of screen time per day (DoHA 2011), with screen time considered to be the viewing or use of any technology with a screen, including an iPad. While it is impossible for educators to track the culture of each child's specific individual use and amount of screen time accessed in the home, concerning iPads, computers, television, or even smartphones, it was essential that the preschool includes iPad use in the media policy. Exciting new research on screen time has emerged to inform educators and families of the benefits of active screen time. Active screen time involves the child engaging in both cognitive and physical activities (Sweetser et al. 2012). Furthermore, Sweetser et al. (2012) link the benefits of active screen time during the preschool years with increased cognitive development and improved school readiness.

At this stage it is difficult to determine the long-term advantages or disadvantages, as the use of mobile technology within early childhood is really just beginning. Through our survey for families, it was revealed by a parent who teaches high school that children entering high school were lacking basic fine motor skills. Could this be the result of too much use of mobile technology? Such was the opinion of this parent.

With the educators being informed of all aspects of using iPads in mobile teaching, considering both advantages and disadvantages, the service concludes it is an essential tool for today's young learners. Educators feel mobile technology is an important addition to the curriculum for all children; however, it is important that iPads make up a small component of the daily curriculum and are used to support children's engagement in learning rather than drive it.

Experiences are and will remain fundamental to develop a child's learning, which foster the skills considered necessary for our children to mature into successful and contributing members of our community. Problem solving, creative thinking, curiosity, resilience, self-motivation, and independence (DEEWR 2009) have long been considered necessary dispositions of effective learners. Today, mobile technology is recognized as a pedagogical tool that supports learning and the acquisition of life skills within early childhood educational contexts.

## 2 Future Directions

For mobile technology to be used in an efficient way in early childhood, educators need to educate themselves on how to use this in teaching as a learning tool. Educators must also ensure that children are still being offered plentiful opportunities for active, hands-on learning that is so important in the early years. The preschool sees mobile technology being used increasingly in the future, particularly as a means to access the variety of resources that are now accessible online to expand children's interests and learning.

## 3 Cross-References

▶ iPad Program in K-12 Education: Pilot Year
▶ Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom
▶ Mobile Learning: Critical Pedagogy to Education for All
▶ Mobile Technologies for Teaching and Learning
▶ Mobile Technology in K-12 Environments

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# Mobile Technology in K-12 Environments 42

Dean Cristol, Moonsun Choi, Robert Mitchell, and
Jonathan Burbidge

## Contents



**Abstract**

In 2010, the Obama administration set two educational priority goals: (1) to raise the proportion of college graduates from 39 % to 60 % and (2) to close the achievement gap so that all students who graduate from high school are ready to succeed in college and careers. To achieve these goals, the National Educational Technology Plan (U.S. Department of Education, Office of Educational Technology. *Transforming American education: Learning powered by technology*. Washington, DC: U.S. Department of Education, Office of Educational Technology, 2010) suggested that education must undergo "revolutionary transformation rather than evolutionary tinkering" and emphasizes the importance of

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leveraging technology "to provide engaging and powerful learning experiences, content, and resources and assessments that measure student achievement in more complete, authentic, and meaningful ways" (p. v). Mobile learning capitalizes on the allure and student mobile technology expertise, by promoting mobile technology as an integral part of the learning process. Mobile learning provides flexibility and a mechanism for students to experience education seamlessly in all learning environments. This chapter describes mobile learning through the lens of Kindergarten–Grade 12 education. Initially, it is suggested that a sociocultural theoretical approach for student and teacher engagement with technology will lead to stronger understanding of how actors in mobile learning interact with technology for learning purposes. When understanding how students engage with mobile technology, researchers must consider the roles and behaviors of teachers in the mobile learning environment. Finally, the how teachers are prepared to teach in a mobile learning environment is critical to understand the mobile learning process.

## 1 Introduction

Technology can be integrated to support teaching and learning, but it is difficult to implement in practice for the following reasons: decisions about technology design and curricular roles (Pea 1987; Zbiek et al. 2007), teacher knowledge and attitudes (Graham and Thomas 2000), and institutional constraints (Kaput 1992; Zbiek and Hollebrands 2008). Teachers' efforts to integrate technology have become further complicated since the release of the National Educational Technology Plan (USDE 2010), due to the availability of mobile learning devices, cloud computing and collaborative learning environments, and game-based learning technologies in K–12 education, as well as technology expectations for students and teachers (Johnson et al. 2011).

Along with a press for technology integration, educators continually struggle to effectively educate all students in an equitable manner. Rather than a deficit rational that attributes academic failure to student background or economic or social circumstances, successful educators engage students using diverse learning strategies that apply innovative digital multimedia, thereby stimulating students to thirst for the twenty-first-century knowledge and skills (Brown 2010; Valencia 1997).

Two recent reports described the shifting trends of science, technology, engineering, and mathematics (STEM) education in the USA and education's impact on the economy. The National Science Board (NSB 2014) biennially mandated *Science and Engineering Indicators* (SEI) report provides a quantitative depiction of the America's science and engineering readiness. Indicators suggest that the US dominance has slipped in the areas of research and development. While the USA is still a leader in STEM-related research, the gap between the USA and the rest of the world has contracted in the last decade. The report concludes that developed countries are no longer the controlling influence of STEM, but developing STEM professionals has become a democratize enterprise in many developed and developing countries. A product of the new STEM democracy is the development of indigenous high-technology capabilities.

In the second report, the Organization for Economic Cooperation and Development (OECD 2010), *The High Cost of Low Educational Performance*, suggests the economic success of a country is less influenced by the quality of the schooling than by the quality of learning outcomes. The US moderate gains in student achievement seen in international surveys such as *Program for International Student Assessment* can dramatically increase the gross domestic product (Fleischman et al. 2010). A possible influence on student achievement is to utilize the ubiquitousness of mobile devices to prepare students for the STEM focused globalized economy, because the devices are consistently used for the communication and informational needs of students and teachers inside and outside of learning environments.

Mobile learning provides flexibility and a mechanism for students to experience education seamlessly in all learning environments (Ash 2009; Johnson et al. 2011; Manzo 2009; Shuler 2009; Shuler et al. 2013). Some school systems are using mobile technology as a way for students to connect to the outside world (Ash 2009). Mobile learning devices (MLDs) are relatively affordable and accessible and often reinforce difficult learning concepts and a mechanism for collaboration outside regular school hours (Franklin and Peng 2008). Many management skills used by teachers in the classroom are transferable to learning activities on the students' MLDs and teaching students accountability for what they are learning (Franklin and Peng 2008).

Mobile learning technology levels the learning field, due to the relatively low cost and its access in most households, including those that lack laptop or desktop computers and connection to the Internet. "It is no longer a question whether we should use these devices to support learning, but how and when to use them" (Trotter 2009, p. 1). Zbiek et al. (2007) stated the need to "study and develop characterizations of judicious use of technology [and] identifying promising variables" (p. 1201). Mobile learning applications developed by researchers, educators, and students that utilize mobile learning unique features challenge the education community to reconceptualize their beliefs about the use of this technology in light of the call by several states for a keener "interplay between societal demand and educational response, as well as the implications of advances in learning science and learning technology" (Partnership for 21st Century Skills 2007, p. 1).

Mobile learning has the potential to motivate student interest in STEM, to enhance student learning in STEM, and to transfer and sustain their interest toward a STEM career (Johnson et al. 2011). Why can the current generation of students sing the technology song so easily after only a short introduction, while their parents and teachers struggle to stay in tune? Considering students' ability to accommodate to the new technology, it seems logical to ask students what does and does not work in order to find the most effective ways to facilitate learning. Therefore, involving students is an important part of the teaching process (Druin 2002). Student participation in mobile learning needs to be active: using mobile learning inside and outside of classrooms, participating in the design and development of the curriculum-based applications, and sharing their learning experiences locally, nationally, and globally. Success of high school students in twenty-first-century learning environments needs to have a level of technology facilitation success program (Druin 2002). Students need to move beyond the role of user and participate in the analysis and assessment of new technologies; their input will encourage programmatic and technological readjustments in dedicated mobile learning environments.

With the addition of mobile technology as a significant instructional and learning tool, an evolved educational setting consists of three inseparable components: students, teachers, and technology. As Heid and Blume (2008) suggested, technology changes the interaction between teachers and students through well-planned activities. Utilizing appropriate technology is a transformational learning experience for students whose skills are aligned with the twenty-first-century skills (Partnership for 21st Century Skills 2007). By creating a dynamic interaction cycle of exploring, conjecturing, verifying, and generalizing, students will interact in meaningful learning (Chua and Wu 2005). Appropriate use of technology enables students to develop and test their conjectures with immediate feedback.

Fostering students' critical thinking, collaboration, and creativity across US classrooms was at one time perceived as a luxury promoted by teachers who adopted constructivist pedagogy; however, students' development of these skills are now perceived as a necessity as they prepare to contribute to a knowledge-based society. Instructional practices that facilitate students' development of critical thinking, collaboration, and creativity have been connected to high academic achievement, as research suggests that such skills support students' conceptual understandings of academic content and may increase students' motivation to learn academic content (Lopez-Morteo and Lopez 2007; Wenglinsky 2005).

The three types of isolated knowledge (technological, content, and pedagogical) develop into an interconnected knowledge: pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological, pedagogical, and content knowledge (TPACK) (Koehler and Mishra 2005; Mishra and Koehler 2006; Niess 2005, 2006). The mobile technology roles and responsibilities must be understood by all participants in the learning process to addresses the need to learn how to use these easily accessible technologies judiciously to help teachers develop professionally as they advance in their TPACK. Understanding the important role of technology in education may be a struggle for some educators, but it is imperative that they become competent users of technology if they are going to facilitate the twenty-first-century curriculum. Competency is derived from opportunities to improve education: *Encouraging* "anywhere, anytime" learning; *Reaching* underserved children; *Improving* twenty-first-century social interactions; *Fitting* with learning environments; and *Enabling* a personalized learning experience (Shuler 2009).

Shuler (2009) states, "More than half of the world's population now owns a cell phone and children under 12 constitute one of the fastest growing segments of mobile technology users in the U.S." (p. 4). In 2013, "78 % of teens now have cell phones, and almost half (47 %) of those own smartphones. That translates into 37 % of all teens who have smartphones, up from just 23 % in 2011" (Madden et al. 2013). The Horizon Report (Johnson et al. 2011) suggests mobile learning is an appropriate and dynamic use of technology that is readily available to most teachers and students (Franklin and Peng 2008; Hooft and Vahey 2007; Traylor 2009; Trotter 2009). The Universal Design for Learning (UDL) advocates innovative design and delivery of instruction, such as mobile technology for students with a variety of learning needs (King-Sears 2009).

Mobile learning provides flexibility and a mechanism for students to experience education seamlessly in most learning environments (Johnson et al. 2011; Shuler 2009). Many school systems are using mobile technology as a way for students to connect to the outside world. Mobile learning devices (MLDs) are relatively affordable and accessible, and often reinforce difficult learning concepts and a mechanism for collaboration outside regular school hours. Many management skills used by teachers in the classroom are transferable to learning activities on the students' MLDs and teaching students' accountability for their learning (Franklin and Peng 2008).

Mobile learning technology levels the learning field, due to the relatively low cost and accessibility in most households, including those that lack laptop or desktop computers and connection to the Internet, while bridging the gap between digital natives (students) and digital immigrants (teachers) (Prensky 2012). "It is no longer a question whether we should use these devices to support learning, but how and when to use them" (Trotter 2009, p. 1).

The majority of the studies reported most mobile learning had positive outcomes (Wu et al. 2012; Ke 2009). For example, 33 studies showed positive outcomes, which showed students were more engaged in mobile learning activities and there were improved student achievement, enhanced learning motivation, and benefits from mobile learning. Research outcomes of ten studies illustrated mobile learning had limited effects on student learning. These studies indicated that mobile learning had partial positive influence on student learning but mainly did not affect their learning. One study reported negative outcomes, which presented that mobile learning did not have a great impact on students' current study.

In this chapter, mobile learning is described through the lens of Kindergarten–Grade 12 education. A sociocultural theoretical approach will be taken to comprehend the social foundations of mobile learning and technology. From theoretical approach, the authors discuss the student centeredness of mobile learning, where students conduct their own learning through their experiences with mobile technology. The final section briefly explores the impacts of mobile technology on teacher education.

## 2 Social Foundation of Mobile Learning

### 2.1 Understanding Mobile Technology Through a Sociocultural Theoretical Approach

Advances in modern communications technology have led to developments in the way in which individuals interact with each other and with the technological artifacts. Townsend (2000) suggested and, perhaps more adroitly, predicted that these developments "will undoubtedly lead to fundamental transformations in individuals' perceptions of self and the world, and consequently the way they collectively construct that world." Such a position is one shared by other scholars investigating the effects of technological advances on society (Boyd 2009; Wellman 2001).

The unfettered mobility of various devices, afforded them by their wireless connectivity, ensures that distance and/or location is no longer a significant hindrance in the communicative capacity of individuals and communities. A point is supported in the early twentieth century by John Dewey (1916) who suggested that communication is a major driver of the development of community and that "Persons do not become a society by living in physical proximity... A book or a letter may institute a more intimate association between human beings separated thousands of miles from each other than exists between dwellers under the same roof" (p. 4).

## 2.2 Access and Digital Divide

According to Elliot Soloway, in an interview with *The Journal* (Nagle 2011) , developments in the technology have assured that the costs are declining for access to the basic levels of connectivity and, consequently, mobile technology can offer opportunities to create and share information to those in lower socioeconomic circumstances, where before their status would have limited technological connectivity. Soloway states that "[g]iven the cost of the device, it is very conceivable that every child, rich or poor, can have one 24/7." Indeed, the key social benefits associated with mobile technology are perhaps best summarized by Klopfer and Squire (2008) who suggest "portability, social interactivity, context, and individuality" (p. 95) as the main affordances. In terms of opportunity to engage, Marsden (2008) highlights the way in which these features address the limitations previously experienced by individuals looking to participate in digital content creation and general digital participation.

The capability for mobile technology to provide the kind of connectivity that has, in the past, been associated with expensive and extensive computer hardware means that, to some degree, the questions of access to the Internet are answered (Mitra 2009). Formerly disconnected communities, those without the cultural or financial capital to purchase or operate a computer, are now able to do just that with mobile technology. Cell phones and tablets not only provide computing functions and the ability to create content, but they provide the significant ability to access the Internet.

## 2.3 Role of Mobile Technology in Education

One of the main areas in which developments in mobile technology are most keenly felt is in education, a position supported by Rossing et al. (2012) who state that "changes in technology continue to alter possibilities for learning and create new challenges for pedagogy" (p. 1). According to Beetham and Sharpe (2007), many scholars and education professionals are exploring approaches to students becoming more engaged as creators of digital content and other resources. However, despite the acknowledgement of the advantages mentioned above, there is still a need to develop a better understanding of the role of mobile technology within the learning environment.

## 3 Students' Aspects in Mobile Learning

### 3.1 Student-/Learner-Centered Mobile Learning

Although educators widely use the term "mobile learning," there is no consensus on its definition so the concept of mobile learning is still unclear (Crompton 2013a, b; Traxler 2009). Since 2005, when mobile learning appeared as a recognized term in a Google search (Crompton 2013a), many scholars and practitioners attempted to define mobile learning. In general, mobile learning is characterized as "personal, spontaneous, opportunistic, informal, pervasive, situated, private, context-aware, bite-sized, portable," (Traxler 2009, p.13) or "the availability of technologies supporting flexible, accessible, personalized education" (Kukulska-Hulme, Agnes 2010, p. 1). Traxler (2011) portrayed mobile learning as a new learning opportunity in five ways: (1) contingent learning, changing experience students have by responding to the environment; (2) situated learning, in which learning occurs in the conditions applicable to the learning; (3) authentic learning, which is connected to immediate learning goals; (4) context-aware learning, in which the environment and history affect learning; and (5) personalized learning, fitting into each peculiar student according to his/her interests and preferences. Mobile learning's most important characteristic is the student centeredness by enabling students to easily access Internet, search for information (knowledge), communicate/interact/share ideas with others in real time, and individually and collectively do their own work anytime and anywhere.

### 3.2 Mobile Devices/Applications/Systems Created for Mobile Learning

Mobile devices provide students with learning opportunities to support their individual and/or collective learning needs with limited time and space constraints. It is certain that using mobile technologies for teaching and learning is an irreversible trend in education. The mobile learning trend scholars and educators began noticing changes in student learning behaviors when mobile devices such as PDAs (personal digital assistants) were first introduced as innovative learning tools and started to see adaptation in their learning as newer devices such as cell phones and in a few years smartphones and tablets were more frequently used in learning environments allowing for more student centered learning (Cochrane 2013).

Early results began to appear in empirical studies on mobile learning from 2010 to 2013 in scholarly journals such as *Computers and Education*, *British Journal of Educational Technology*, *Innovations in Education and Teaching International*, *Educational Technology Research and Development*, and *Journal of Computer Assisted Learning* (see appendix). A majority of these studies focused on usage of the devices, helping industry and educational institutions to better understand what types of devices were being used for learning. Researchers concentrated on creating mobile learning systems/applications to answer specific research questions about the hardware and software. However, this research trend had adapted to school systems permitting students to use their personal mobile devices in classrooms, commonly known as bring your own devices or BYOD. By allowing for BYOD, students were learning from different devices and software, creating innovative research studies where the researchers and educators had less control over the learning tools (variables) and learning contexts (Hwang and Tsai 2011; Shih et al. 2011; Wu et al. 2012).

### 3.3 The Influence of Mobile Learning on Student Outcomes

Before the move to BYOD environment, a significant portion of studies reported positive outcomes (Chu et al. 2010; Hwang and Tsai 2011). For example, the learning achievement of the 5th grade students using PDAs equipped with two-tier test guiding system was improved when they learned natural science in Taiwan (Chu et al. 2010). This positive outcome was also shown in students with special needs. Fernández-López et al. (2013) created a mobile learning platform called “Picaa” based on iPad and iPod touch for children with special educational needs. The use of Picaa enhanced the development of learning skills and promoted their interests in learning and attention. While some studies reported only mixed results, according to Ozcelik and Acarturk (2011), there was no difference of test scores between the computer science college students using camera-equipped mobile phones and 2D barcode technology and those using the computer screen.

It is difficult to explore learning outcomes in the ways teachers teach students in the context of mobile learning or how students and teachers consider the mobile learning environment. Factors to take under consideration are the roles and behaviors of teachers in this new learning environment. From this perspective, studies with both preservice and in-service teachers need to be conducted in order to encourage their teaching to be associated with the technologically enhanced learning environment.

## 4 Teacher Education and Mobile Technology

Efforts to support teacher incorporation of mobile technology began with the expansion of student smartphone accessibility in the early part of the twenty-first century (Clough et al. 2007; Merchant 2012). Early scholarship centered on controlling student usage of the new technology with a focus on mobile safety and avoiding instructional distractions (Kolb and Tonner 2012). Early incorporation followed a linear path that mirrors the adoption of other forms of educational technology such as laptop computers and web-based resources (Lever-Duffy and McDonald 2008).

Training teachers to utilize and incorporate mobile learning devices in instruction began in the early years of the twenty-first century. Hill (2003) noted that mobile technology in the K–12 classroom was being tailored to "meet design requirements of users" (p. 71). Within the process of promoting mobile technology, the development of communities of practice to facilitate instruction with mobile technology and articulating expectations and strategies for mobile technology usage among preservice teachers become primary themes. Mandatory in-service teacher training on the use of mobile technology held within individual school districts was found to have mixed results in terms of effectiveness and long-term sustainability (Sharma 2007). While some participants in these training sessions expressed increased interest to utilize mobile technology in their classroom, many expressed resistance to the mandatory nature of implementation (Sharma 2007; Herro et al. 2013). In contrast, the incorporation of mobile technology was found to be immediate when various incentives (stipends, release time, and technological access), within groups of educators forming communities of practice, were utilized (Herro et al. 2013).

At the college/university level, the empowerment of preservice educators to utilize and incorporate mobile technology within their daily instruction continues to be used. Foulger et al. (2013) developed a five-stage process for implementing mobile technology within the K–12 classroom from exploration to full implementation (exploration, planning, isolated use, multiple uses, and full implementation). This five-stage process is also echoed in observations in American primary schools where students from kindergarten to 4th grade utilized mobile technology extensively (Herro et al. 2013). Merchant (2012) echoed many of these findings as he also included an examination of the social impact of the use of mobile technology and the linkage to the role of privilege in schools.

## 5 Future Directions

Ultimately, when examining mobile learning's impact, researchers, educators, and administrators must always return to the user, the students who come to school empowered with technological knowledge and the ability to access information. The adults' role is to support students' understanding and refinement of the accessible information. Curriculum must be developed that utilizes a twenty-first-century curricular framework (Partnership for 21st Century Skills 2007) that involves the consistent use of technology, a "legacy curriculum" skill that teachers need to learn to become successful twenty-first-century educators (Prensky 2008). Technological skills are the nonjudgmental mediator and partner between students and teachers. The nature of an activity utilizing appropriate technology can transform learning from a static exercise into a dynamic fluid learning experience for students whose skills are more aligned with the twenty-first-century skills. Students' meaningful learning occurs when they are "curious and willing to learn things they consider useful, enjoy solving "real-life" problems, ... [and] begin to think critically" (Pennington 2009, p. 3). Learning to solve problems and issues witnessed inside and outside of the classroom is an invaluable skill. Appropriate use of technology enables students to develop and test their conjectures with immediate feedback.

Understanding the interplay of teacher content knowledge and pedagogy from a decidedly instructional technology perspective will enable teacher educators to design effective and ongoing technology-focused professional development. Teachers need content knowledge as well as technological knowledge to be successful in the twenty-first century (ISTE 2014). The roles and responsibilities of educators and students must be understood as we increasingly bring the wireless world into the classroom. Understanding the current role of technology in the learning environment may be a struggle for some educators, but it is imperative if they are going to facilitate the twenty-first-century learning experience.

Scholars and practitioners started to pay attention to the use of mobile devices such as PDAs (personal digital assistants), mobile phones/smartphones, and tablet personal computers as mobile learning (Cochrane 2013). Rather, recent studies show that the meaning of mobile learning is more connected to designing mobile learning systems/applications. At the early stage of the development of mobile technologies, mobile learning studies were conducted in informal educational settings. However, many schools began to permit students to use their own mobile devices (BYOD, bring your own devices) in class, allowing various mobile learning studies for different ages of students and in different subjects to be available in formal educational contexts (Hwang and Tsai 2011; Shih et al. 2011). Concurrently, there was a push to design learning systems/applications specifically for mobile devices (Wu et al. 2012). Regardless of what types of mobile devices were used, researchers put a lot of emphasis to creating mobile learning systems and applications that reflected specific research pursuits. Currently, there is a substantial research focus emphasis among mobile learning researchers on the design of mobile learning systems and applications rather than developing mobile learning hardware for learning environments.

It may be a natural outcome to see positive results because many mobile learning systems/applications were already targeted on improving mobile learning. However, while it is difficult, it is important to explore students' engagement with mobile devices equipped with mobile learning systems and/or applications or ways teachers teach students in the context of mobile learning or how students and teachers consider the mobile learning environment, therefore, knowing what the roles of teachers and students are and what they are doing or what they can do in a mobile learning environment.

Successful mobile learning experiences allow school districts to utilize mobile learning technology in their schools through professional collaboration. Each participant becomes an integral piece in the network and contributes value to the learning system (Siemens 2005). In contrast to traditional models, mobile learning experiences are as follows: (1) trusts users as codevelopers, (2) harnesses collective intelligence, and (3) controls unique data sources that get richer as more people use them (O'Reilly 2005). Effective mobile learning experiences "level the learning field" by responding to gaps and weaknesses through research-based recommendations. Educators and students can guide local schools to develop a technology plan aligned with the Common Core Curriculum, twenty-first-century learning goals, and acceptable user policy, by addressing pedagogy, technology infrastructure, policy, professional development, community engagement, funding, and organization as necessary components of a sustainable model for supporting future students and educators.

## 6 Cross-References


- ► Characteristics of Mobile Teaching and Learning
- ► Learning to Teach with Mobile Technologies: Pedagogical Implications in and Outside the Classroom
- ► Mobile Learning: Critical Pedagogy to Education for All
- ► Mobile Technologies and Learning: Expectations, Myths, and Reality
- ► Novel Education Pattern Applied to Global Crowd of all Ages: Mobile Education
- ► Student Feedback in Mobile Teaching and Learning
- ► Transformation of Traditional Face-to-Face Teaching to Mobile Teaching and Learning: Pedagogical Perspectives


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# Part V

# Evaluation of Mobile Teaching and Learning Projects

# Evaluation of Mobile Teaching and Learning Projects: Introduction

# 43

Helen Farley and Angela Murphy

## Contents



**Abstract**

Mobile learning is often seen as the panacea for universities, struggling to provide flexible learning for students. Even so, very few institutions are prepared or unable to provide the necessary resourcing across a range of areas to make it possible. The requirements are likely to stretch across the areas of pedagogical and ICT support, teaching relief to allow for course and program redesign and helping both educators and students acquire the digital literacies they need to fully leverage the affordances of mobile technologies. This section investigates how mobile learning initiatives can be implemented in higher education institutions such that they are effective and sustainable. The chapters in this section adopt a variety of viewpoints, exploring the issues around mobile learning adoption and evaluation.

In the decade and a half since the beginning of the new millennium, mobile computing technologies have evolved rapidly, enabling increasingly sophisticated methods of communication and interaction. As a result of the incremental improvements in design, tendency toward reduced size, increased functionality, improvements in data storage capability, and the reliability and ubiquity of the networks that support them, mobile technologies are increasingly perceived as essential to the conduct of people's everyday lives (Evans-Cowley 2010).

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In the educational context, ubiquitous connectivity and the portable nature of these devices facilitate access to collaborative and contextualized learning experiences which translate into greater ownership of learning processes (Wong 2012a). Furthermore, these technologies are becoming ever more affordable, presenting unique opportunities for facilitating the flexible delivery of contextualized learning experiences for diverse student cohorts. However, despite the enhanced capabilities of mobile technologies, the field of mobile learning is failing to keep pace in terms of pedagogical considerations (Traxler 2007). This is evidenced by the relative paucity of theoretical frameworks that focus on the impact of mobile technologies on learners and their experiences of mobile learning (Kearney et al. 2012). Consequently, most mobile learning initiatives are piecemeal, are poorly supported by the institution, and are not sustained beyond the original project funding or continue once the project leader leaves the institution (Mueller et al. 2012).

A significant challenge facing most educational institutions is identifying strategic and operational priorities for investment in mobile learning capabilities within a rapidly changing field while maximizing the educational outcomes for students and minimizing institutional costs. Over the past 10 years, a number of pilot or experimental research studies have been conducted across sectors to investigate the impact of mobile technologies on learning and teaching (e.g., Elias 2011; Biggs and Justice 2011; Wong 2012b). One of the most consistent conclusions of these studies is that there are still a number of barriers that influence the adoption of mobile learning initiatives in education, both at an institutional and at a user level. Higher education institutions are cautious about investing extensively in mobile technologies because of the rate of emergence of new models and the speed with which devices become obsolete. Few higher education institutions have therefore implemented well-financed and highly visible mobile learning initiatives that are operationalized within policy and practice.

A report conducted for the Joint Information Systems Committee (JISC) e-learning program in late 2010 indicated that the most prominent issue in the field of mobile learning is the lack of full-scale evaluations of mobile technology in higher education (Wishart and Green 2010) and the absence of a stable platform from which to effectively research the role, drivers, and impact of mobility on learning (Park 2011). Several attempts to conceptualize mobile learning have been made (e.g., Traxler 2007; JISC InfoNet 2011; Pachman et al. 2011; Vavoula and Sharples 2009), yet none have been sufficiently targeted to ensure comprehensive and rigorous coverage of the rapidly developing and changing landscape of contemporary mobile learning networks and technologies.

This section explores some of the issues involved with the evaluation of mobile learning initiatives but further looks at the ways in which these challenges are addressed in a variety of learning and institutional contexts. This section begins with ▶ Chap. 46, "Moving Towards the Effective Evaluation of Mobile Learning Initiatives in Higher Education Institutions", providing an overview of the mobile learning evaluation frameworks that already exist. The chapter opens with an exploration of current use and pedagogical goals of various mobile learning initiatives. The authors then turn their attention to identifying the challenges in evaluating mobile learning initiatives. This sets the scene for their critical consideration of a number of frameworks including the *Evaluation of Technologies Framework* (Ng and Nicholas 2013); *Critical Analysis* (Frohberg et al. 2009), a *Framework for Analysing Mobile Learning* (Sharples et al. 2007), and *Pedagogical Forms for Mobile Learning* (Laurillard 2007, based on work in 2002). The chapter concludes with the proposal of a new framework derived from data collected as part of a 3-year funded project in an Australian regional university.

Though mobile technologies have been widely adopted by students (e.g., see Murphy and Farley 2012), educators are still struggling with when and how these technologies should be used for learning. Melissa Nursey-Bray in ▶ Chap. 47, "Moving with Mobiles – Using IT in the Classroom as Against Online: Comparative Reflection from South Australia", explores these issues. This chapter investigates how mobile devices can be used to deliver online content but goes further by exploring how mobile devices can be used to transform face-to-face teaching methods using a South Australian case study.

Tairan Kevin Huang, Jin Cui, Corinne Cortese, and Matthew Pepper delve into how emerging mobile technologies can be used for Peer Assisted Learning (PAL) in ▶ Chap. 51, "Internet Based Peer Assisted Learning: Current Models, Future Applications, and Potential". The authors posit that emerging technologies can be leveraged to accommodate learning in light of the changing student lifestyle. In this chapter, a number of models for PAL are examined along with the technological requirements of establishment and maintenance of Internet-based PAL programs.

In ▶ Chap. 48, "Service-Learning Application in an M-Learning Course", Margaret Sass begins by investigating the rationale and pedagogical intent behind mobile learning or m-learning. These ideas are then transferred into the domain of service learning, whereby learning takes place within the context of the community in response to community needs in order to facilitate a powerful learning experience for the student. Social media can be used effectively to this end, providing a quality learning experience using a platform with which students are already comfortable.

The next chapter focuses on the evaluation of specific mobile learning initiatives in higher education. The chapter by Aimee Zhang, ▶ Chap. 49, "Student Feedback in Mobile Teaching and Learning", describes a mobile learning project titled *Tutors in Pockets*. In this project, a mobile application or "app" was developed for iOS and Android mobile devices. The app was used in undergraduate economics education in an Australian university. The effectiveness of the app use in this context was evaluated using both quantitative and qualitative measures.

Emerging technologies bring with them opportunities to leverage the affordances of these technologies for learning. Though it is tempting to recreate old ways of teaching in new ways on these technologies, it is potentially more effective to evolve new ways of learning altogether. One of the ways that many educators are engaging students in new ways is through gamification, leveraging gaming elements to enhance learning. Izabel Rego, in ▶ Chap. 45, "Mobile Language Learning: How Gamification Improves the Experience", explores how gamification can be used to promote student learning through enhanced engagement. The focus of her chapter relates to language learning using mobile devices. To this end, she explores the affordances of a number of mobile applications, specifically Language Learning Game (LLG), Duolingo, and LingoBee.

When e-learning first became popular in education, many educators simply placed PDFs of hardcopy materials onto a webpage or learning management system. Very little account was taken for optimizing the materials or content for the online environment. Much the same is happening with assessments, where e-learning and paper-based assessment systems are merely transposed to the mobile learning environment. ▶ Chapter 50, "Transforming Assessments into the Digital Domain" by Rodney J. Clarke, explores how assessments can be optimized for use with mobile devices using genre theory. This exploration makes use of a specific case study from a first-year information systems subject.

One of the difficulties with emerging technologies is that they come and go. Just a few years ago, the personal digital assistant or PDA was hailed as the game-changing device that could revolutionize mobile learning. At the time of the PDAs' peak of popularity, tablets were not visible in the device market. Since their release in 2010, iPads have changed all that. Along with their popularity for social networking and entertainment, educators have been finding innovative ways of using iPads for education. In a few select institutions around the world, iPads have been distributed to students and educators on a large scale. The chapter from Lynnae Rankine-Venaruzzo and Dennis Macnamara, ▶ Chap. 44, "iPads as Educational Tools"," explores how such an implementation can be achieved with optimal results. The chapter explores a number of avenues of approach such as staff capacity building in designing interactive mobile-enabled learning activities and assessment tasks and showcasing good practice among others.

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# iPads as Educational Tools

# 44

Lynnae Rankine-Venaruzzo and Dennis Macnamara

## Contents



**Abstract**

The deployment of nearly 45,000 iPads to university students over a 3-year period has occurred at the same time as an institution-wide transformation to blended learning approaches and experiences.

(UWS About iPads retrieved from http://www.uws.edu.au/learning_teaching/learning_and_teaching/ipad_initiative/about_ipads_at_uws. Accessed March 02, 2015.)

However, the iPad has been a symbol of innovation and commitment by the university to create digitally rich learning environments that excite and challenge students and educators. Their presence at this scale within the university has impacted every department beyond the classroom and involves teams of specialists from all corners of the physical and virtual campus. The iPad has given teaching staff a "license to thrill" and students more flexibility in how and

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when they learn. Staff capacity in designing interactive mobile-enabled learning activities and assessment tasks is key to the transformation of learning across the university and involves a hub-and-spokes approach that caters for a geographically disperse campus network and respects diversity in academic skills and nuances in discipline contexts. Seminars, mini-conferences, and summits provide a space for academics to experience using iPads and mobile technologies to share specific examples of iPad teaching and learning strategies with peers. Showcasing good practice involves academic, professional, and support staff sharing experiences and approaches to teaching innovation. Governance, timetabling of physical learning spaces, acquisition of new technologies, recognition of changes to academic workload in digital learning environments, authentic digital assessment, and catering for devices other than iPads are just some of the challenges ahead.

## 1 Introduction

A lot can happen in 4 years. In 2010 when the iPad was launched by Apple, it was surrounded by hype. This new touch-screen device enabled people of any age to download and read books and look at videos and images together. That same year, the Australian and New Zealand version of the Horizon Report referred to the "promise of mobiles" in education because of the new ways devices like iPads offered people to connect, communicate, share, and access tools for learning (Horizon Report 2010, p. 5). As Marx and James in 2010 said, this device was "revolutionary." In this same year, the University of Western Sydney (UWS) ran a large institutional survey of students seeking insight into how students used technologies in their learning. Nearly all students had access to a range of technologies like personally owned laptops and computer labs on campus, and they were active in their use of technology for study and rated themselves as technologically literate. However, student ownership and access to mobile technologies was low (5 %) and their desire to use these technologies much higher (45 %).

In 2012, the university embarked on a transformation of the curriculum to design blended learning environments for nearly 1,000 undergraduate units/subjects. To achieve this nearly 50 learning design specialists were embedded in the faculties to help build the capacity of teaching staff to design vibrant digital learning environments. A full description of the transformation can be found at UWS Designing for Learning (retrieved from http://www.uws.edu.au/qilt/qilt/designing_for_learning. Accessed March 02, 2015).

## 2 Background

The University of Western Sydney has eight campuses situated in Australia's third largest economic region, serving its growing population. Cumulatively these campuses bring over 200 years of rich history as a learning and teaching institution.

The institution has several on-campus lectures and tutorials and services over 42,000 culturally diverse students who juggle significant work or career duties as well as their studies.

## 3 A Blend of Strategies

The blended learning strategy was an institution-wide curriculum renewal initiative to blend all first year units by 2014 and all remaining units blended by 2016. The quantum of units was approximately 1,000.

Blended learning is defined as "the combination of times and modes of learning, and integrating the best aspects of face-to-face, community based and online interactions for each discipline. The design of units and programs of study for optimum learning takes into account learner needs, discipline accreditation requirements, a mix of directed and self-directed activities, and available resources and infrastructure (UWS Quality in Learning and Teaching retrieved from (http://www.uws.edu.au/qilt/. Accessed March 02, 2015). This approach aimed to increase flexibility in how, when and where students learn. It did not preclude units (or indeed whole programs), being fully online where appropriate" (Rankine-Venaruzzo et al. 2014, p. 59).

This definition of blended learning was designed to be agnostic to specific technologies and focus more on the student learning needs. There was flexibility in how the blend was applied to units taking into consideration cohort levels, discipline requirements, and professional or industry standards. The type of blending consists of:

- Engaging on-campus classes and vibrant campus cultures
- Accessible online learning materials synchronously and asynchronously
- Learning activities that engaged with the local community

The intent with blending units is to also offer both increasing and graduated opportunities for self-directed learning, vital skills for twenty-first-century learners.

Enabling this transformation involved significant monies for workload relief for academic staff to redesign their units, and more than 40 specialist learning design staff were employed. These staff with academics were assigned locally across the campuses of the university. These staff work in a hub-and-spokes model with a small central team with the remit of supporting curriculum change, building capacity in teaching, researching learning technologies, and building communities of practice. The central team provide leadership and expertise to the blended learning support staff in schools and run targeted professional development to build capacity, so blended learning staff are not only more effective in their roles but remain at the cutting edge of digital design.

In late December 2012, another initiative commenced at the university. Over 15,000 iPads were purchased for first year students and continuing staff as part of the blended learning strategy (UWS iPad Story retrieved from http://www.uws.edu.au/newscentre/news_centre/story_archive/december_2012/uws_deploys_ipads_to_support_it-enhanced_learning. Accessed March 02, 2015). The implementation of these iPads happened at speed as students were receiving their mobile devices in January the following year. To enable this deployment at scale and within a tight time frame, cross-department teams were formed with representatives from marketing, student support, academics, security, IT, senior management, policy section, academic registrar units, and external consultants such as logistics and device suppliers including Apple itself. Many of the team members did not even know each other before the iPad rollout commenced. The collaborative university-wide teamwork ensured a rollout that was much smoother than anyone could have imagined. Leading the rollout were the executives from the university and from Apple and three distinct delivery teams: pedagogy, technology, and distribution. The scale of this operation created challenges in the shipment management to campus, ensuring appropriate wireless network access, the management of individual devices, and access to apps.

In 2010, students were asked about their experiences in using technologies in their learning. The focus of this survey was to understand the student experience and expectation of technologies for learning, social, and work activities. At this stage, 50 % of students had a mobile phone with Internet access, only 38 % were using this in their learning experience and 38 % wanted to do more learning with a mobile device. Only 5 % of students in 2010 had an iPad or a tablet device, and 45 % wanted to have such a device for their learning. Students commented that "when waiting at a bus stop on campus, they could take out their phone and check on updates in the learning management system or access student email." There was evidence from this large-scale survey as well as other student surveys that students wanted more flexibility in how and when they learn, and the iPad is deemed to be a device that could facilitate this. The decision then to purchase and roll out 15,000 iPads in 2013 was not a marketing decision although it was used in marketing information to students. Over the next 3 years, a total of 45,000 iPads would be in the hands of the student and staff population as key devices enabling learning and teaching transformation (UWS iPad initiative retrieved from http://www.uws.edu.au/learning_teaching/learning_and_teaching/ipad_initiative/about_ipads_at_uws. Accessed March 02, 2015).

A top-down strategy to develop a blended learning approach across all programs with a greatly enhanced usage of learning technology was the first phase. The university then set about winning the hearts and minds of staff during the operational rollout of this plan. Partly this was achieved through providing adequate support and resources for the change, partly by allowing flexibility at the program and unit level within the overall plan and quality framework. The initial purchase of iPads indicated that the institution meant business. However, scaling up to 45,000 iPads over 3 years would have a profound impact on the institution. By 2015 UWS had moved to offering a suite of fully online programs (UWS Online retrieved from http://www.uws.edu.au/dvcacademic/dvc_academic/uwsonline. Accessed March 02, 2015). There are macro-institutional ramifications including pedagogy, teaching development, professional practice, resource development, as well as student learning. Four years on from the first launch of iPads, the rollout of over 45,000 iPads at the university has highlighted that iPads can be both a symbol and a device for institutional and curriculum game changing.

## 4 A License to Thrill

Digital learning environments, flexible programs of study, the rise of open and free education, and vibrant learning experiences are factors students consider when choosing a university (Mazoue 2013; Harden 2013). Mobile devices, like iPads, enable students to be more active and engaged in university learning (Daly 2014; Dickie 2014). iPads have been useful in helping students to feel more confident in their learning and help academics to achieve a level of creativity and exploration in designing learning experiences for students or, as one academic announced in a workshop, “a license to thrill” (Rankine and Macnamara 2014).

iPads enable “movement, circulation, and close-up interactions,” and the academic does not need to devote their time and energy in front of the classroom to “present” or “lecture” (Morrone et al. 2012). Student usage of iPads and mobile devices for learning has increased dramatically with a significant increase in the frequency with which students are accessing online activities, tools, and resources via mobile devices. Providing iPads to students has enhanced participation in learning.

The device is about creation, not just consumption. The iPad can accompany any person of any age in any profession or creative pursuit to achieve more than what they may have been able to previously without the cool mobile device in their hands. Morrone et al. (2012) noted that the reason the iPad is engaging for learning and teaching is because of its “form” and “cool factor” (p. 3). They argue that the iPad promotes active learning, brings people together, and helps students feel more confident in their learning. The collaborative nature of these devices creates “classrooms that are more communal and visual in emphasis”(p. 3).

### 4.1 Teaching Development

Digital and mobile learning increases access to learning, enhances quality of units/courses, and improves efficiencies in class management (Bohle Carbonell et al. 2013; Ertmer 1999; Griffin and Rankine 2010; Moskal et al. 2013; Vaughan 2007); however, it challenges the norms, beliefs, and values of academic staff (Rankine-Venaruzzo et al. 2014). As a multicampus institution with diverse skill sets and knowledge of academic staff in their capacity to use iPads effectively in teaching, there was a requirement for a multitiered and diverse approach to teaching development (Rankine and Macnamara 2014) to cater for early adopters and enthusiasts (Rogers 1995).

A hub-and-spokes model and team approach to designing for learning are integral to the development of teaching staff. Teams of academic specialists, content experts, learning designers, curriculum advisers, and technical specialists design digital learning resources and activities. These specialists are positioned within the schools. At the center, a small team provides institution-wide professional development, nourish communities of practice, and showcase good practice as exemplars and case studies.

Teaching development programs cater for the novice user through more advanced and experiential academics willing to give something new a try. For the novice user, sessions cover the basics about how to create folders, access apps, set up the wireless network access, and enable email accounts. These sessions are hands-on, in-person activities where staff explore their devices and have immediate support and advice if required. Using iPads in various teaching contexts is key to the teaching development approach to build capacity and confidence in academic staff using these devices. Face-to-face workshops and webinars are provided to the staff to explore apps and teaching strategies around mind mapping, digital storytelling, student creation of resources, and developing rich media learning materials.

### 4.2 Learning Communities

Communities of practice are recognized as a significant factor in changing both individual and organizational knowledge but are challenging to design and manage. Multiple, broad, engaged, and expanding communities of practice are provided for academic, professional, and blended professional staff.

Seminars, mini-conferences, and summits provide a space for academics to experience using iPads and mobile technologies in their teaching and are regularly held to enable them to share their examples of iPad teaching and learning strategies with peers. These champions are collegial change agents taking strategies and examples back to their schools. Guest speakers who are already well experienced in the use of iPads and mobile technologies are invited to share developments, challenge norms, and encourage further experimentation.

Forums are held on different campuses and feature presenters from all schools and different departments to share experiences and perspectives in using iPads in teaching and learning. They are designed to share experiences in terms of successes and lessons learned, showcase innovations, and discuss issues that are relevant to designing learning in higher education using mobile technologies. Presenters at the forums include academic staff and professional staff who are involved in supporting blended learning and who are assigned within schools and in diverse organization areas across the university. Research students are also encouraged to present. Open discussions and panel debates have proven to be popular as they provide opportunities to share concerns and discuss strategies to address issues that are impacting on digital and mobile learning.

These events provide a valuable networking opportunity and enable academics and blended professional staff who may not normally get together to share experiences, showcase teaching innovation, and debate issues affecting them and their students. These forums also provide a peer environment where experiences of new designs for learning and uses of learning technologies – both positive and not so positive – can be shared safely, reducing isolation and concern.

The use of iPads has brought in a new level of campus experience, for example, using augmented reality around landmarks and facilities on campus or conducting discipline-related site visits to encourage students to be explorers and discoverers. Lectures are increasingly using response systems to receive prompt feedback from students and engage even the more quiet students in class discussions. Students are creating and curating digital content and publishing via social media and within the learning management system.

iPads also allowed students to access their courses anywhere; Wi-Fi is provided both on and off campus. This gave an aura of flexible access for students' study and brought to life anywhere, anytime study for students. Interestingly there has been some anecdotal evidence (in part from Wi-Fi usage) that students were coming on campus more often after the number of compulsory on-campus learning activities was reduced. Students liked the open learning spaces and the opportunity to use facilities to do the type and style of learning they wanted at a time convenient to them.

iPads were also used to take learning into the community and bring the community onto campus. This could be as simple as taking pictures of house building for construction programs, to recording conversations with the community for social science courses, to using augmented reality for enhancing geography field trips.

## 4.3 Showcasing Good Practice

The implementation of the blended learning strategy and the iPad initiative enabled institutional conversations and collaboration between academic staff, blended professionals, technical specialists, and student learning advisors. Strong connections were forged where previously only pockets of collaboration existed, and this "middle-out" leadership approach worked well with the strong "top-down" leadership provided by the executive staff. These combined approaches enabled the university to balance the tensions that exist between institutional vision, creativity, and innovation which have been recognized as key features for learning and teaching transformation (Childs et al. 2013).

Showcasing good practice is encouraged at different levels within the university. At the whole-of-institution level, regular blended learning forums were held across the different campuses with academic, professional, and support staff sharing experiences and approaches to teaching innovation. The forums included guest speakers from other institutions to talk about common issues like copyright, accessibility, game-inspired learning, and designing authentic assessment tasks. The forums also enabled academic staff to receive multidisciplinary feedback on new teaching ideas and extend their professional learning networks beyond their own disciplinary group. Within the individual schools, a whole or part of the day was set aside for colleagues to share their learning designs and examples of teaching innovation. These more intimate gatherings enabled staff to share experiences and participate in localized professional development.

Sharing good practice does not always happen in a forum. Cross-pollination of ideas happens in different ways. Vignettes in a rich media format showcased teaching and learning in action and provided academics with another avenue in which to share their teaching experience or include as evidence in a teaching portfolio for promotion ambitions. Vignettes of teaching practice provide insight into the sometimes invisible-to-the-rest-of-the-world classroom that is normally only accessible by teaching staff and students.

## 4.4 Transformative Learning Spaces

Like many other Australian universities, contemporary and flexible learning spaces are available to students on campus, and recent investment in the redesign of flat-floor and tiered teaching spaces to create collaborative learning spaces has reinvigorated the student on-campus learning experience. Students bring their mobile devices to the campus for individual and group work in formal and informal spaces. With nearly 500 teaching spaces across the campus network, spaces that have been redesigned are evaluated, and feedback from academic staff and students sought to enable modifications and refinements as remaining spaces are redesigned (Radcliffe 2009). Positive outcomes included:

- Learning spaces are facilitating group work, presentations by students, and collaborative activities in class. These spaces are rarely used for assessment and invigilated examinations.
- Teaching staff have modified their curriculum to take advantage of learning spaces with more student-led activities, more group work, and more self-directed student learning activities.
- The use of these spaces has increased student-to-student interactions and increased participation in collaborative activities.

Furthermore, evaluation showed that informal, formal, and social learning spaces facilitated more group work, presentations, and collaborative activities. Teaching staff have adapted these spaces to their teaching style to take advantage of them and design more student-led activities in class, and 100 % of respondents indicated that these spaces have highly enhanced the flexibility of the teaching and learning experience.

However, challenges were raised and ranged from pedagogic considerations to operational aspects and include:

- Enabling peer assessment, self-assessment, and monitoring of individual student work in group activities in formal learning spaces

- Supporting BYOD approaches and technologies
- Experimenting with lockup charging stations
- Providing more writing surfaces
- Enabling dynamic presenters to present while people watch the presenter and any projected images/content

### 4.5 Transformation Without iPads

It is not suggested that the successful institutional transformation only worked because of iPads as the university may well have been transformed anyway due to other strategic endeavors. It could be argued that the purchase of iPads could have been a distraction from the main game of curriculum reformation as it was certainly a high-risk strategy. Indeed many at the time suggested just this, especially as the transformation was supposed to be learning design led, not technology led and device focused.

There was a pervading staff perception in late 2012 that big strategic changes had been announced before by the senior executive but successfully passively resisted by the faculty staff and middle managers. The staff expressed these thoughts to those charged with implementing blending learning. The iPads changed that mood. There was not a cry of why are we doing this but just one of "what about me, can I have one too." So yes transformation would probably have occurred without iPads in the end, but it is suspected it would have been slower and more painful.

## 5 The Next Frontier(s)

Concurrent to the implementation of the blended learning strategy and the iPad initiative is a concerted effort around evaluating the strategies and seeking evidence that student learning is improving. There is early evidence showing that student performance and achievement of learning outcomes are improving, failure rates are dropping from subjects that previously had serious retention issues, and staff are more willing to experiment, create, and innovate. Learning and teaching are being transformed at the university; however, there are further challenges.

### 5.1 Digital Assessment

While learning is more student centered at UWS and uses digital resources, learning technologies, and mobile devices central to the student experience, there is a divide between the learning activity and formal assessment tasks. Authentic assessment, maybe even digital assessment, is one of the challenges ahead. In 2014 a glimpse of this new world was evident in an open iPad examination.

The first iPad-enabled exam at the university, and possibly Australia, was held in July 2014 with over 200 business students (UWS iPad exam retrieved from http://www.uws.edu.au/auws/arounduws_home_page/auws_archives/2014/july/the_ipad_exam. Accessed March 02, 2015). Students used their own notes on their iPad and searched Google and a couple even updated their status on Facebook and Twitter. Not all students used their iPad during the exam, and it was reflected during exit interviews that their reason was because they were used to preparing for open-book exams without relying on technology. Some students were concerned that they may not have reliable Internet access, and all interviewed students said that they were less stressed in preparing for the examination. This single-assessment approach has triggered debate within the organization about authentic assessment using iPads, and no doubt there will be more work on this front in the year ahead.

## 5.2 BYOD

All institutions need to be careful not to get locked into any single-technology device or system, and UWS was acutely aware of this with the purchase of iPads. iBooks have been created to support student literacy development; however, ePub versions are also created to ensure equity in access. As new devices become more ubiquitous and available, students may not bring in iPads to class. They may wear their technology on their body or face or choose to study fully online and not attend on-campus classes. The current landscape as we know it will change and evolve and reliable infrastructure is essential to support future teaching and learning advancements.

There is a plethora of learning and teaching apps and apps to help with organization and productivity. Navigating this landscape where there is an app for everything can be challenging for the teaching staff; how do they know which app will suit their learning and teaching need? To ensure a consistent learning experience for students, the university modified the Basic Standards for Digital Learning Environments (UWS Learning Standards retrieved from http://www.uws.edu.au/qilt/qilt/designing_for_learning/blended_learning/elearning_standards. Accessed March 02, 2015) to include dimensions afforded by mobile devices such as access to learning materials from any device, instructions for students about how to use an app effectively, and flexible options to enable students. The Basic Standards are designed to be applicable in diverse ways in which digital learning environments, (including the learning management system, other UWS-supplied learning technologies, and mobile apps), are used to support and enhance learning to include mobile devices.

So while 45,000 iPads are part of the UWS learning and teaching landscape, the design of learning activities and digital resources is largely device agnostic.

### 5.3 Organization Frameworks and Policies That Support Digital Learning

The transformation of learning and teaching practice and the role of the iPad in this process have sharpened the focus on other, nonteaching-specific university activities:

- Designing learning spaces for formal, informal, social, and private experiences involved teams from the Information Technology department, capital works, timetabling, learning and teaching, and the library and student representatives.
- Timetabling class activities have shifted from a regular weekly booking at a set time and venue to irregular bookings in non-standard times.
- Governance around learning technology acquisition has seen rapid development to cater for more mobile-enabled learners and educators less reliant on the institutionally provided learning management system as the central digital learning environment.
- Allocation of academic workload around a digitally enabled and equipped workforce already balances the intensive commitments of research and university governance.
- Developing business and financial approaches that support digital learning increase retention rates of students and staff, increase enrolments, and improve graduation successes. Effective and sustainable funding includes growth within cost containment (see Fig. 1).

## 6 Future Directions

When the first tranche of 15,000 iPads were handed out to new students in 2013, there seemed to be a buzz around campus that had not been seen before (UWS iPad news story retrieved from http://www.uws.edu.au/newscentre/news_centre/more_news_stories/thousands_of_students_attend_ipad_collection_day. Accessed March 02, 2015). Students came to campus with their parents or their children to receive their new iPad. There is still a buzz as students get their hands on their new tool for learning. Walk around the campus and there are students congregating in formal and informal learning spaces, and sharing a coffee with peers transforms from a catch up to a collaborative discussion about learning. Observe a class in action. Students have their devices, iPads or other mobiles, handy and are actively using them in personal or collaborative learning activities.

Academic staff also have their iPads with them as they attend classes or meetings, and the mobility and the flexibility of these devices equip them with immediate access to any information or file they may need. The executive staff now

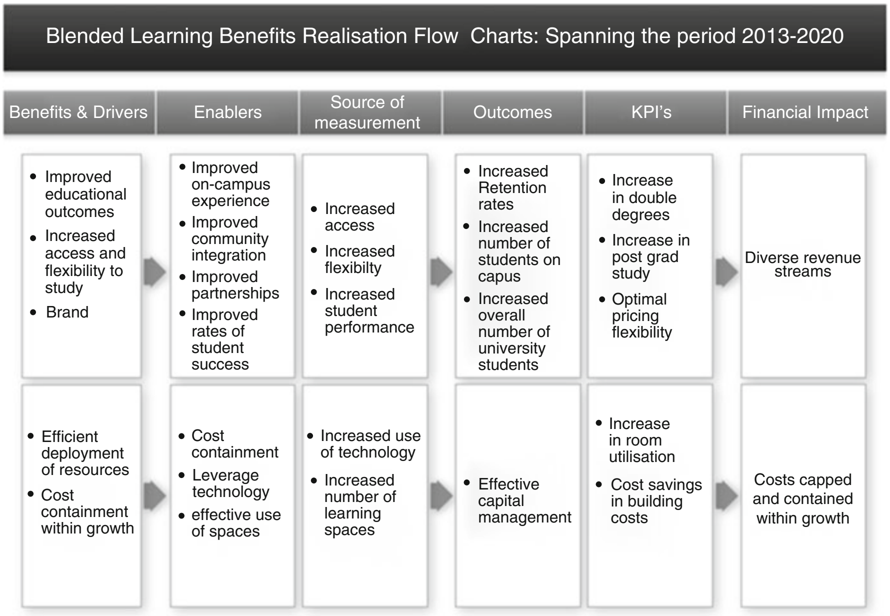


**Fig. 1** Blended learning realization chart

attend meetings with their mobile devices handy rather than reams of papers and documents to file through, and through simple observation, it is clear that using iPads is part of business as usual, from teaching and learning through the administration and governance.

iPads gave staff a license to thrill, they gave students a reason to come, and they gave the institution the air to breathe for curriculum transformation. It was a strategy full of risk as there was no pilot or trial. This strategy could have been a disaster but perhaps that is the essence of why it was, and is, a game changer.

The benefits from the iPad deployment are likely to be seen in full in future years. While enrolments have increased evidence is needed that iPads enrich and deepen student learning. Satisfaction and retention rates show indicators that the strategies are working well; however, it is at least 4 years before final outcomes are proved that the iPad initiative is truly successful in every way. At UWS between 2012 and 2014, the purchase and deployment of 45,000 iPads were indeed an institutional game changer.

## 7 Cross-References

► Characteristics of Mobile Teaching and Learning
► Tutors in Pockets for Economics

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# Mobile Language Learning: How Gamification Improves the Experience

# 45

Izabel de Moraes Sarmento Rego

## Contents



**Abstract**

The learning process can be improved through the incorporation of evolving information and communication technologies to teaching. But it is not enough to use cutting-edge technology. The focus must be in promoting the development of skills that traditional teaching cannot adequately address. In this way, mobile devices, particularly smartphones and tablets, present exciting opportunities today. These devices, largely used by students, allow access to information in a ubiquitous way – anytime, anywhere. This ubiquity, aligned with other mobile learning features – such as high memory capacity, built-in video cameras, voice recording capabilities, and geolocation capabilities, among others – addresses several foreign language learning needs, in the modality known as mobile language learning. Play is a human activity used to entertain, teach, and transmit culture. Recently, games have been studied in a systematic way, where game elements are extracted and applied in corporate and educational situations. In mobile learning, game strategies – known as gamification – are often used to enrich the student experience, fueling motivation and promoting meaningful

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learning. In order to achieve the best results, it is important for the teacher, or other learning experience designer, to be knowledgeable of gamification elements and their application when creating mobile language learning activities. This chapter highlights the main elements of gamification that can be exploited for teaching languages, and it examines three experiences of language teaching trough mobile learning. It also analyzes how these experiences exploit gamification strategies to promote student engagement in the learning. Understanding how gamification strategies improve student learning in these experiences is important in order to advance the pedagogical and technological research of mobile language learning.

## 1 Introduction

Learning a foreign language is increasingly in demand today as new technologies blur geographical boundaries and make access to information and people from remote locations possible.

Even with the advanced development of tools that help in the translation of texts, such as Skype's simultaneous translation tool (Skype Translator) or Google's voice translator application, intrinsic human characteristics, such as the ability to critically analyze information, to grasp humor and irony, and to identify implicit meanings in a message, are necessary to extract meaning from language. While translation tools help, they do not replace the human need to learn to communicate in other languages.

Mobile device technology can be a great ally if it is used to promote not only a more meaningful language learning experience for students but also to increase methodological efficiency by allowing access to education anywhere and at any time.

The modality of mobile language learning uses mobile devices to teach foreign languages. In this modality, the technology resources of mobile devices – such as video cameras, voice recorders, and Internet browsers – are exploited in individual or collaborative activities. Among the pedagogical resources used, game strategies – or gamification – are quite frequently employed in order to engage and motivate students.

What is gamification? What elements can be exploited in language learning activities for mobile learning? How does gamification improve the learning of a foreign language? Understanding the answers to these questions is paramount to designing motivational activities and, at the same time, promoting meaningful learning of the language.

In Sect. 2 of this chapter, the concept of mobile language learning and the main features of language learning through this modality of education will be briefly discussed. Section 3 broaches gamification and the main elements explored in language teaching. Section 4 presents an analysis of the use of gamification in three foreign language teaching applications. Section 5 is a conclusion, comprising a reflection of findings and a proposal for future studies.

## 2 Mobile Language Learning

Mobile learning (or m-learning) is a new teaching modality that follows the student's current learning needs. This student is constantly moving from one place to another, and he is accompanied by mobile devices, such as smartphones and tablets, presenting opportunities to offer him educational activities so he can keep studying outside the formal classroom.

It is possible to find different definitions of mobile learning in the academic literature. Moura (2010) considers m-learning a new educational paradigm based on the use of mobile technologies: "In general you can define m-learning as any form of learning through battery-powered devices that are small enough to accompany people anywhere and anytime" (Moura 2010).

Despite ease of access, it is important to consider that mobile learning efficiency depends on the development of teaching strategies appropriate to the learner, considering his or her learning style, background, and context (e.g., considering where he or she lives – socially and geographically).

Following the current trend of fusion between classroom and distance learning, Zhang (2015a) points out that the special characteristics of mobile devices and technologies should be taken into consideration before adopting mobile learning into any educational project. The author suggests that, rather than replacing classroom learning, mobile learning should be seen as a complement to traditional teaching.

In the academic literature, the definition of mobile learning has evolved through three main phases: the first focused on the mobile device; the second turned the focus to learning outside the classroom; and the third highlighted the mobility of the student (Moura 2010). The main characteristics that define the last and current phase are the ability to continue learning beyond the time and geographical limits of formal education, the ability to use the student's context to aid learning, and the ability to collaborate between peers. Students are no longer passive recipients of learning content but instead exercise autonomy, creating and editing content and communicating with teachers and peers.

Despite advances in mobile technology and in educational research, mobile learning initiatives do not always achieve this third phase – where the mobility of the student is focused – satisfactorily. McCombs (2010, cited Zhang, 2015a) argues that technical limitations and a lack of understanding of student needs by mobile learning project developers are still impediments to implementing true "anytime, anywhere" learning. Some technological barriers, such as the lack of access to high-speed Internet on mobile devices, also hamper implementation.

Even so, the sophistication and creativity of new applications is constantly improving, bringing real-world mobile learning closer to what researchers believe to be the ideal state of this modality, which is contextualized, collaborative, and ubiquitous.

Among the relevant characteristics of mobile learning, learner mobility is considered by many authors (Peng et al. 2009; Moura 2010; Sharples 2006; Traxler 2005) as its main feature. Other relevant features include the presence of a mobile technology device that, among various features, allows access to the Internet, access and ability to record audio and video, and file storage. Currently the most widely used devices are smartphones and tablets, but the early mobile learning research focused on PDAs (personal digital assistant), voice recorders, MP3 players, and regular mobile phones.

Planning and developing m-learning activities may be challenging but worth the effort as resources and learning activities can be shared anywhere and at any time, allowing wider access to education, reaching remote locations and also those with very limited financial resources.

However, as explained below, technology and pedagogy both need to evolve so that mobile learning initiatives become more accessible and effective.

## 2.1 Mobile Learning in Foreign Language Learning

Learning a language is a long and continuous process. In order to encourage faster and more effective learning, it is necessary to expand the time and space limits of classroom, enabling the student to have contact with the foreign language at different moments of their daily life. Foreign language learning can work more effectively if the student has the opportunity to access learning content along his day.

Therefore, as mentioned earlier, one of the areas of teaching that can largely benefit from mobile learning is foreign language learning. Recent studies (Kukulska-Hulme and Shield 2008) demonstrate that mobility of the learner and mobile devices can provide great benefits for language learning.

This form of education can been used in different contexts and with different teaching approaches, from the translation method to teaching based on experience. This is positive, since greater access to educational activities leads to higher benefits to learners of foreign languages.

Some researchers call this area of knowledge MALL: mobile-assisted language learning (Kukulska-Hulme and Shield 2008). MALL offerings have changed as mobile device technologies have evolved. Initially, offerings focused on the use of voice recorders and of palmtops (PDA). With the advent and adoption of the mobile phone, new offerings explored SMS (short message service or text message). As mobile phones gained more features and connection capabilities, MALL initiatives evolved to include native applications (installed on the device). Today, smartphones allow the use of native applications with Internet browsers, geolocators, video cameras, and audio recorders together in the same application, along with other features.

However, even with many different technological features, many mobile language learning offerings still use very few technological resources. Translation and vocabulary exercises are the most widely available. Few offerings promoting collaboration, context exploration, and ubiquity (access anytime and anywhere) have been developed. In general, current offerings merely migrate the dynamics of traditional classroom teaching into mobile devices.

Learner mobility and mobile devices can promote a more engaging and meaningful language learning experience. However, to advance foreign language mobile learning, teaching strategies that exploit technological resources and engage learners through experiences that are meaningful in their context of use need to be developed. Game strategies can help.

The following section is a reflection on the use of gamification to the teaching of foreign languages. The main elements of gamification will be presented and three examples that exploit such resources for teaching languages will be analyzed.

## 3 Gamification

Games have been a part of human culture since ancient times. There are records of games being played as far back as 3000 BCE (Historic Games 2014). In addition to the playful and entertainment aspects, games can also be used to transmit knowledge from generation to generation. Therefore, playing can be a way of teaching and learning. Language, logic, motor coordination, spatial distribution, and a myriad of other cognitive skills can be taught and learned through games like chess, RPG (role-playing game), video games, and others.

In many cases, learning takes place intuitively and spontaneously while playing. Learning is not always the main goal of a game, but the result of engaging in the game's tasks, of repetition, of engaging in trial and error, and of overcoming challenges. However, for educational purposes, it is possible to propose goals and to use gaming strategies to make learning challenging and engaging.

Considering the ability to influence player behavior, Werbach (2014) proposes the use of the theories of persuasive design to show how a gamified activity can influence motivation and user ability. Building on Fogg's theory (2009, cited Werbach, 2014), which considers that motivation and ability lay in a continuum, the author considers it necessary to identify where the user is on this continuum to develop a "trigger" that promotes his motivation and ability: "Game-like experiences can promote both motivation (by making activities feel more engaging) and ability (by promoting learning, achievement, and feelings of confidence)" (Werbach 2014).

To promote interventions that cause behavioral change, Werbach (2014) suggests that gamification should be seen as a process. Therefore, it is not necessary to classify weather a task is gamified or not nor to determine the degree of gamification of tasks. According to the author, to build this continuous leads designers to strive to enhance the strategies of the games.

From another perspective, Kapp (2012) believes that gamification is the use of elements traditionally thought of as for a game or "fun" to promote learning, engagement, and problem-solving skill. In his book "The Gamification of Learning and Instruction: Game-based Methods and Strategies for Training and Education," Kapp defines gamification and its components through an educational lens and presents strategies to bring gamification to the educational context, whether in the classroom or in a virtual learning environment.

According to the author, "Game-based techniques, or gamification, when employed properly, have the power to engage, inform, and educate" (Kapp 2012). According to the author, the purpose of gamification in education is to create a system where participants engage in an abstract challenge, defined by rules, interactivity, and feedback resulting in a quantifiable product, ideally generating an emotional reaction.

Kapp (2012) presents some game aspects that are essential for gamification in learning. Among them, the most relevant are:

- Mechanics: with a schematic of points, rewards, and stages to be overcome
- Aesthetics: with great influence on the player's engagement and her desire to participate in this experience
- Game thinking: converting an everyday experience into an activity that has elements of competition, cooperation, and storytelling.

In the author's view, these elements seek to promote engagement, which is essential for successful learning through a gamified experience.

In the following section, these and other relevant elements necessary to create a gamified dynamic that positively impacts learning will be discussed.

## 3.1 Gamification Elements

There are a few ways to categorize gamification elements. One of the most widely used is to group them into three categories: dynamics, mechanics, and components (Werbach and Hunter 2012). Dynamics represent the highest level of abstraction of a game: constraints, emotions, narrative, progression, and relationships.

Mechanics are basic processes leading to a sequence of actions that generate the player's engagement: challenge, chance, competition, cooperation, feedback, resource acquisition, rewards, transactions, turns, and win states.

Finally, components are the most easily observable elements by the player. The fifteen most important pointed out by authors Werbach and Hunter (2012) are achievements, avatars, badges, boss fights, collections, combat, content unlocking, gifting, leaderboards, levels, points, quests, social graphs, teams, and virtual goods.

This section will not exhaust all gamification elements but will rather focus on those considered most relevant to the context of this discussion.

### Goals

When it comes to learning experiences, the definition of the learning objectives is the starting point. Without them, there is a risk of losing track along the route, resulting in a playful and motivating experience without concrete student learning results.

In a game, victory is the ultimate goal. Reaching it means the end of the game. Therefore, it is customary to establish intermediate goals that lead to this ultimate goal. Thus, the student is motivated to move ahead and get feedback as she develops skills and overcomes challenges.

### Mechanics

Mechanics are systematized in rules, and rules are the essence of a game. They dictate how the game will work, when it will end, and how the stated objectives will be achieved. There are different types of rules, grouped by Salen and Zimmerman (2004) as operational rules (describing how the game is played), constitutive or foundational rules (formal structure that supports the functionality of the game), implicit rules or behavior rules (governing the social contract between two or more players; in other words, etiquette), and instructional rules (governing the learning process through the game). So, setting rules, it is an important step to define the game mechanics.

### Aesthetics

Aesthetics are of great importance in the participant's engagement: "Appropriate and aligned visuals, attention to detail, simple contrasts, or colorful backdrops create an immersive environment that contribute to the overall game experience" (Kapp 2012).

Consistency is the main factor to be considered in the aesthetics of a game. Therefore, it is very important to take into account the audience for whom it is intended, taking care, for example, to not use childish aesthetics in a game designed for adults.

### Game Thinking

Game thinking converts everyday experiences, whether professional or educational, into more playful and dynamic activities. Werbach and Hunter (2012) define game thinking as a way to use all available resources to create an engaging experience that motivates the desired behaviors.

Bringing this concept into education, it is important to observe teaching situations and identify opportunities to enrich them with the resources of gamification. This demands that the educator or designer get to know the repertoire of gamification strategies and elements that are available and critically look at teaching and learning experiences, identifying ways to make them more engaging and meaningful to the learner.

### Collaboration

There are several gamified learning experiences where students study and play by themselves, usually in a virtual environment. However, when thinking about mobile language learning activities, it should be taken into account that collaboration is a very important element in promoting collective knowledge building. Through the exchange of experiences and mutual help among peers, students have the opportunity to become more engaged with the challenge. Group work also increases commitment, helping to reduce evasion.

### Reward and Competition

Reward structures involve but are not limited to scores, badges, and rewards. Behind these elements are driving forces of human development: motivation and competition.

Kapp (2012) believes that conflict, competition, and cooperation are inherent parts of the game: “The meaning of play in the context of conflict is to become a winner while avoiding a loss at the hands of an opponent. (. . .)” Competition is where opponents are “constrained from impeding each other and instead devote the entirety of their attentions to optimizing their own performance. (. . .) Cooperation is the act of working with others to achieve a mutually desirable and beneficial outcome.”

Even if a reward is virtual, the possibility of winning something motivates the player to continue, seeking new badges and rewards. Competition can be exploited through simple game elements such as rankings, where players can view their position compared with opponents and feel motivated to improve their performance to achieve a higher rank.

This monitoring of performance itself is an important way to promote metacognitive skills in the learner, allowing him to monitor his own learning. Kapp (2012) criticizes e-learning courses and classroom instruction which generally do not provide easily traceable progress reports in the formats of leaderboards, badges, or rewards. Reward structures can be regarded as a form of feedback, allowing the student to know her position in relation to the expected performance.

### Feedback

In games, feedback is constantly given. According to Kapp (2012), the frequency and intensity of the feedback is opposed to traditional teaching. According to the author, “Games provide informational feedback. Feedback in learning or playing game is designed to evoke the correct behavior, thoughts, or actions.”

The author refers to two types of feedback. The first is more informational, showing the learner the degree of success or error of his behavior, thought, or action. The second is more educational, providing information to the learner to guide her toward the right end performance.

The feedback does not need to look like a simple text message stating whether the student is right or wrong. In the words of Hunicke (2009, cited Kapp, 2012), “juicy” feedback needs to be tactile (giving the player the feeling that the feedback is happening on real time), inviting (making it a moment desired by the player), repeatable (can be received several times when the player achieves objectives), coherent (related to the game context), continuous (the player does not need to wait for it, happening as a natural result of the interaction), emerging (flowing naturally in the game, giving the sensation of belonging to the game environment and not interrupting or distracting the player), balanced (the player knows he or she is getting feedback and reacts based on feedback), and fresh (it is a bit surprising, containing unexpected turns, and it is interesting and inviting).

### Progression in Levels

Progression in levels is used to achieve three objectives (Kapp 2012). The first is to assist the evolution of the game narrative, presenting new information to sustain player engagement. The second objective is related to strengthening and developing skills, focusing on the development of the same skills in the later levels of the game, but requiring more speed and making them more challenging. The third objective is that the levels serve as motivation, as small victories by the player who moves from one stage to the next.

Therefore, levels in the game are used to serialize the challenge and the narrative, increasing motivation and preventing the game from becoming boring and tiring. The challenge is to combine these elements so that the game does not become too easy or too hard.

### Storytelling

It is a big challenge for gamified learning designers to take into account the student's context. One possible way is creating a narrative or storytelling, bringing relevance and meaning to experience.

The name of the game, characters and stages, and some graphic elements are usually sufficient to activate the story that will unfold in the player's imagination.

According to Kapp (2012), stories bring meaning, context, and guide action. The main elements of the narrative used to develop games are the characters, events, tension, and solution.

Considering the topics presented above, the most significant gamification elements for mobile language learning are summarized in the Table 1:

Learning tasks that employ gamification do not always utilize all these elements. However, it is important to know them all and make conscious decisions about which elements to use. The main objective is not to transform learning activities into full games but to enrich the student's experiences, motivate her, and make learning more meaningful.

In the following section, three mobile language learning experiences will be analyzed from the perspective of gamification, highlighting strategies, and elements used.

## 4 Gamification in Teaching Languages

The use of gamification strategies is widely used in the classroom teaching of foreign languages and can be seen in educational materials and activities that exploit recreation and competition to engage students in language learning. Currently, some mobile learning offerings also use game strategies for the teaching of foreign languages. Here, three foreign language mobile learning with gamification offerings will be discussed. Elements of games that are used and others which could be used to enrich the experience will also be analyzed.

**Table 1** Gamification elements for mobile language learning

| Goals | Narrative | Rules | Feedback | Reward structure | Progression degrees | Graphic aspect |
|---|---|---|---|---|---|---|
| *Educational* | *Context* | *Operational* | *Educational* | *Competition* | *Narrative* | *Aesthetics* |
| *Ludic* | | *Behavioral constitutive* | *Informational* | *Cooperation* | *Ability* | *Consistency* |
| | | *Instructional* | | *Collaboration* | *Motivation* | |

### 4.1 Language Learning Game

Sultana et al. (2012) present a collaborative game proposal for foreign language learning. Named LLG (language learning game), the tool is designed to help adult learners learn a foreign language using smartphones. Learners must already have some language knowledge to participate in the game. In terms of technology, a smartphone that runs Java and has access to the Internet is needed. The authors presented an example of English language teaching.

The game proposes that a small group of three to five participants collaboratively creates a story in English. Each participant writes a sentence and submits it to the group. The other participants may suggest spelling and grammar corrections. The original and the corrected versions of the sentence are submitted to a vote by the group, which chooses the option that seems to be the most accurate.

Then, another participant writes a sentence that follows the previous one. The process repeats until all students have written a sentence, which completes a cycle. The game runs for three to four cycles. In the end, a supervisor – someone with a high command of the language – assesses the story created and suggests corrections. Finally, everyone gets a version of the full story and a virtual flashcard with the supervisor's corrections.

An important aspect of LLG is anonymity: the participants do not know who is in their group. According to the authors, this prevents people from feeling intimidated, afraid of making mistakes. The authors also point out that competition can lead to a situation where students with greater language proficiency earn rewards and student with limited knowledge of the language gain nothing. Therefore, they believe that everyone benefits in collaborative offerings, where students are encouraged to create communities of mutual assistance: "Their critical thinking skills increase and their retention of information and interest in the subject matter improves. This in turn leads to higher self-esteem in all the participants, which is the ultimate goal of LLG. It is designed in such a way that all the participants need to communicate with each other frequently" (Sultana et al. 2012).

In the paper presented by the authors, the following gamification elements are identified:

- Objective: to promote the self-esteem of learners of a foreign language.
- Mechanics: to write sentences that compound to a story.
- Collaboration: to correct other participants' sentences, to vote on the correct sentence among the different versions presented, and to write a sentence that will continue the story.
- Feedback: participants correct the sentences for spelling and grammar; a supervisor reviews the story and points out corrections that students did not suggest.

In addition to receiving the final version of the story, the authors point out that the best writer and the best group should be rewarded, but not to name the reward so that students cannot discover the other participants of the game.

It is noted that progression levels are not displayed. The authors note that, in the pilot, teachers who accompanied the game expressed interest in implementing LLG in their courses, demonstrating that it is a complementary activity to a wider teaching curriculum. Perhaps that is why there is no concern about levels of progression in the game. Although not explicit, it is possible that the complexity of the game increases as participants gain greater knowledge of the foreign language, which can make it more challenging for the whole group.

The themes for the stories are not mentioned in Sultana's article but the group supervisor could suggest a theme or situation for the construction of the story, for example.

Competition can stimulate student engagement in the game while be complementary to collaboration. On one hand, the anonymity of participants favors freedom from judgment in relation to making mistakes but, on the other hand, recognition from peers promotes social engagement, which is important for collaboration.

## 4.2 Duolingo

A free and widely available foreign language learning application, Duolingo was analyzed by Petit and Santos (2013) from the point of view of language teaching methodology and gamification.

The authors point out that the application uses quite old teaching methods and modern gamification strategies at the same time. Duolingo activities are based on the translation of texts (teaching methodology dating back to the nineteenth century) and teaching grammar and vocabulary in isolation (methodology that emerged in the mid-twentieth century). Petit and Santos (2013) believe that this methodological choice is made for economic reasons, since teaching vocabulary out of context excludes the need for human mediation.

When a student starts learning a new language, the application presents vocabulary translation exercises, always with reference to a language that can be the learner's native language or another available language. One exercise, for example, has a word in the source language and four images with different words for the learner to choose the correct translation. By choosing one of the words, the application plays an audio recording of the chosen word.

The same type of exercise is repeated for the translation of sentences. Sometimes images are available as translation support resources, but sometimes they are not, unlike the audio feature (which is always available). Even in early lessons, exercises are presented where the learner must write the translation of words and short foreign language sentences in the reference language.

The system has some flexibility for accepting more than one translation option whenever possible, and words without orthographic accents, although drawing the user's attention when he writes without accents.

In the Spanish course for Portuguese speakers, 64 different lessons were identified. The names of the lessons are always topics of grammar or vocabulary such as plurals or colors. The initial lesson has 18 screens with different exercises, all centered around the translation of words and short sentences.

The user begins the first lesson with four hearts, called “lives.” If she misses an activity, she loses a heart. If she loses the four, she will need to redo the lesson. At the end of each lesson, she receives a number of points according to her performance.

Among gamification strategies, Petit and Santos (2013) highlight the system of life, points, and competition. Competition takes place when the user adds other users to their list of friends. The system will notify the user about the performance of friends, encouraging them to reach the scores obtained by them.

The most prominent gamification elements in the application are:

- Mechanics: the rules are clear and presented as the user advances in the game.
- Aesthetics: it is very intuitive and visual resources are exploited both for teaching the language (with images related to vocabulary) and to make the user experience more pleasant.
- Feedback: the user receives feedback immediately when completing an exercise. The system also gives tips when orthographic accents are not used properly or when more than one answer is possible.
- Levels of progress: the 64 lessons identified in the Spanish course, for example, are grouped into levels. To advance from one level to another, not all lessons need to be completed. If the user believes he has the required knowledge for that level, he can submit to a test called a “shortcut” to validate his knowledge and advance to the next level.

Among the gamification elements that are not exploited, the lack of use of the student’s context and collaboration among peers stand out. From the point of view of language learning, the lack of use of the learner’s context in the design of the activities is a very important element. It would be necessary to further investigate if a learner who completed all the lessons will be a competent speaker, able to communicate in a foreign language. Regarding collaboration, the presence of friends serves as stimulus for competition, but a form of collaboration in solving tasks was not identified.

## 4.3 LingoBee

Going in the opposite direction, Procter-Legg et al. (2014) propose that learning should be seen as a social activity, happening inside a community of learners. To explore how these factors promote language learning, the researchers conducted a study in different countries to develop and test the application LingoBee, designed to support language learning on mobile devices.

LingoBee is part of the SIMOLA (Situated Mobile Language Learning) project, created through a partnership between six countries (Simola 2012). The application supports six different European languages and Japanese. It is an open source app, developed for the Android OS.

LingoBee's objective is to develop knowledge of vocabulary in a context. The learner creates her own virtual flashcards with the words and phrases she is learning. In each flashcard, she describes the word and can link a picture, record the pronunciation of the word, or link a web link. The application has a *text-to-speech* feature to help with pronunciation.

These flashcards are stored in the system repository and are shared among users who can view, edit, and vote on entries. This repository has search tools that facilitate the search for specific content.

The authors identify LingoBee users as social networkers, since learners construct meaning together while creating the multiple inputs used to add and edit these entries. The application also allows users to create a social profile with a username and contact information, encouraging social interaction among peers.

Although not presented as a game per se, it is possible to identify gamification elements in the LingoBee application:

- Objective: it is clear that the proposed objective is the dominance of vocabulary in a foreign language.
- Collaboration: this element is crucial to motivate the engagement of the user in the application, since, by collaborating with peers it is possible to validate if the entries presented are correct.
- Feedback: occurs through interaction with peers, through comments, edits, and voting on entries in the system.
- Aesthetics: in Procter-Legg's article, it is possible to identify some screenshots of the application and verify that the design is intuitive and functional.
- Context: the application explores the learners place and time. He can, for example, take a picture of an object that is in front of him and create an entry with new vocabulary in the foreign language. The application is a great example of how to exploit context for teaching languages through mobile learning.

Among the gamification elements neglected, game mechanics and rewards stand out. Regarding the mechanics, rules are not displayed. Also, no reward structure is evident besides the votes of fellow learners and the level of personal satisfaction achieved in learning.

The authors propose that the social context promotes learning. They argue that social networks break down the barriers between formal and informal learning and are currently becoming a path sought by students.

LingoBee explores gamification elements taking into account current concepts of teaching foreign languages, in particular the student's context, and peer interaction, making it an interesting Mobile Language Learning offering.

## 5 Future Directions

Considering the cases presented below, it is possible to conclude that learning foreign languages can be enhanced by mobile learning and by gamification strategies. Currently, studies on teaching approaches indicate that elements such as context and collaboration are very important when learning a foreign language (Telles 2009; Figueiredo 2006).

The challenge in using gamification elements in mobile language learning is to go beyond activities focused on the acquisition of specific elements, such as vocabulary and translation of sentences, and expand the horizons to more complex offerings considering student's context and the different forms of collaboration among peers.

One of the trends in the convergence of technologies for education is a blended format (Johnson et al. 2014), where educational activities will take place partly in person and partly online, both through computers and through mobile devices. This will lead designers to focus not only on technology devices but especially on teaching strategies, considering the best resources to promote learning wherever the student is.

In this sense, gamification strategies will be very important to engage and motivate students in learning beyond of the institutional limits of formal education, wherever they are and whenever they want to learn.

## 6 Cross-References

▶ Business Models for Mobile Learning and Teaching
▶ Characteristics of Mobile Teaching and Learning
▶ Design Considerations for Mobile Learning
▶ Gamification and Mobile Teaching and Learning
▶ M-Learning and U-Learning Environments to Enhance EFL Communicative Competence

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# Moving Towards the Effective Evaluation of Mobile Learning Initiatives in Higher Education Institutions

**46**

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## Contents



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**Abstract**

Mobile learning is viewed by many institutional leaders as the solution for a student cohort that is demanding an increasing flexibility in study options. These students are fitting study around other aspects of their lives including work and caring responsibilities, or they are studying at a geographical location far removed from the university campus. With ubiquitous connectivity available in many parts of the world and with the incremental improvements in design and affordability of mobile devices, many students are using mobile technologies to access course materials and activities. Even so, there are relatively few formal mobile learning initiatives underway and even fewer evaluations of those initiatives. This is significant because without a rigorous evaluation of mobile learning, it is impossible to determine whether it provides a viable and cost-effective way of accessing courses for both the student and the institution. This chapter examines the broad groupings of uses for mobile devices for learning, before considering the evaluation frameworks that are currently in use. The characteristics, affordances, and issues of these frameworks are briefly discussed. A project to develop a Mobile Learning Evaluation Framework is introduced, which will consider evaluation from four aspects: (1) pedagogical learning, (2) pedagogical teaching, (3) technical, and (4) organizational.

## 1 Introduction

Mobile learning is an emerging area of interest for higher education institutions, but both the theoretical foundations and practical implications of mobile learning for those institutions are still being explored (Kearney et al. 2012). Until fairly recently, research into the impact of mobile learning initiatives on teaching and learning was still being undertaken on a fairly ad hoc basis within Australian universities. Mobile learning initiatives are frequently championed by individual practitioners with little buy-in from their institutions (Carter and Salyers 2013). Mobile learning is, however, being increasingly seen as a new and compelling way to engage students. Consequently, a number of higher education institutions in Australia have embraced the potential affordances of mobile technologies and implemented mobile learning initiatives of varying sizes.

The University of Adelaide was one of the first Australian universities to provide mobile devices to students on a large scale. The university handed out free iPads to all students enrolling in a science degree in 2011, with the aim of providing students with flexible learning opportunities and teaching materials that were more accessible, more relevant, and more frequently updated (Murphy 2011).

The University of Western Sydney (UWS) has more recently provided 11,000 iPads to all first year students and staff in 2013 to support learning and teaching innovation (Griffith 2012a).

These programs have attracted extensive attention both within the mainstream media and in academic circles in relation to the potential pedagogical value of these initiatives. The National Tertiary Education Union has been highly critical of the UWS program, citing that the initiative arose at the expense of some language study courses which were abandoned. The university was also criticized for using expensive iPad technologies, rather than cheaper notebooks using Android systems, which would potentially be more useful for document processing and assignments (Griffith 2012b). These criticisms highlight the types of concerns that may discourage institutional leaders from considering the wide-scale implementation of mobile learning projects. These concerns indicate that the readiness of students, educators, and institutional leaders to effectively embrace the potential of mobile learning has yet to be fully be explored in Australian higher education institutions. There is also significant variation in the literature regarding the mobile technologies being used, the educational settings under investigation, and theoretical frameworks to support the sustainability of mobile learning initiatives (Ng and Nicholas 2013).

Readiness is related to the concept of adoption phenomena. Readiness can be viewed as "behavioral readiness," "perceived readiness," "organizational readiness," technical readiness," and "environmental readiness." For example, behavioral aspects can be directly borrowed from the previous adoption models of Fishbein and Ajzen's Theory of Reasoned Action (TRA) (Fishbein and Ajzen 2010) in the context of intrinsic motivation (Davis et al. 1992) and affect toward use (Thompson et al. 1991; Venkatesh et al. 2003). Similarly, the concept of perceived readiness can be borrowed from a number of adoption, innovation, and diffusion theories (e.g., see Fishbein and Ajzen 1975; Davis et al. 1989; Rogers 2000).

The greater use of mobile technologies for learning and teaching has a number of significant implications for higher education institutions at a pedagogical, infrastructural, and policy level (Dahlstrom 2012; see ▶ Chap. 24, "Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom" by Kraglund-Gauthier; ▶ Chap. 6, "Framework for Design of Mobile Learning Strategies" by Boude Figueredo and Villamizar in this handbook). For example, prior to considering implementing these types of initiatives, universities need to consider whether they are ready, i.e., whether current wireless internet infrastructure should be upgraded or whether the format of current course materials is suitable for display on mobile devices. The implications of providing students with mobile technologies as opposed to encouraging students to bring their own device (BYOD) policies also require careful consideration. This chapter provides an overview of the potential practical and theoretical implications of implementing mobile learning initiatives at an institution-wide level. The chapter also presents an overview of current models used to assist higher education institutions in evaluating the potential impact and benefit of mobile learning initiatives.

## 2 Influence of Mobile Learning Initiatives on Teaching and Learning Within Higher Education: Review of Current Use and Pedagogical Goals

When considering whether or not to implement mobile learning initiatives in higher education institutions, it is easy for leaders and administrators to become fixated on the financial, logistical, or technological challenges or benefits. Cost, adaptability, and scalability are most frequently cited as the drivers encouraging the adoption of mobile technologies in specific learning environments (Patten et al. 2006), and frequently the potential pedagogical affordances of these devices are given less consideration. Educators and curriculum designers are faced with the challenge of identifying ways to use mobile technologies for more than simply practical purposes and need to do more than simply alter the presentation style of a traditional lecture or alter the physical locale of teaching and learning. Pedagogical change must accompany the adoption of mobile devices (Jeng et al. 2010), and educators are faced with the challenge of leveraging mobile devices in ways that are educationally appropriate rather than technologically complex (Roschelle 2003). Research also needs to move on from the usability and features of mobile devices to incorporate a broader pedagogical framework (Kissinger 2013).

Five aspects of the use of mobile learning have emerged from the literature: (1) altered delivery of content and knowledge storage, (2) portability, (3) creativity, (4) bridging the knowledge and application gap, and (5) interactivity. Mobile learning allows for an alternate delivery of content and knowledge to the traditional lecture format with students sitting within a classroom passively listening to a knowledgeable person at the front of the room. This is related to the issue of portability of devices students use for learning. Portability also frees students from the traditional lecture situation and allows them to learn at a location remote from the campus. Mobile devices also allow for greater opportunities for developing creativity in students. Another positive aspect of mobile learning is the development of the link between the interests and experiences of students with higher education – bridging the knowledge and application gap. Finally, the aspect of interactivity also broadens the learning experiences of higher education students beyond the traditional passive learning situation. These five aspects will be explored in more detail below.

### 2.1 Altered Delivery of Content and Knowledge Storage

In studies of iPads, particularly in higher education, these devices were found to be mainly used as repositories of content and portals to delivery mechanisms such as iTunes U for course materials (Cooper 2012; Murphy 2011). Further, students preferred the use of the iPad when the material was integrated with the curriculum (Manuguerra and Petocz 2011). Kissinger (2013) explored the learning experiences of students using eBooks in higher education as a replacement to traditional textbooks and other reference material and found students expressed feelings of competence and valued using the eBooks for their learning. Students appreciated the portability of eBooks. Though recently, doubt has been cast on whether students learn as effectively from eBooks as from printed materials (Flood 2014). Much work remains to be done in this space.

In order to accommodate learning across a range of devices in a variety of contexts, course materials should be provided in a number of common file formats. Students typically use a variety of mobile devices using a range of operating systems (iOS, Android, Windows, Blackberry). For those students using laptop computers, materials should be provided as PDFs, or in the .doc, .xls, or .ppt formats (Murphy et al. 2014).

To enable students to be able to annotate lecture slides (for face-to-face students) or to access notes when on the go or when grabbing portions of time opportunistically (face-to-face and distance students), notes should be provided in various formats that match the students' study practices: not just in HTML, .doc, and .ppt but also PDFs which can be annotated with many apps and can be used across various platforms and with various applications (Murphy et al. 2014). Portability of information formats to different brands of device, and the creative tools currently available on them, is a major concern.

## 2.2 Portability

Devices such as iPads have also been used for student learning in the field, such as with paramedic students (Williams et al. 2011) making the most of physical portability of mobile devices. Podcasting also moves students from the traditional place of the lecture to a chosen location (Dyson et al. 2009; Gkatzidou and Pearson 2009). McGarr (2009) reviewed the literature and found that podcasting in higher education was most commonly used to provide recordings of otherwise conventional lectures. In addition, podcasting provided supplementary material to the lecture. A less common use of podcasting was student-generated, creative podcasts.

It would not be helpful to record lectures as podcasts with those subjects that require complex formulae to be demonstrated or with strong visual elements necessary for understanding and so on, but for most courses, this would be useful. Podcasts allow students to make use of the time when they are on the go, moving between venues, while exercising, during a commute, and so on. Again, podcasts should be provided in multiple file formats to allow use on a wide range of devices. An educator does not necessarily need high-end hardware to record podcasts. Most smartphones have a voice recorder and this will produce recordings of a sufficient quality for most purposes (Murphy et al. 2014).

## 2.3 Creativity

A greater use of mobile learning for creative purposes rather than simple replacement of the traditional learning environment is required. Eyadat and Eyadat (2010) named the connection between technology and creativity in higher education "the missing link." These researchers found that there was a significant difference between the experimental (using technology) and control (receiving traditional teaching) groups of students in their creativity levels. A creative problem solving framework and mobile tool was employed by Wood and Bilsborow (2014) with higher education students, finding that students were more confident to generate solutions to problems and did, indeed, demonstrate greater creativity and divergence in their assignments. Similarly, Terkowsky and his colleagues found that students could work creatively in STEM (science, technology, engineering, and mathematics) subjects using ePortfolios, remote access laboratories, and learning environments accessed via mobile devices. The activities included facets that were known to promote creativity, namely, learning by doing, producing a product, and fostering self-reliance (Terkowsky et al. 2013). The sound and video recorders, cameras, and the ability to access web 2.0 tools for editing and sharing found in most modern mobile devices make it very easy for students to create and share content, wherever they are and whenever they want. These affordances of mobile devices, coupled with carefully designed activities, can foster creativity in students far beyond what is generally encountered in the traditional, didactic classroom.

### 2.4 Bridging the Knowledge and Application Gap

Augmented reality mediated via mobile devices has been employed in order to better align student experiences and interests with higher education learning and the application of that learning, as well as encouraging creativity and novel solutions to problems. Augmented reality can facilitate problem solving via presentation of scenarios and gameplay (Herro et al. 2013; Squire and Klopfer 2007). It can help learners visualize complex structures, such as anatomical structures, by enabling them to virtually manipulate or walk around an object (Wu et al. 2013).

Even so, using mobile devices for augmented reality gaming is not all positive as Hildmann and colleagues found in a multinational comparison study. There were more participants strongly opposed to the mandatory use of mobile devices in their higher education courses than were strongly supportive (Hildmann and Hildmann 2009). The authors note, however, that the results may not be representative of the wider university population. The five studies reported on included from 36 to 221 participants, a relatively small sample. Problems of connectivity are particularly heightened when using mobile devices for augmented reality and gaming (Herro et al. 2013; Hildmann and Hildmann 2009). Also, there can be issues when the mobile devices have to interface with other technologies or require ubiquitous connectivity for optimal performance (Wu et al. 2013). These technological difficulties can lead to students disengaging from the learning activity, frustrated at the time spent in troubleshooting issues, and diverting attention away from the learning.

### 2.5 Interactivity

The interactivity enabled by mobile devices has been explored in higher education with generally positive results (Franklin 2011). For example, the use of microblogging services such as Twitter and other social networking sites such as Facebook was incorporated into multiple higher education courses in New Zealand over a four-year period with perceived success by students (Cochrane and Bateman 2010). Again, these authors said that integration of mobile learning into subjects requires a paradigm shift on behalf of the lecturers and this takes time. Cheung and Hew (2009) also noted that mobile devices were most commonly used as communication and multimedia access tools which have resulted in technology simply serving as a different means to the same instructional or learning goal. To effect real change, the affordances of mobile devices which enable interactivity must be leveraged.

The levels of interactivity between lecturer and student have also been enhanced through the use of mobile devices for immediate assessment of student understanding (Cochrane and Bateman 2010). Using wireless technology and mobile devices such as iPod Touch and iPhone, for example, Stav and his colleagues were able to provide a more flexible and cheaper system than "clickers" for students to use in class (Stav et al. 2010). Using mobile devices in this way allows for more interactivity with the lecturer than just a questioning of students when only one student at a time can respond. It also allows for interaction by students who are normally too shy to respond in the classroom (Lam et al. 2011).

Based on the research literature in the domain of wireless, handheld devices in an educational environment, mobile learning is not limited simply to retrieving information and resources. Mobile learning can be much more sophisticated. For example, mobile learning can involve interactively linking with other learners around the world, peer reviewing and learning in real time, and participating in a learning environment irrespective of the location. Hence, mobile learning provides the ability for participants to share resources in a live learning environment. Wireless, handheld devices in the higher education domain have enormous potential to improve learning and the educational experience of students, which is yet to be realized. However, these technologies and the evaluation of their use for learning pose some challenges.

## 3 Challenges in Evaluating Mobile Learning Initiatives

With mobile learning, the focus is less on specific mobile devices and more on enabling students to engage in learning from any location and at any time, regardless of the type of technology in use. Mobile technologies have features and functionality that can be used to supplement and enhance both online and blended learning environments and therefore have the potential to deliver a wide variety of new outcomes for learners, lecturers, and the educational system. As a result, there is a need to determine the specific requirements when considering learning design in the context of mobile learning. Hence, it is necessary to validate the impact of mobile learning principles and initiatives on actual teaching and learning outcomes.

A common problem encountered in evaluation models for educational technologies such as mobile devices is that many models focus only on isolated components of mobile learning. For example, models may single out the device, the user, or the institutional context with little consideration of how all of these may interact. These complex interactions need to be suitably expressed within any framework or model under consideration. After a thorough review of the literature, Ng and Nicholas (2013) indicated that there is currently no appropriate model of sustainable mobile learning in institutions.

Fundamental to the evaluation of mobile learning is the need to conceptually define just what "mobile learning" is. John Traxler (2007), professor of mobile learning at Wolverhampton University, noted that "mobile" is far more than a mere qualification of the concept of learning. Instead, mobile learning has emerged as a distinct concept complementary to other emerging concepts such as the mobile workforce and a connected society. Traxler (2010) noted that initial attempts to define mobile learning focused exclusively on the mobile devices themselves, making particular reference to handheld or palmtop electronic devices. The next definitions showed an increased focus on mobility, but that focus was largely on the mobility of the technology. The following category shifted away from considering the technology to instead underscore the mobility of the learner and the learning process. Those definitions of mobile learning which only incorporate a description of the technology may become obsolete as mobile technologies and the emerging features of these technologies are changing quickly (Farley et al. 2013).

There is a convergence of mobile technologies in single devices which can function as a phone, media player, multimedia, and wireless computer with GPS capability and sensor capability. Further, the explosion of mobile apps can potentially extend and leverage this growing list of multifunctional features (Sharples et al. 2007). Another equally important convergence that has also been occurring is personalized lifelong learning through the interplay between mobile devices and new ways of learning that are emerging (see Table 1).

Table 1 provides examples of the interplay that can occur between new ways of learning and the current and increasingly expanding multifunctionality of mobile devices. It is worth noting that mobile apps further extend the ways which this multifunctionality can be leveraged for learning. Traxler (2007) makes a good point in this regard, in that there are also constraints involved with mobile learning facilitated by students using BYO mobile devices as not every student will have access to the latest mobile devices. The technological diversity and limitations of mobile devices such as mobile phones and tablets provide as many challenges as well as opportunities for academics and institutions wanting to embrace mobile learning in the delivery of the courses. Education and mobile learning are not at the forefront when these types of mobile devices are designed, manufactured, and marketed with corporate, retail, and recreational use in mind. Sharples et al. (2007) suggested that from a theoretical perspective, mobile learning must be tested against the following criteria:

**Table 1** Interplay between new learning approaches and mobile technologies creating new learning opportunities (Adapted from Sharples et al. 2007)

| New learning | Multifunctionality of mobile devices | Examples |
|---|---|---|
| 1. Personalized | 1. Personal | Digital identity, contacts, calendar, photos, videos |
| 2. Learner centered | 2. User centered | Learning can be contextualized to an individual's preferences and technological capabilities of a mobile device |
| 3. Situated | 3. Mobile | Learning can be situated to a user's location |
| 4. Collaborative | 4. Networked | Learning activities and outcomes can be shared with others regardless of their location, as long as they have mobile broadband internet access, either synchronously or asynchronously |
| 5. Ubiquitous | 5. Ubiquitous | Mobile technologies are readily accessible to all across a range of mobile devices and different types of networks with internet access |
| 6. Lifelong | 6. Durable | Increasing mobile learning can be stored permanently as part of the digital footprint of users |

- Is it significantly different from current theories of classroom, workplace, or lifelong learning?
- Does it account for the mobility of learners?
- Does it cover both formal and informal learning?
- Does it theorize learning as a constructive and social process?
- Does it analyze learning as a personal and situated activity mediated by technology?

A Mobile Learning Evaluation Framework needs to consider a number of key issues such as the technological support for mobile learning. Cochrane (2012) listed technological support as one of the critical success factors for mobile learning projects, suggesting a series of introductory technical workshops and intentional Communities of Practice during the planning and implementation of mobile learning initiatives (Cochrane 2012). Botcicki and colleagues (2011) recommended both technological and social scaffolding were necessary for students to fully participate in collaborative mobile learning opportunities. Technological support also needs to be considered in those instances where mobile learning is being deployed in developing countries where the technical infrastructure and support are likely to be limited. This aspect of mobile learning needs to be evaluated from the student, academic staff, and institutional level perspectives.

Beyond investigating and describing the technological aspects of a mobile learning initiative, a number of other questions need to be asked and represented in a Mobile Learning Evaluation Framework:

- Are there sufficient mobile learning opportunities that can be delivered to students and do these mobile learning opportunities leverage the multifunctionality of mobile devices such as smartphones and tablets as the technological boundaries of mobile learning are becoming blurred?

- How do we accommodate the needs of students who do not have access to mobile devices and/or do not have access to mobile broadband internet?
- How can institutions provide personalized mobile learning that accommodates the learning styles and needs of individuals and their technological capability?
- How do we evaluate academic staff effectiveness in developing mobile learning opportunities which leverage the multifunctionality capability of mobile devices including always on connectivity?
- How do we evaluate the effectiveness of mobile learning opportunities from a pedagogical perspective and are these in line with the broad aims and objectives of academic institutions?
- Is institutional policy providing the impetus and support for academics to develop mobile learning opportunities for its students?
- How do we accommodate the diversity of student populations in providing mobile learning opportunities?

## 4 Development of Frameworks for Evaluating Mobile Learning in Higher Education

A Joint Information Systems Committee (JISC) eLearning program report, published in late 2010, stated that the most significant issue in mobile learning is the absence of full-scale evaluations of mobile technologies in the higher education sector (Wishart and Green 2010). The same report also bemoaned the lack of a stable model from which to effectively research the role, drivers, and impact of mobility on learning (Park 2011). There have been several attempts to theorize mobile learning, yet none have succeeded in ensuring a comprehensive and rigorous analysis of the swiftly developing landscape of mobile learning initiatives, networks, and technologies. Some models are emerging directly in response to the proliferation of mobile learning initiatives; others are adapted from existing evaluation frameworks for other technologies. The section below will provide a brief, critical overview of a few of the mobile learning frameworks and models identified in the research literature.

### 4.1 The Evaluation of Technologies Framework: Ng and Nicholas (2013)

Ng and Nicholas 2013's Evaluation of Technologies Framework is focused on mobile learning in primary and secondary schools, rather than in higher education institutions. Their research addressed how the interactions between stakeholders and between users and devices influence the sustainability of a mobile learning innovation in a particular institution. The emphasis is on how person-centered notions of sustainability are important for innovation. This Technology

Evaluation Framework explains the interplay between a range of players or stakeholders and provides a holistic picture of mobile learning which considers the roles of the key stakeholders in the adoption of mobile learning (Ng and Nicholas 2013). Though useful, there are significant implications in applying this model to mobile learning in the higher education context. Individual educators are more likely to determine the successful adoption of any mobile learning initiative, and typically, universities are much larger orders of magnitude and complexity than individual schools. The Evaluation of Technologies Framework has emerged relatively recently and, as yet, has had limited impact on the planning and implementation of mobile learning initiatives in higher education. However, this may change given time.

### 4.2 A Critical Analysis: Frohberg, Göth, and Schwabe (2009)

Frohberg et al. (2009) critical analysis can't really be considered a framework – no formal structure is proposed. However, the authors identify the central benefits and values of 102 mobile learning initiatives, before naming common pitfalls and making some recommendations. Frohberg and colleagues reviewed the literature using a methodology based on the work of Sharples et al. (2007). A weakness of this approach, by their own admission, is that this work is literature-based and not based on primary data. It is also possible that key literature was missed because key studies could have been published in journals of another discipline rather than in the educational technology or mobile learning journals (Frohberg et al. 2009). It was also formulated before the emergence of tablets and smartphones. However, this research makes an important point and concludes by saying that mobile learning is best used for learning in context, rather than just information delivery which can be done by other means. The researchers also suggest that advanced learners be targeted first (Frohberg et al. 2009). As the title suggests, this may indicate the future of mobile learning, yet very few educators are ready for such a nuanced and advanced view of mobile learning.

### 4.3 A Framework for Analyzing Mobile Learning: Sharples, Taylor, and Vavoula (2007)

Sharples et al. (2007) argue that conversation is the driving process of learning. This research builds on the work of Laurillard (2002) which previously built on the work of Pask (1975). This research is important as a foundational work which is specific to mobile learning. However, this research was conducted before tablets and smartphones become mainstream consumer devices, although it does refer to PDAs. This research provided some useful insights by looking into individual mobile learning initiatives which is appropriate given when it was written, well before the widespread adoption of mobile devices such as laptops, tablets, and smartphones.

### 4.4 Pedagogical Forms for Mobile Learning: Laurillard 2007 (Based on Work in 2002)

Laurillard's (2007) Conversational Framework has gained considerable traction in educational technology research, but is not mobile specific. The basis of this framework in formal learning is that it rests on two levels: (1) a "discursive" level between student and teacher which accommodates theory, concepts, and description building and (2) an "experiential" level, also between student and teacher, but which focuses on practice, activity, and procedure building; both levels are interactive. Interestingly, this research also considers the importance of informal or unstructured learning which may be as important as formal learning in evaluating the effectiveness of mobile learning as a paradigm shift in learning in the higher education sector.

## 5 Developing a Mobile Learning Evaluation Framework

Over the previous decade, a number of studies have been conducted across sectors to investigate the role of mobile learning in learning and teaching (e.g., Elias 2011; Biggs and Justice 2011; Wong 2012). These studies consistently demonstrate that there are a significant number of difficulties that hinder the adoption of mobile learning, both at an institutional and at a user level, both educator and learner. Higher education leaders are wary about investing heavily in new mobile technologies because of the rate with which they become superseded. Consequently, only a small number of higher education institutions have deployed well-resourced mobile learning initiatives.

Researchers at the University of Southern Queensland (USQ), in partnership with researchers at the Australian National University (ANU) and the University of South Australia (UniSA), are working to develop a Mobile Learning Evaluation Framework (MLEF). This is one of the five projects at USQ funded under the Australian Government's Collaborative Research Network funding secured by the three partner institutions. The aim of the MLEF project is to support leaders and educators in higher education institutions to provide sustainable mobile learning opportunities to students. This project will result in three significant outcomes:

1. A standardized model to explore how mobile learning initiatives impact on learning and teaching in higher education
2. A review and analysis of the broad spectrum of pilot studies and initiatives that have been implemented in Australia and elsewhere and the kinds of approaches used to evaluate them
3. A Mobile Learning Evaluation toolkit: a set of principles, procedures, and methods that can be used to promote the collection and review of information related to new mobile technologies, the objective evaluation of mobile learning

initiatives, and prioritization of proposed investments in mobile learning within various learning contexts

In order to measure the educative value of a particular educational technology, Quinton et al. (2010) recommended three areas of focus: pedagogical, technical, and organizational. For the purpose of this project, this model will be adapted by further breaking down the area of pedagogical to pedagogical (teaching) and pedagogical (learning), so that four primary themes will be explored during the data collection and analysis activities. The challenges, needs, and issues will be examined at each level when considering the implementation of mobile learning initiatives. Therefore, this project will focus on the following four areas:

- **Organizational**: Clarification of the institutional policies and practices that currently support or hinder the implementation of mobile learning initiatives
- **Technical**: Identification of the supporting technical infrastructure and technical support, as well as the priorities, standards, and protocols that will impact on the success of mobile learning initiatives
- **Pedagogical** (**teaching**): Reflection on the strengths and inefficiencies of current mobile learning practices as well as the barriers and critical success factors that impact on the adoption of mobile learning initiatives
- **Pedagogical** (**learning**): Exploration of the current expectations of mobile learning and insight into current formal or informal mobile learning practices to identify gaps in current services and student learning needs

In addition to the four areas above, this research has identified that the "readiness" of the institution and the learning and teaching environment through the wireless handheld devices is a critical component for the successful implementation of mobile learning initiatives. "Readiness" is defined as the extent to which the educational institution is prepared to deploy and support mobile learning initiatives in terms of technology, organization, management, and learning and teaching resources. Figure 1 is a diagrammatic representation of the relationship between the various aspects of higher education impacting on mobile learning initiatives.

The Mobile Learning Evaluation Framework project aims to create a flexible framework to fulfill the foreseeable needs of users, both educators and learners, in the deployment, support, and evaluation of mobile learning initiatives. An iterative approach will be employed, each phase incorporating the learnings from the preceding phase, allowing the inclusion of emerging innovations as the project progresses. Participatory monitoring and evaluation (PM&E) methods will be employed in the development of the project. This methodology has evolved through the broadening of participatory action research (PAR) into evaluation (Lennie 2006). It employs a holistic approach, accounting for the diverse perceptions and interpretations of project participants, collaboratively engaging them across all levels of the project (Estrella 2000). These methodological underpinnings of the

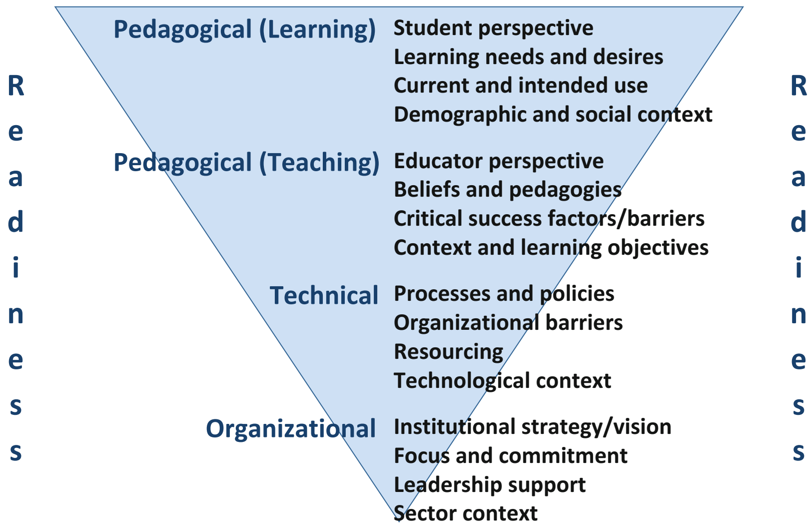


**Fig. 1** The relationship between various aspects of higher education impacting on mobile learning initiatives

project will confirm that the project outcomes are relevant across a wide range of real-world learning contexts.

### 5.1 Stage 1: Development of the Mobile Learning Evaluation Criteria

The focus of the first stage of the project will be on developing the preliminary evaluation criteria and framework. The following groups, representative of the four foci of the framework (pedagogical – teaching and learning – technical, and organizational), will be consulted to pinpoint the needs, expectations, and challenges when considering the deployment of mobile learning initiatives:

1. **Pedagogical** (**learning**): Students at each of the three partner institutions who are interested in mobile learning who will be able to contribute input on needs and preferences
2. **Pedagogical** (**teaching**): Educators from a variety of higher education institutions across the world who have attempted to implement mobile learning initiatives
3. **Technical**: ICT or learning systems that support representatives responsible for technical infrastructure, standards, and protocols
4. **Organizational**: Senior management at the partner institutions and higher education institutions across the world who have implemented pilot studies or institution-wide mobile learning initiatives

As participatory action research forms a fundamental part of the project, participants will be invited to review and comment on research findings and deliverables. Social media channels established as part of this project and a project blog will be used to enable these interactions.

## 5.2 Stage 2: Validation of Evaluation Criteria and Development of Models and Frameworks

The evaluation criteria will be validated during second stage of the project. This stage also sees the confirmation and development of the framework. In order to ensure that the evaluation criteria are reliable and representative of the Australian higher education sector, a large-scale survey will be deployed. Four survey instruments will be developed, corresponding to each of the framework's foci. Data collected during the first stage of the project will serve as the item pool for the surveys. These surveys will measure and describe institutional context, adoption drivers and barriers, user expectations and needs, pedagogical criteria, and the perceived impact of mobile learning initiatives. The draft instruments will be sent to the participants and a panel of experts for formal review. The first iteration of the survey instrument will be piloted on a sample of students and educators at one of the partner universities. The data collected will be analyzed using SPSS and the results will be used to refine the instruments. The data obtained from participants completing the refined surveys will be used to calculate reliability and validity of the instruments, validate the framework using techniques such as structural equation modeling (SEM), and obtain the normative data. The data will also be analyzed in order to segment and profile the differences in mobile learning by students and educators across various regions, demographics, age groups, and study fields.

## 5.3 Stage 3: Finalization of the Mobile Learning Evaluation Framework

During the final stage of the project, the finalized Mobile Learning Evaluation Framework and resources will be made available on the online website to be accessed freely by the education community. The toolkit will also act as a resource for the community that will enable the identification of mobile learning initiatives that have been demonstrated in pilot and experimental studies to contribute to high-quality learning experiences and which can be reused and adapted across learning contexts.

The project is currently in the first stage: development of the mobile learning evaluation criteria. This component of the research has included an extensive project management phase which involved developing the preliminary project website and blog and development of the project plan. During the initial stages of planning the research activities and conducting a literature review, it was identified that few researchers are in agreement about the definition, attributes, and affordances of mobile learning. This was a gap in the research identified by the project team that requires redress in order to develop a theoretically sound evaluation framework. Consequently, an online Delphi survey was developed to reach out to experts in the mobile learning research community in order to develop a consensus definition of mobile learning. The findings from the final phase of the Delphi technique will contribute to the foundation of the Mobile Learning Evaluation Framework.

The project team is also currently recruiting and conducting focus groups and interviews with educators and students at the three universities (USQ, UniSA, and ANU). The interviews with mobile learning pioneers will be held in the form of webinars that will be available for participants of the mobile learning research community to attend. These webinars will also be made available as open educational resources on the project website to be used and accessed freely, accompanied by a case study about the project.

Key learnings that have been identified during this phase are that educators and researchers have differing ideas about what mobile learning means and that this disparity in understanding often hinders adoption of mobile technologies for learning and teaching among educators. An additional learning is that sufficient time for effective project management and planning is a key consideration when developing large-scale research studies, and the amount of time required for these activities can be easily underestimated.

## 6 Future Directions

Mobile learning has surfaced as a new learning paradigm, becoming an intense focus of research as the technologies become ever more capable of supporting learning in both blended and mobile-only modes (Kukulska-Hulme et al. 2011; Engel et al. 2011). The ubiquitous connectivity of mobile technologies enables new ways of communicating, erases physical boundaries, and allows for the formation and support of distributed communities of learners (Garrison 2011, p.1). As the National Broadband Network (NBN) becomes more widely available in Australia, enabling ultrahigh-speed connectivity and unprecedented levels of access, education will shift from face-to-face and traditional distance education models to mobile models. This will enable educators to reach out to learners in regional, rural, and remote areas.

Mobile devices provided and supported by the university make network and information administration manageable. But devices are expensive for the institution, and students typically already own one or more mobile devices such as smartphones, tablets, and laptops. These are devices that they bring to campus and expect to use directly in learning and in support activities. Allowing the practice of bring your own device (BYOD) enables the university to shift the costs of ownership and administration to the user from the institution but faces the administration of the university wireless access network with security risks from allowing a wide range of devices and systems access over its enterprise network, in common with other noneducational institutions (Godfrey 2013). These concerns typically lead to the university barring or restricting the use of some operating systems and applications that users normally rely on, turning the normally seamless device and services into something visibly patchy and possibly crippled. Ironically, these restrictions can mean that the learner may experience a worse mobile learning environment when on campus, despite being closer to the hub of face-to-face learning activities. For the institution to reduce these access barriers for the sake of mobile learning will mean an increased cost in network administration to maintain network security, undercutting the original promise of reduced cost from BYOD and mobility.

However, slow institutions have been to adapt their provision of services and content; students are using their own portable devices. They choose between their devices for specific purposes, preferring smaller portable devices such as tablets for consumption (reading) and larger or more fixed devices (laptops and desktops) for creation of content (writing) (Dahlstrom 2012) – and choosing smartphones and tablets to support and manage their formal and informal learning activities, although possibly using different apps for social and academic purposes (e.g., see ► Chap. 19, "Tutors in Pockets for Economics" by Zhang et al. in this handbook). In reviewing the literature, five aspects of the use of mobile learning have emerged, namely, (1) altered delivery of content and knowledge storage, (2) portability, (3) creativity, (4) bridging the knowledge and application gap, and (5) interactivity.

Given this diversity, it becomes imperative to evaluate mobile learning initiatives to ascertain their impact on learning and to ensure their sustainability allowing for the considerable investment of time, money, and resources. Though a number of evaluation frameworks exist, either emerging as a direct result of the increased emphasis on mobile learning or through the adaptation of other eLearning frameworks, none are sufficiently nuanced to address the issues and answer the challenges associated with deploying mobile learning initiatives across a wide range of higher education contexts. Consequently, the latter part of this paper describes a project underway at the University of Southern Queensland, the Australian National University, and the University of South Australia that is more pragmatic in its approach. The project will develop a Mobile Learning Evaluation Framework that will aid in the selection and justification of mobile learning initiatives. Participatory monitoring and evaluation (PM&E) methods will be used to develop outcomes and deliverables. The resultant Mobile Learning Evaluation Framework will consider the issues and challenges associated with deploying and sustaining mobile learning initiatives from four distinct perspectives: (1) pedagogical learning, (2) pedagogical teaching, (3) technical, and (4) organizational.

## 7 Cross-References

► Framework for Design of Mobile Learning Strategies
► Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom
► Tutors in Pockets for Economics

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# Moving with Mobiles – Using IT in the Classroom as Against Online: Comparative Reflection from South Australia

**47**

Melissa Nursey-Bray

## Contents



**Abstract**

Understanding how to move with the times and build curricula that use mobile technologies has been an emerging challenge for educators worldwide. This chapter explores not only the efficacy of mobile technologies in delivering online curricula but considers how you may use mobile Information Technology (IT) devices in class to enhance face-to-face teaching. This chapter presents the argument that students still require some focused attention; hence there is a danger of overusing mobile devices for online delivery, yet, with careful tutoring, the use of mobile devices can in fact enhance pedagogical outcomes in courses that require continual updating and benefit from the exploration of case studies.

## 1 Introduction

The use of mobile devices is becoming increasingly de rigueur. Specifically, the use of mobile devices, whether they are laptops, tablets, iPads, or mobile phones, is on the rise. For example, Dennen and Hao (2014) note that ownership rates for cell phones was at 95 % in the United States, allowing unprecedented access by students to mobile learning, Unsurprisingly, e-Learning has burgeoned as a result, including the development of digital e-books and off-the-shelf learning applications that

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encourage use of mobile devices in classrooms (Dennen and Hao 2014). Whether or not it has any pedagogical power is less clear. Increasingly, those teaching in higher education are under pressure to develop skills in "e" or online technologies to facilitate learning and ultimately graduate outcomes. As early as 2000, results of a student survey found that increasingly, students want interactive lectures and group-based activities and are in general, nonresponsive to conventional modes of formal lecture and tutorial programs (Sander et al. 2000). In this context, e-Learning offers great capacity for building flexibility in the pace and distribution of learning (Chinyio and Morton 2006, p. 74). As such, multiple trials are taking place across the world in the development of online, hybrid, and blended learning programs (Rennie and Morrison 2012). Many mobile frameworks have evolved including the framework for the rational analysis of mobile education (FRAME) (Koole 2009), the m-learning framework (Motiwalla 2007), the mobile Computer-supported collaborative learning (CSCL) framework (Zurita and Nussbaum (2007), and the Mobile affordances, Conditions, Outcomes, Pedagogy and Ethics (M-COPE) framework (Dennen and Hao 2014). Ensuring that curricula are designed to be responsive to student needs is essential, as this will encourage the long-term sustainability of student learning (Castleford and Robinson 1998). However, interactive and e-delivery must be underpinned by pedagogical intent (Conole et al. 2004). As Alexander and McKenzie (1998) note, technology in itself does not result in improved quality or productivity of learning, what is most critical is the curriculum design of the student learning experience. Rich et al. (2000) argue this is an important gap noting the "paucity of educational and pedagogic underpinnings of the developments made in the use of ICT to teach geography."

Building on this, Kirkwood and Price (2005) add: "although ICTs can enable new forms of teaching and learning to take place, they cannot ensure that effective and appropriate learning outcomes are achieved. It is not technologies but educational purposes and pedagogy, that must provide the lead, with students understanding not only how to work with ICT but why it is of benefit for them to do so." In essence, it is the exploitation of ICT for "rich pedagogical use" that will serve learners across multiple target groups and at various tertiary levels.

Ensuring best practice in the use of educational technology can also ensure the versatility of teaching geography in higher education. Geography, in its investigation of the relationship between people and the environment, is by its very nature interdisciplinary and as such particularly suited to a suite of learning tools in curriculum delivery (Martin and Treves 2007). Indeed, as a discipline, geography "has always been considered a pioneering discipline in this regard" (Castleford and Robinson 1998, p. 377). As Lynch et al. (2008, p. 137) note of e-Learning in geography: "Using information technology effectively allows students to grapple with real-world problems, access appropriate information quickly and easily, share their ideas with fellow students...and construct new knowledge and meaning for themselves in a relevant interesting context."

How is this working in practice? In this context, the time is right to find ways of repositioning and reshaping disciplines such as geography and to embrace these new expectations by provision of new and innovative curriculum design (Enrique 2011; Rennie and Tara 2012). Using a combination of peer and student evaluations, critical reflection of my own practice and a basic strengths, weaknesses, opportunities, and threats (SWOT) analysis, this chapter presents the results of an evaluation of a comparative trial of students' use of mobile devices within three different courses – (i) an online unit in Climate Change Adaptation, (ii) a face-to-face environmental impact assessment course within the discipline of geography, and (iii) a postgraduate course in community engagement.

## 1.1 Case Study One: Environmental Impact Assessment

EIA is an undergraduate course that takes students through the process of EIA via the use of case studies. This course introduces the methodology of environmental impact assessment (EIA) as a vital tool for sound environmental decision-making. It provides an introduction to the concepts, methods, issues, and various stages of the EIA process. The various stages of the EIA process, such as screening, scoping, EIA document preparation, public involvement, review and assessment, monitoring and auditing, appeal rights, and decision-making, are examined. The course mainly focuses on EIA in Australia and in particular draws on case studies from South Australia, but also includes other EIA systems of other countries. The variability of EIA systems within Australia and other countries is highlighted.

Course content is perhaps best suited to an intensive or short course, so its division into 12 weeks of delivery via a conventional two lectures/one tutorial format is not conducive to optimal delivery. A key component of the course involves trying to deepen student insight into the process via interrogation of real-life case studies and exercises. These are in turn constructively aligned with the assessment which requires students to simulate activities that practitioners might conceivably be asked to undertake in the field. For example, via case study instructions, students are asked to conduct a stakeholder analysis or to write a referral based on processes/activities currently in train.

### The Trial

In an attempt to build the detail and simulate real experience, this trial explored the ways in which the use of mobile technologies can be used in the classroom to develop deeper thinking, enhance critical reflection via group interaction of cases at hand, and enable on-the-spot interrogation of information supported by the teacher. Table 1 below summarizes the ways in which this effort was invested.

The same techniques were implemented over six tutorial classes of about 15 students each. Forty percent of the cohort came from the Faculty of Sciences with the rest from various disciplines within the Faculty of Humanities, Arts, and Social Sciences. There was roughly the same proportion of males to females. Students were then asked to reflect on the use/application of mobile devices as an aid to their learning. Insights gained as a result were surprising.

**Table 1** Summary of mobile device activities, environmental impact assessment

| Activity | Example of interaction with mobile device |
|---|---|
| Develop student understanding of the EIA referral process | Get students to access web site for referrals, read said referral documents, and discuss what/how their response would be if they were (i) a member of a community and/or (ii) Federal government decision-maker |
| Ensure students become familiar with EIA documents | Google and find an EIA in practice. Read documents, then in groups compare and contrast similarities and differences between them, and using a handout given on EIA flow, identify what stage of the EIA process the said examples are |
| Students learn how to do stakeholder analysis/consultation on preset case study/scenario | In groups get students to research, then allocate stakeholder roles for the scenario, then each student to then develop a stakeholder perspective in relation to the details of the case |

## Lessons Learned

Firstly, it became clear that not all students have as much facility when accessing and using mobile devices as was first supposed. For example, a simple task, such as trying to find information about Sydney Airport EIS processes seemed to cause concern among students. It emerged that it is not the facility with mobile media that is the issue but the capacity of students to do research that was problematic. Given they were undergraduates, the development of research capacity is yet nascent, so it put undue stress on students when they were asked to find particular bits of information. Further it became clear that many students, apart from basic googling and accessing their many social media sites, were not actually familiar with the more sophisticated capacity of the various mobile devices they were using. Indeed the following comment reflects this concern, on the topic of a tute assessment that required use of the mobile device: "The mobile learning and online tasks were OK, but really if they are going to be worth 10 % we should have had a lecture on how to do the online task."

Secondly, it also emerged that while all students appeared to own or have access to mobile devices, not all mobile devices are equal. Fashioning learning tasks that have pedagogical underpinnings and at the same time engage students, work well – when the device works too – but becomes an exercise in frustration if not. It is hard to predict how various programs, software glitches, and links that worked at first and suddenly don't, will affect in class learning.

Moreover, because these activities are in class, the frustration becomes very apparent.

In terms of active learning, the intent to use mobile devices did not meet their promise. Activities tended to have the (unintended) effect of stifling group interaction by closeting students off from each other as they each sought to engage with their devices rather than each other in the quest to obtain the information they needed to do the task. In many cases, time ran out before students were able to pool their information and then complete the task. Again this mitigated against the pedagogical intent behind this trial.

Feedback also indicated that students, in some cases, resented the use of mobile devices in class on the basis that they felt it was a “cop-out” by the lecturer, indicating laziness on their part, and showing a lack of willing to do “real teaching.” Set against ongoing institutional pressure for more mobile and technological-driven teaching, this was another surprising outcome – perhaps students do, after all, want traditional forms of information delivery and learning interaction. In this case, feedback highlighted that the attempt to use mobile devices in class made them feel less cherished and nurtured in their learning enterprises. Additional comments showed that a few students even felt this meant that the coordinator was not “across the subject.”

Finally, it was not clear that deeper learning was achieved by using mobile devices in class. Surface learning, skimming over information, and trying to read dense information quickly emerged as characteristics of class behavior. Class discussions after group and mobile work highlighted that no real gain had been made via use of mobile devices in class activities. Neither was time saved due to the fact that many students had to complete tasks after class they would normally have finished in class due to being distracted in using the device for information retrieval or analysis. Importantly this was also a function of the fact that students all read at different paces and further that roughly 30 % of the cohort were English as second language (ESL) speakers. Cumulatively, all these factors mitigated against the potential benefits of a deliberative application of mobile device use in class to enhance pedagogical learning outcomes.

## 1.2 Case Study Two: The Instructional Module: Introduction to Climate Change Adaptation

The unit Introduction to Climate Change Adaptation is one of four modules that comprise a 100 % online Graduate Certificate in Climate Change Adaptation. The course relies on an innovative application of interactive pdf technology which students complete via a series of embedded learning tasks. The course is further supplemented by online lectures, readings, and assessments, uploaded via the MyUni platform.

The unit introduces students to what climate change adaptation is, the legal and policy requirements for professionals working in the field, and the science underpinning it. The unit aims to develop student skills in accessing and synthesizing the most up-to-date information on law, policy, and science relevant to climate change adaptation (Nursey-Bray and Miller 2012). The unit will also equip students with an understanding of the concepts used in the field of climate change adaptation.

### The Trial

The primary form of instructional delivery was via the use of an interactive pdf. To date, interactive pdfs have been being used in advertising or other contexts, such as being the platforms for more interactive forms of magazines or newsletters. In this course these tools were adapted for deliberative use as part of a trial in creating interactive online curricula. An interactive pdf is an instructional tool that allows the user to "click" and be taken to another information source. Unlike other interactive tools such as "Activate," the interactive pdf is not akin to a wiki or virtual web site. It can be uploaded to a platform like Blackboard and then accessed online – or it can be downloaded to a student's computer. As a tool it can encourage student-centered learning and offers important versatility for geography and sustainability courses (Lynch et al. 2008).

Unlike other interactive learning tools, an interactive pdf can embed multiple types of information and media. Hence rather than citing a reading, an interactive pdf may have a photo of the author, and the student can "click" on the photo and the relevant reading (by that author) will "pop"-up in another window ready for the student to read. In other cases, a click can take the student to YouTube for a lesson, to view an international case study. Importantly, interactive pdfs enable the teacher to embed media such as video or audio in the actual document allowing the student to watch or listen lecture – in which case, aka Harry Potter, it can be viewed either by opening up a new window, online via a link, *or* as a "talking head" *within* the pdf itself.

### Lessons Learned

The use of an interactive pdf while innovative was not easy to implement. Again there were similar issues within the student cohort relating to access and equity. For example, due to the fact students were effectively completely online, there emerged clear differences in student capacity to do the work based on their individual access to or model of computer. Their mobile devices were more or less able to access and download the pdfs.

A related issue was the "weight" of the pdfs: Being large files, different students had varying challenges in downloading them. Some students were not able to afford the type of computer needed, so relied on access to others via libraries and other public places, but again given that many students were living remotely (hence doing an online course), this access was difficult.

The challenges implicit in this circumstance were additionally complicated by the fact that administrative and support systems within the university were not set up to service the pdfs and that they required a specific software and skills to update, meaning that ongoing revision of the curricula has additional difficulties. Further institution-wide integration of technological and pedagogical teaching, marketing, and administration is needed to assist making such innovations a success.

Student feedback highlighted the view that a course in being 100 % online was perceived as being less work for the teacher and specifically should involve less work for them. Students complained that the unit required them to do a lot of the work, via their mobile devices rather than it being "given to them on a plate."

All students assumed they could just do an online course without effectively making time for it, and so ultimately many were swamped by their other life commitments.

Interestingly, despite the innovation of the interactive pdfs, students seemed to prefer a recorded lecture and tute task style of external delivery. A series of prerecorded short (5–10 min) expert lectures were enthusiastically endorsed as of learning value, and students unanimously requested more of them. This highlights that face-to-face contact, even when virtual is valued, and must become part of how we engage with the idea of mobile devices and mobile learning.

Finally, a key finding was that just because students know how to use mobile devices did not mean they knew how to do online research. Much use of mobile devices is catalyzed around this activity, so it is clear that more work needs to go into building student capacity in this area.

## 1.3 Case Study Three: Community Engagement

Community Engagement is a postgraduate course taught as part of a Master's degree in Environmental Policy and Management (MEPM) and the Masters of Planning (MPL). A mixture between the two degrees, the course usually attracts a cohort in between 20 and 30 students, most of whom have prior or ongoing work experience, often in government. They conventionally are mature-aged students and at least 30 % of the group are international students. Thus the class is often diverse and dynamic. The course itself aims to teach students the theory and then practice of community engagement. Assessment is constructed around making the students apply and construct community engagement principles in practice.

### The Trial

Due to the diverse cultural nature of this class and the reality that many students are also working at the same time, mobile learning, using IT in class as well as constructing online tasks, was trialed. In the first case, in an effort to build motivation and understanding of the differences in community engagement in different cultures, a series of exercises were set throughout the course, where students were asked to break into groups and together google information on a series of questions around community engagement. Students were also instructed to view various YouTube clips (in class) of community engagement in practice and then reconvened as a whole to discuss their varying views on the different experiences they had viewed.

The second element introduced into this class was the use of Articulate Storyline to facilitate a week of online learning. For this exercise, Articulate was preprepared and then uploaded in a particular week and necessitated students going online to go through the activities within it. This technique was employed to substitute for an entire week worth of face to face learning and instruction, with Articulate enabling students to (i) watch an online lecture, (ii) access various links/clips, and (iii) complete exercises. 10 % weighting was allocated to this assessment.

### Lessons Learned

The experience of combining mobile learning with online learning in the same course was instructive. Overall, students enjoyed undertaking the in-class mobile learning. Given the cultural diversity of the group, this aspect of the course not only enabled them to apply their learning within their own cultural contexts but also enabled a sharing of cultures and information that would have been difficult to achieve from lecture-type delivery alone. It also enabled a two-way interaction where students taught the instructor about new areas.

Resoundingly, however, the online week using Articulate was a failure. Student feedback shows that they did not enjoy the experience and that, as it was timed for the week following midsemester break (a 2-week period), it created disruption to class flow and cohesion. Two students simply refused to do the work, despite the fact it was worth 10 %. Students who did complete the task nonetheless did not provide the level of detail or analysis that was expected. This perhaps is partly due to the fact that student energy went into learning a new program, rather than focusing their learning on the content and assessment task itself. Student feedback also highlighted a preference for doing a field trip (even if self-directed) rather than the Articulate exercise. Further analysis indicates that the nature of the subject is relevant when considering how and when to use mobile learning and online-teaching techniques. In this case, where mobile in class IT exercises help enhance learning, the online element was not suited to the subject matter. This experience highlighted for me not only the necessity of trialing different techniques in different courses, but also the importance of ensuring one doesn't make assumptions about the universal efficacy of mobile and online techniques unless they are tailored properly to content and the student cohort in each case.

## 2 Future Directions

So where to go from here? These lessons highlight that some important reform is needed in the use of mobile devices to enhance learning (Graham and McNeil 1999). Firstly, whether accessing mobile devices in class or encouraging mobile learning from mobile devices via online curricula, students need to be taught how to do the exercises from a technological as well as a learning point of view.

Second, we need to ensure that there is integration between IT staff and teaching personnel so that there is harmonious rather than frustrated use of technology to do exercises, especially where those exercises are assessed. Third, teachers need to talk students through why they are using these technologies and for what. This will help students understand that in fact such teachers are attempting to exercise innovation and need students help in making it work. This will also enhance group interaction (▶ Chap. 6, "Framework for Design of Mobile Learning Strategies"), and assert the utility of models for mobile learning that can be built to assist building reforms. Moreover, reforms can be tailored to self-directed learning (▶ Chap. 4, "Design Considerations for Mobile Learning").

Further, while the use of mobile technologies can in theory democratize knowledge dissemination and learning, in practice this is not always the case. Indeed, it creates uncertainty in that students do not always feel confident that they are accessing the “correct” type of knowledge yet simultaneously universities are no longer the only “holders” of knowledge. Hence they not always seen as legitimate purveyors of it; there can also concurrently exist a reticence to consult the lecturer or course support person for advice.

Creating conditions that enable versatility in teaching practice is also a key process; this is one way forward in creating pathways to the implementation of e-Learning. Given the experience of implementing mobile learning techniques across three different types of courses, it is clear that developing an overall strategy for how to implement e-Learning could be helpful and alleviate the inherent or potential for ad hoc trials in various courses over time (Lynch et al. 2008).

Finally, given the differential skills and abilities of student cohorts, learning and assessment tasks need to have boundaries; lecturers must not expect too much. Deeper learning can also be found in many other forms of delivery, and the use of mobile devices for deeper learning is more applicable to independent learning tasks, done out of the classroom in students’ own time. It is important to resist the temptation to overuse mobile devices. Further, as Alexander (2006) points out, the ongoing pressure to build technology into teaching also requires teachers to build their own technological capacities – this is a task that requires time, and on top of the effort already invested in curriculum development, should be supported and not ignored or belittled: “teachers need assistance to be effective at integrating mobile learning, and assistance involves not only learning how to operate the devices but also . . .plan mobile learning activities” (Dennen and Hao 2014, p. 399). Induction for both staff and students is an important step in the learning process and should be built in to the curricula in its own right.

Nonetheless, the use of mobile devices to enable students to develop their skills while face-to-face – or alternatively access curricula such as the pdfs anywhere – has the potential to build interdisciplinarity and reshape discipline-based courses in productive ways (Sharpe and Beetham 2010; Whalley et al. 2011). As Cranford-Wesley (▶ Chap. 5, “Designing a Mobile Applications Curriculum: Overview”) and Kshama Pandey and Neetu Singh (▶ Chap. 8, “Mobile Learning: Critical Pedagogy to Education for All”) note, it is also important to develop multiple pathways in mobile learning design. The use of mobile devices in each case allows the creation of spaces for the discipline of geography to utilize the best that online technologies can offer. In particular, their visuality encourages students to “see and feel” the subject, especially important for environmental and sustainability disciplines such as geography, and given field trips and other experiential teaching opportunities are reducing with tighter fiscal conditions, are an added bonus. Indeed a “self-paced virtual working environment” is “particularly suited to geography as a discipline” (Carr but cited in Lynch et al. 2008, p. 139). It is possible that the effectiveness of class mobile learning-based exercises can also be refined to foster group learning, peer interaction, and a sense of class identify, thus building graduate attributes as well as group cohesion and learning. Such approaches could also help facilitate inquiry-based or problem-based learning.

There are many advantages to mobile learning. Geddes (2004) notes four benefits that accrue from adopting mobile learning techniques: (i) access, (ii) context, (ii) collaboration, and (iv) appeal. Use of mobile technology also enables the implementation of multimedia and interactive learning tasks, provides incentives for students to be active learners – indeed assist lecturers in information provision – and in the context of many geography subjects, connects then to field sites in ways impossible before. The use of mobile learning technologies also enables students to create their own data repositories, in turn, an effective means by which lecturers may (i) build their own data bases, while (ii) tailoring the course to reflexively meet student needs. In this way it becomes possible to marry technology with learning. This is essential because ensuring pedagogical integrity in implementing curricula still matters and should not be obfuscated by glamorous (but empty) technologically based teaching. Another impact of effective mobile learning is that learning becomes a sense-making process, where students can have interplay with existing data while building on them. In this way, innovation and transformative learning can occur – especially across and within disciplines.

The use of mobile devices to enhance learning certainly has potential particularly in developing pedagogies around self-directed and self-regulated learning (Saks and Leijin 2013; Sha et al. 2011). It can integrate digital resources with authentic learning contexts (Hwang et al. 2013). However, it must not be overused and teachers must not expect too much of such mechanisms. Ultimately, like good writing, good teaching does not need to be swamped by detail and complex jargon. Good teaching relies on simple direct techniques to relay complex ideas, and if we can find ways of utilizing mobile technologies to enhance learning in simple straightforward ways, the possibilities are endless.

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# Service-Learning Application in an M-Learning Course

48

Margaret Sass

## Contents



**Abstract**

With the increasing popularity of smartphones, tablets, and laptops among college students, higher education institutions are beginning to implement these devices into the college curriculum. The academic community has realized that using mobile devices may encourage and increase academic intelligence. This troika relationship between the student, the mobile device, and the course is

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a form of m-learning, a method of teaching that is being practiced more and more throughout national and international campuses. Sharples et al. (Mobile learning. Springer, pp 233–249, 2009) state that “exploration is essentially mobile in that it either involves physical movement or movement through conceptual space, linking experiences and concepts into new knowledge” (p. 4). Education should be exploratory to the student, kindling a desire to learn more and do more.

This chapter examines the pedagogy behind m-learning and discusses the relationship of m-learning with service-learning curriculum. The challenges of m-learning are discussed, as well as the ways to successfully implement social media tools into the college classroom that includes a service-learning project or focus. This discussion’s purpose is to encourage instructors to consider using a form of m-learning in the classroom in collaboration with service learning as a way to engage the student in a familiar platform.

## 1 Introduction

Elementary-age children to elderly adults are carrying smartphones, living a life that revolves around mobile devices. Some are talking, texting, playing games, or surfing the web. This is accentuated in K-16 classrooms throughout the world as well. In fact, it’s unusual to see students of all ages without a phone. Aware that the popularity of such devices will increase rather than decrease, many educators have concluded that such mobile devices are a benefit to the learning process.

With these smartphones, tablets, and laptops overwhelming popularity among college students, learning through these devices is being implemented into the curriculum of traditional, hybrid, and online courses. The academic community has realized that using mobile devices to encourage academic and intellectual growth may be ideal (▶ Chaps. 24, “Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom,” and ▶ 6, “Framework for Design of Mobile Learning Strategies”). This troika relationship between the student, the mobile device, and the course is a form of m-learning, a method of teaching that is being practiced more and more throughout national and international campuses. As Sharples et al. (2009) acknowledged that “exploration is essentially mobile in that it either involves physical movement or movement through conceptual space, linking experiences and concepts into new knowledge” (p. 4).

The MoLeNET program defines mobile learning as “the exploitation of ubiquitous handheld technologies, together with wireless and mobile phone networks, to facilitate, support, enhance and extend the reach of teaching and learning” (MoLeNET 2014). They define mobile devices as “mobile phones, smartphones, PDAs, MP3/ MP4 players (e.g., iPods), handheld gaming devices (e.g., Sony PSP, Nintendo DS), Ultramobile PCs (UMPCs), mini notebooks or netbooks, handheld GPS or voting devices and specialist portable technologies used in science labs, engineering workshops or for environmental or agricultural study" (MoLeNET 2014). This definition provides a beginning platform to describe what devices are considered mobile, but with such a rapid-changing technology industry, these devices will only become bigger and better as with the websites and apps they are in sync with.

This chapter examines the pedagogy behind m-learning and how it works in collaboration with service-learning curriculum. The challenges of m-learning are discussed, as well as the ways to successfully implement social media tools into the college classroom or a service-learning project. This discussion's purpose is to encourage instructors to consider using a form of m-learning in the classroom in collaboration with a service-learning curriculum as a way to engage the student in a platform they are comfortable with.

## 2 Literature Review

One of the challenges of m-learning is compelling the student to be responsible for his/her learning experience. When a course instructor requires the use of mobile devices, they are considered more a "guide" than a lecturer. Educational content is still being transferred from instructor to student, but the method on how to do that is being reconfigured. This structure can be uncomfortable or unfamiliar to students due to their lack of exposure to student-centered learning in a much dominated teacher-centered world.

When a course is online, students must self-regulate. Self-regulation is defined as "a student who is regulating his or her learning is able to set task-related, reasonable goals, take responsibility for his or her learning, and maintain motivation" (Heikkilä 2006, p. 101). Self-regulation pinpoints the need for the student to take responsibility of his/her own learning. It puts them in the driver seat, allowing them to have an interactive experience with the learning process. The instructor does not need to feed them the course content. The student experiences it through different mediums, including technology. However, this method of learning may be extremely difficult for students that do not have self-discipline or time management skills. Also, there is no classroom per se, but usually an educational platform (Moodle, Blackboard, etc.) on the World Wide Web for academic and social interaction that students may be unaccustomed to when used in a course. There tends to be a lack of direct contact (aka "human touch") found in a regular class (Shudgon and Higgins 2006).

However, self-regulation in the classroom, mainly in learner-centered classrooms, can increase the skill set of students that a traditional lecture-based class may not offer. Students are required to manage their time to complete all assignments. They are required to organize the material that is provided in the classroom and analyze it intently for academic success, such as watching videos, reading articles, researching with search engines, or collaborating with peers that may be living in a completely different country. They become even more familiar with academic Internet tools, making them much savvier when they are ready for the workplace.

In addition to self-regulation is technology-enhanced learning (TEL), the essence of m-learning. The University of Sheffield (2014) defines TEL as "e-learning, also known as online learning or technology enhanced learning (TEL) adheres to the basic tenets of face-to-face teaching, e.g. clear aims, specific learning outcomes, valid and reliable evaluation and assessment but with additional flexibility through the use of technology." The University of Sheffield continues to emphasize that the educator needs to focus on the learning objectives and utilize technology, but not focus on technology.

Lack of past use of technology may hinder some individuals when a course requires mobile devices. Traditional-aged students (18–22 years old) being born within the world of mobility could also encumber them, because their use of mobile devices may have only focused on entertaining activities. Opening a new world of opportunity with their mobile devices attributed to their learning brings value to their education. They are able to learn with devices that they are familiar with, making the transition from just playing games and surfing the net to learning about key educational concepts that will make them successful in school and in the workplace. The additional skill set is a definite advantage for students.

## 3 Service Learning

Service learning is a form of academic community engagement where service meets academia. Service learning started to receive more attention in the 1990s by the academic community as well as the federal government. It evolved from experiential learning, with the concept that "doing" is better than listening and taking notes. The concept of a more interactive education began with Dewey. He believed that "education must begin with psychological insight into the child's capacities, interests, and habits" (Dewey and Small 1897, p. 6). Once those are acknowledged, students should apply their educational interests for further exploration, developing a desire to discover. By the 1980s, Dewey's philosophy evolved into experiential learning, a concept defined by Kolb (1984) as "a perspective from which to approach these practical problems, suggesting a typology of different knowledge systems that results from the way the dialectic conflicts between adaptive modes of concrete experience and abstract conceptualization and the mode of active experimentation and reflective observation are characteristically resolved in different fields of inquiry" (pp. 37–38). Dewey and Kolb believed in student's direct interaction with the environment, the main model of service learning.

Bringle and Hatcher (1996) define service learning as "credit-bearing educational experience in which students participate in an organized service activity that meets identified community needs and reflect on the service activity in such a way as to gain further understanding of course content, a broader appreciation of the discipline, and an enhanced sense of civic responsibility" (p. 222).

The idea concept behind service learning is that students are provided a powerful learning opportunity in a community environment. In order to reach that high level of learning, students must reflect upon their activities. Reflection can derive in the form of writing, group discussions, individual journals, and so on. Kaye (2004) describes service learning as employing four phases: preparation, action, reflection, and demonstration. In preparation, the student investigates the social problem and whether it is being resolved within the community. Once evaluated, the student (s) serve at a community nonprofit agency in order to assist them with that social concern. How they serve should coincide what the organization needs and what they are studying in the class. The third phase, reflection, is a significant aspect of service learning as it fosters students to think about their service and how it impacts them academically and personally. The last phase, demonstration, is the opportunity for students to display what he/she learned through the experience. This can be in the form of an essay, a presentation, or other creative formats. This phase is also the opportunity to include digital resources and technology to showcase what the student has learned.

Service learning tends to be a supplement to a traditional course or an extra-credit project in a lecture-based class. However, with the new generation being born within a world of technology, it can be argued that service learning can be part of hybrid and online courses with the assistance of certain social media sites and mobile learning hardware as a phone, tablet, or laptop. Many social media sites are ideal candidates to richly supplement service-learning curriculum as discussed below.

## 4 Social Media Sites

The World Wide Web continues to evolve so quickly that social media sites either build upon what they provide or new sites become available. Additional information on online tools and collaboration can be found in Bryant and Bates (2015) article that discusses a constructivist viewpoint for online formats. Below are some of the social media sites that have some staying history; however, this chapter only touches upon the major Internet resources that are available at one's fingertips (also see ► Chap. 19, "Tutors in Pockets for Economics"). Educators have vast amounts of websites that they can use for free or for cost to enhance their teaching and learning. The best way to explore the up and coming new educational websites and apps is by googling what you are searching for or reading articles about the newest websites you and your classroom should use.

## 5 Digital Badges

Digital badges are increasing in popularity among our younger students. It may seem similar to Boy Scout or Girl Scout badges, but in a digital form and utilized by adults. Once a person achieves this badge, he/she can post it in their Mozilla

Backpack or showcase their accomplishment on their LinkedIn or Facebook site. Many universities and colleges have used digital badges in the classes as a new way to showcase student outcomes. “Digital badges have the potential to be the effective and flexible tools teachers have long sought to guide, recognize, assess, and spur learning. And they can recognize the soft skills not captured by standardized tests, such as critical or innovative thinking, teamwork, or effective communication” (Fontichiaro and Elkordy 2014, p. 13).

Purdue University has created a digital badge program called Passport that is available for instructors and administrators. A major component of this passport is reflection, which occurs within the badge program by having students answer in-depth and prompted questions in order to meet the requirements of the badge. Not all digital badges are based on education, but a vast majority exposes a student’s competencies to make them more marketable to graduate school and employers. Digital badges are a “flexible, inclusive ecosystem that connects formal and informal learning, skills and dispositions. . .” (Fontichiaro and Elkordy 2014, p. 15).

A service-learning digital badge can be created for a course as a supplement or a project portfolio depending on the instructor’s desire. Most digital badge sites are free and accessible in which the instructor can develop very personable and content-specific digital badges. A digital badge could work well in a service-learning course, because students can upload their reflection thoughts and essays or showcase the visual aspect of their project, something that is not always highlighted in a traditional resume.

## 6 Pinterest

Pinterest is an extremely popular visual platform that individuals and businesses are using and creating bulletin boards on a variety of subject matter. Though it’s most popular for personal and business reasons, educators are seeing the value of using this site for educational purposes. As a suggestion for an assignment, use Pinterest as a weekly assignment for juniors and seniors. Students are interested in this structure, because of (1) the flexibility and (2) the opportunity to do “work” at home. This allowed them to plan for other things during that class period. Each week students can create a new Pinterest page based on the chapter we were studying. Have students search for 10 visual pictures that represent that chapter and to write at least three sentences on why the visual picture represents the chapter and how. Students that are visual learners are keenly interested in this type of project. Those that prefer lecturing may feel disadvantaged. However, this assignment is good for all types of learners, because some learn by the visual choices they make while others learn by writing about it. Overall, the assignment can develop a high level of critical thought.

This same concept could be used in a service-learning course, and in fact, it has. Other schools and universities have created Pinterest sites for their service-learning projects. This works especially well for service-learning projects where the population they are serving cannot be shown on websites, presentations, etc. such as abused women in a shelter. Students can post a picture of a shelter or a picture that represents abuse without exposing the actual parties being affected. Students can then provide the "visual" aspect of service learning or volunteering and how their efforts are affecting social change or social knowledge. Students can then share their Pinterest pages with the world and allow others to use their visual aids for their Pinterest sites.

## 7 Popplet

Popplet is a mind-mapping tool that can be operated by an individual or a group. This is a great visual brainstorming site that allows users to add information via pictures, videos, and text. This can be an abundant platform for students to collaborate on projects. Popplet is also an impressive tool for individual projects as storytelling, managing a large social issue project and building the visual connections, or even as a way to describe a certain population, a certain organization, or even a certain class.

Many service-learning projects are group based for several reasons. One reason is logistics. Working in groups may ease the responsibility and the travel. Second, service-learning groups can make a greater impact than perhaps an individual. A service-learning group could create a Popplet to organize their activities or attach certain responsibilities or actions to the social problem at hand. For example, a group working at a homeless shelter may be able to pinpoint certain activities directly related to homelessness and work collaboratively to see where there are "connections" with this visual aid. It also highlights the responsibilities of each member of the group and keeps them on task.

## 8 Blogs

Blogs, a form of writing on the Internet, are popular for the fact that people can write and reflect at a moment's notice. In 2012, WordPress, a popular blog site, reported that over 100,000 new WordPress sites were created every day with 319 million people viewing 2.5 billion pages monthly (Chareonlarp 2012). Even though millions create and maintain a blog, this is not a novice concept. Blogging became prevalent in the 1990s (Williams and Jacobs 2014) and continues its popularity. Blogging may be seen as providing information about one's thoughts and ideas, but it can also be a collaborative conversation with others in a classroom setting. Blogs utilized in higher education are also seen as a great benefit to students as it encourages more interaction among group members outside of walls of a classroom. By posting a blog, students can increase their writing capabilities and collaboration with other bloggers. Ferdig and Trammel (2004) add that blogs encourage critical thought, participation between students, and flexibility.

Within the blogging realm, students have an opportunity to share information about certain classroom content, including service-learning projects. Students could write a weekly blog using Weebly, Blogger, or Blogspot and share their trials and tribulations of his/her service-learning project. They can follow others in the class and allow a more cooperative online relationship with peers. This instigates discussion beyond the classroom and a more flexible practicum for students with demanding responsibilities.

## 9 Twitter

Twitter is still an extremely popular social media site, especially for organizations and famous individuals. Though a fairly common tool for marketing and promotion, more and more educators are using this tool for interaction between themselves and the students. In fact, Twitter has 284 million monthly active users, 500 million Tweets sent out a day, and 80 % of users are on mobile (Twitter 2014). Instructors can tweet articles, instructions, updates, etc. all through a Twitter feed. Also, students can follow each other and keep in contact. This may work better than email, because it's instantaneous through texting, and the user is limited to 40 characters. In other words, being precise in your tweet is necessary to get your message across.

As many popular social media sites, Twitter continues to grow with followers. Sometimes it is challenging to keep up with followers as well as manage your own posts. Twitter seems to attract a younger crowd than the more popular site Facebook (Fox et al. 2009). With Twitter being used more in education, research tends to follow. In fact, Junco et al. (2011) found that Twitter enhanced grade point averages.

## 10 Twitter Pilot Study

Twitter can be a great tool for moments of reflection. In a pilot study in a communication course in a rural community college, students were required to sign up for Twitter during the 2nd week of class, post their Twitter addresses on blackboard, and then follow the other students in the course. Students were encouraged to tweet with their "subgroups" which were smaller groups that they had a service-learning project with. Many students used Twitter as another way to interact with each other as well as group logistics.

This pilot study used a quasi-experimental, pre- and post design. Students were required to complete a group service-learning project in their communication class while using Twitter and blogging as part of the service-learning project. All participants in this study were not self-selected, as they randomly enrolled in these communication courses without any knowledge of the class structure. A total of 26 students completed a survey at the 4th week of the semester and at the conclusion of the semester simultaneously. The semester was a 16-week class period. Students' communication competency was measured with the Communicative Adaptability Scale (CAS). This assessment is known for its validity and reliability based on previous studies (Wheeless and Duran 1982; Duran 1983; Duran and Kelly 1988; Hullman 2007). The CAS assesses communication competence that measures flexibility and adaptability in social settings in an appropriate manner. The CAS subscales matched and measured the class objectives as interpersonal skills, social skills, presentation skills, and mass communication knowledge. Duran (1983) first created the instrument with a total of 20 items (Duran 1983), but then increased the instrument into a 30-item instrument (Duran and Kelly 1988) on a five-point Likert-type scale from 5 = "always true of me" to 1 = "never true of me" that measures six different items of communicative adaptability.

A series of t-tests were used to see any significant change. The t-tests were conducted for each individual group comparing the pre- and posttest of the CAS. The test evaluated whether Twitter and blogging made any significant difference on any of the CAS subscales. A significant result on the articulation subscale of the CAS was found. The results show that Twitter and blogging improved students' grammatical skills. By combining a service-learning project with Twitter and blogging, it stimulated student's articulation skills. This may suggest that the additional form of writing through Twitter helps students' articulation, and having a positive topic as service learning may enhance it further.

The results encourage the implementation of service learning with Twitter into college curriculum as a motivating and intermingled network for students to reach class objectives. This pilot study raises many questions regarding the ability for students to use other social media tools in the classroom as well. This needs to be further explored in a larger group of participants with nontraditional students that struggle with Internet access or how to use them. This might encourage educators to investigate constructive ways to provide a technological aspect to classes easily accessible by all students.

## 11 YouTube

YouTube is the one of the more popular medium instructors and teachers use due to its visual content, easy access, easy use, and flexibility to find almost anything at any time. YouTube is a helpful resource to share visual and audio information from instructor to student and vice versa. Instructors can video tape and post lectures. They can create these lectures right in the classroom or even a green room, if they have access to one. Students can post academic videos and/or audio PowerPoints. YouTube has even created a new channel titled YouTube EDU which consists of channels created by universities and colleges (Snelson 2011). This format provides everyone access to free education. However, these videos can be private among the class or only to the user. These YouTube videos should be short (no more than 7 min) and entertaining.

YouTube can also increase student engagement by conveying content in a different way that students find appealing. Clifton and Mann (2011) suggest that YouTube can "further stimulate deep learning students need to be encouraged to relate, compare, and analyse ideas. Through stimulated discussions students can recognize and evaluate alternative viewpoints and therefore the representation of multiple viewpoints provokes student critical thinking approaches" (p. 312). However, these videos should be used to supplement a lecture, not necessarily replace it (Kelly et al. 2009).

YouTube can be very valuable for lifelong learners. Though not all videos have educational value, such as kittens playing with a paper bag, many people turn to YouTube for new and quick knowledge. For example, if a person wants to change a flat tire, he/she can probably find it on YouTube and watch it at the same time as he/she is changing the tire. If someone wants to watch a short video on American history, there is a strong possibility that many will be available within a quick search. Instructors can enhance the classroom lecture by supplementing it with a YouTube video or posting it as an assignment for discussion as homework or in an online course.

YouTube can also be a great resource for service-learning projects. Students can actually vlog, a form of blogging via the video, right before or after a service-learning project. They can tape, with permission, the actual service-learning project, post it on YouTube, and show it in class as their final project presentation. Students can interview nonprofit volunteers, nonprofit agency staff, or those that are receiving services. For example, in one class, students taped themselves picking up food for a food drive and shared their experiences throughout the day. The advantage is seeing the perspective of others in the class. If students have different service-learning projects, they can try and understand and learn from other students. If one group is working with the homeless, and another is working with veterans, then all students can be visually exposed about each other's projects.

Snelson (2011) mentions with the increased popularity of online education, professors and instructors should invest in developing stronger video production skill to attain higher-quality YouTube videos for their students. Also, to make it educationally productive for students, instructors must make sure that there is a teaching objective(s) and that the video is related to that objective (Thakore and McMahon 2006).

## 12 Instagram

There are over 300 million Instagrammers that post pictures to the very popular website Instagram (Instagram.com 2014). Seventy million videos and pictures are shared every day. It seems natural that such a popular site would make its way into the education world. Hannah Hudson (2015) shares what teachers can do to promote Instagram in the classroom. She suggests that Instagram can be used for history lessons, field trips, and even showcasing favorite books.

Additionally, there is great value for incorporating Instagram with service-learning projects. For example, if a service-learning project entails homelessness, students can snap pictures of what “homeless” means to them. Students could even snap photos through the eyes of a homeless person, trying to develop empathy and a new perspective on the people they are trying to assist. Students shouldn’t be limited to subject of homelessness, but to explain other community service activities the instructor recommends or suggests. Many of those community service projects may include the elderly, animals, or even refugees. With the tool of their smartphone, students, for example, can take snapshots regarding the struggles elderly people go through on a daily basis and take pictures through the eyes of an 80-year-old woman or man.

Opportunities are endless when telling a story or providing a snapshot of someone else’s perspective. Students can also provide their own perspective about some of the local community concerns, creating a bulletin board or a slideshow to share with other students. This can be abstract or provide realist evidence of the growing concerns people face within their communities.

## 13 Snapchat

One hundred (100) million monthly users are currently on Snapchat. Of those users, 70 % are women. The number of Snapchat snaps per day reaches over 400 million (Smith 2015). So what is the interest in Snapchat? People, many of the younger generation, can take temporary pictures, share them, and then the pictures self-destruct. It seems that such an app would be disregarded in higher education, but in fact universities are beginning to use Snapchat. Sopho (2014) shares that schools can promote certain events and even endorse current activities on campus. One of her suggestions is that schools could use Snapchat for campus tours. Based on her comment, universities could promote community service opportunities that are active on campus, allowing students to see for a few seconds active community outreach. Students could then self-promote their own community engagement, possibly attracting other students to participate in these activities. Because the pictures disappear after a few seconds, it would be challenging to make Snapchat part of academic curriculum. However, snapping pictures of a noble cause such as a service-learning project may allure students that never participated in community service events in the past.

## 14 Emaze

Students are becoming bored with Powerpoint, the most popular presentation software out there. emaze, something similar to Powerpoint and Prezi, makes presentations more interesting and exciting for the viewing audience. As Bassa (2013) points out, “Emaze allows users to choose from a variety of templates with built in HTML5 technology, ranging from PowerPoint style presentations, to 3-dimensional patterns, made possible by the advanced graphical capabilities of the system.” It’s common for students to present their service-learning projects as a final assignment which they are graded on by the instructor as well as their peers. With emaze, students can still supply the presentation for academic evaluation, but create something that is different and eye catching. With such interesting graphics and design, these service-learning projects presented on the emaze platform may provide a more “live” experience of their service-learning projects. Educators could argue that such a presentation creates a more attention-grabbing scholarly experience.

## 15 Pros and Cons

As most resources available to educators and administrators, there are positives and negatives associated with m-learning. Positive aspects of m-learning are creative ways of reflection and flexibility. Our world is 24/7 and this allows the student to be responsive whenever and wherever they may feel like it. Students may like this aspect, because they are not being confined to a time and space to complete assignments. They can be engaged anywhere at any time. The disadvantage of this is that it is available 24 h a day, and there may not be a shut-off time for the student or for the instructor. Our population is always in the “on” mode, which does not offer a “down” time.

Additional benefits that Corbeil and Valdes-Corbeil (2007) mention are that less barriers may exist between instructors and students, because students are comfortable with this type of medium. However, on the opposite side, there are students that may not be as comfortable with such devices, because (1) they never found a need to use it or (2) they haven’t had the financial means to keep up with up-to-date technology available. Additionally, certain technology products, websites, and apps evolve daily is not by minute. When the instructor incorporates certain devices and websites for a class activity, he/she may need to change every semester just to keep up with all the technology changes. This can add additional frustration and time to an instructor’s already hectic schedule and overwhelming responsibilities.

As mentioned, it is important to incorporate reflection in mobile activities, but this also has its challenges. Though students may be prompted to reflect and respond accordingly, it doesn’t necessarily create a deeper conception of the material. All the social media accessible to them distract students. They may be responding to a question on a YouTube clip, but then with constant emails, texts, and other tools showing on their phone, they may be distracted. Their concentration and commitment to the activity is then questionable.

## 16 Dos and Don’ts

It’s important for the instructor to have some social presence on the Internet and in the virtual classroom. Without it, the student may feel some disconnection and not thrive in this environment. So how does a professor create a social presence in a social media network? Dunlap and Lowenthal (2014) offer some suggestions that can be introduced in most disciplines. One idea they suggest is having a student and a teacher bio, but takes this bio a step further. They propose a prompt called “One Extra Hour.” They ask students what they would do if they had an extra hour a day to create interesting and engaging dialogue. This provides an opportunity for students to learn about their peer’s values, families, and work. They use VoiceThread to respond via a microphone or webcam to this extra-hour-a-day question. Microphones and webcams can be found on smartphones or other mobile devices as laptops and tablets. Another interesting activity Dunlap and Lowenthal have interwoven in their curriculum is called “Soundtrack of Your Life.” They ask students to create a playlist of six songs: two that represent their past, two that represent their present, and two that represent the future. Many interesting and educational lessons can be found on an Internet search.

The Internet and m-learning can be used asynchronously. However, it can be an excellent experiential world that increases successful collaborative student work. The principles are the same: the instructor needs to make sure there is continual communication with concrete objectives. Students should introduced themselves to each other through email, texts, or face-to-face at the beginning of the project. Then, each student should have a defined role in the assignment, making sure each individual is responsible for being an active and supportive member of the group. Increasing motivation and accountability is necessary for group cohesiveness, which can occur through shared goals and rules that all group members must follow. Continual conversation should occur throughout the project, and the instructor should check to see the progression of the discussion. Suggesting or requiring specific goals to be met each week may be needed by the instructor or a group leader. The instructor needs to help his/her students to be efficient and organized within his/her group and for the class as a whole.

## 17 Future Directions

Social media resources on the World Wide Web can be used to the advantage of instructors and professors. They can make great strides in engaging with their students. However, they need to be intentional about it to increase academic growth and good reflective practice. This is a unique opportunity to be more interactive with students that is not binding by classroom walls. M-learning also encourages students to collaborate and reflect together, allowing students to be more present when focusing on academic work. With service learning and m-learning being combined, the high educational impact can be limitless. With technology tools, websites, and apps changing at a high pace, so can the educational opportunities. The objective and goals of classes may stay the same, but the way to approach students and engage them can vary. Instructors and professors need to keep abreast of the changes that occur so they encourage students’ productivity and interest in education. Additionally, more scholarly research needs to occur for theorists and educators to create conceptual frameworks in the world of education and technology (Antonenko 2015).

## 18 Cross-References

▶ Framework for Design of Mobile Learning Strategies
▶ Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom
▶ Tutors in Pockets for Economics

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# Student Feedback in Mobile Teaching and Learning

# 49

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## Contents



**Abstract**

Mobile learning is believed the trend for future education. It provides real-time, rich content, interactive, teamwork, and work-integrated learning to learners anytime and anywhere. It makes flexible personal learning available to meet the needs for new generation and special students. It also gives opportunities for good educators and good teaching materials to reach thousands of learners all over the world. However, it has also been criticized as lack of personal contacts, lack of body and facial languages, and lack of control on the quality of teaching. Many empirical studies were focusing on the differences between online or mobile learning and traditional learning methods. They tried to find out what could be enhanced for new developed blended learning or mobile learning programs. To assist student learning for Economics subjects, Tutors in Pockets was designed and developed for iOS and Android devices. This study collected primary data from both Australia and China to identify the students' attitude toward mobile learning, their using patterns, and learning patterns on mobile devices, and their experience and expectation for the benefits received from

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Tutors in Pockets. The first section introduces mobile learning and its characteristics. The previous empirical findings are summarized in the second section to compare the advantages and disadvantages for mobile learning compared to traditional learning methods. The third section discusses the design of this study and the mobile program implemented in basic macroeconomic course – Tutors in Pockets. The fourth section presents the sample collected from Australia and China and analyzes the data. The last section summarizes the findings from this study and suggests for future mobile teaching and learning programs.

## 1 Introduction

Mobile teaching and learning (M-learning) is believed the future for modern education (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). It engaged students in their subjects, assisted learning process, enhanced personal learning, and increased discussion and performances (Mishra 2013; Bredl and Bösche 2013; Butoi et al. 2013). Some researchers also found it benefited the lifelong learning (Liaw et al. 2010; Sharples 2000) and benefited special learners (Cumming et al. 2013). There are also some argument on the negative influence brought by mobile devices, such as loose focus and addictive to mobile games instead of learning (Bredl and Bösche 2013).

To assist students learning process, a mobile app (application) "*Tutors in Pockets*" was designed and developed for Economics subjects for iOS and Android devices (see ▶ Chap. 19, "Tutors in Pockets for Economics"). It was introduced to undergraduate and postgraduate students and teachers in Economics subjects from 2011 to 2013 in University of Wollongong. Both qualitative interviews and quantitative online survey were conducted in Australia. The results showed that mobile learning had a positive influence on student's learning process and performance.

Universities and students are also different in different countries (see ▶ Chaps. 35, "Cross-Country University Collaboration Barriers and Solutions", and ▶ 2, "Characteristics of Mobile Teaching and Learning"). To understand the differences on mobile learning in different countries, another survey was conducted in three different universities in China in 2013. The results showed students from different countries and cultural backgrounds have very different expectations on mobile educational apps and different learning styles on mobile devices (see ▶ Chap. 25, "Mobile Education via Social Media: Case Study on WeChat"). Cross-country and cross-culture educational mobile app designers should take into accounts these differences to reach their students and benefit more audiences.

## 2 Literature and Empirical Studies

The skills, knowledge, and expectations of students today are different from those of students ten years ago (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). Oblinger and Oblinger (2005) found Millennials (students born since

1982) are very different from the previous students. They are multitask learners. They prefer multimedia courseware than text. They prefer interactive and network in learning. They have shorter attention spans and poorer text literacy. They are usually lack of reflections and quality of sources. Many empirical researchers found similar results in their studies (Rennie and Morrison 2012; Vogel et al. 2009). How to teach the new generation who was born with all the technology and new devices already been adopted from early childhood in their lives is a challenge to all the educators from preschool to universities. Most educators agreed that the old teaching methods have to be changed to suit new situation and help new students in their learning process. The changes are needed, but how? Mobile technology has been introduced in education for several decades. As many other learning methods, mobile learning has its own advantages and disadvantages.

Mobile learning or distance learning was introduced to high education from the very traditional mobile devices with only black and white screens in the 1970s (Alley 2009). But it grows very fast with the new generation of mobile devices, high-speed data transferring capabilities, and multimedia-supported functions provided by device providers, telecommunication operators, service providers, and content providers in the mobile telecommunication industry (Zhang 2012a; see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). Mobile learning is also adopted by educators in universities, schools, and educational associations. Many leading designers and educators adopted mobile learning or blend learning in their subjects in different disciplines (Bredl and Bösche 2013; Cumming et al. 2013; Fernández-López et al. 2013; see ▶ Chap. 21, "Adoption of Mobile Technology in Higher Education: Introduction"). Multimedia, social media, new technologies, and new devices were adopted and developed too (Holotescu and Grosseck 2011; Yuh-Shyan et al. 2004; see ▶ Chaps. 53, "Advanced Image Retrieval Technology in Future Mobile Teaching and Learning," ▶ 25, "Mobile Education via Social Media: Case Study on WeChat," and ▶ 19, "Tutors in Pockets for Economics"). Thousands of students were benefited from these projects, and they are proved to have positive influence on teaching and learning.

The benefits from mobile learning include correcting misconceptions; increasing learning efficiency; increasing understanding (on complex concepts); facilitating learning from anywhere, anytime; increasing communication between students with their peers and students with teachers; helping students with special needs; engaging students in their studies; enhancing their final performance; helping understand the tasks in real world; enhancing teamwork skills; and benefiting the students' lifelong learning (Akamca et al. 2009; Evans 2008; Fernández-López et al. 2013; Oblinger and Oblinger 2005; Slavin 1980; Sung and Hwang 2013; see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). There are many new benefits that are linked with multimedia learning and learning with social media (Collins et al. 2006; Kennedy et al. 2013; Alley 2009; Vogel et al. 2009; Zhang 2012b). With new technologies and devices which have been introduced into mobile learning, it is expected to bring more benefits to the students and learners. Although mobile learning brought many benefits to educators and students, it is limited by some technical and ethic barriers (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"; Zhang 2012a).

Current technologies still cannot fulfill a real "anytime" and "anywhere" learning due to the quality of signal connection, software and hardware barriers, wireless security issues, and high costs of wireless connections (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). The national security issues, political considerations, and monopoly power in telecommunication industries also influenced the adoption of mobile learning anywhere and anytime (Zhang 2012a). In addition, the high costs on smartphones and wireless data transfer are barriers for mobile learning. Some empirical studies also found that not all the students have smartphones or prefer mobile learning method (Peter and Gina 2008; McCombs 2010; O'Day 2010; see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). There were discussions on if young kids should be have too many screen times per day as it may affect their eye health. Online learning and mobile learning are criticized for its lack of facial and body languages and eye contacts during the teaching process as well as reducing the time for real face-to-face social communications (Qiu and McDougall 2013; Rennie and Morrison 2012). Mobile learning, as most of the other learning methods, does not satisfy the needs of everyone due to its current limitations and individual preference (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning").

Some educators also combined mobile technology with social media to implement their teaching designs (see ▶ Chap. 25, "Mobile Education via Social Media: Case Study on WeChat"). How could we expect the current mobile services and social networks now from 10 years ago? Mobile technology is changing the way people think, learn, and work. It has changed people's life. With new technologies and advanced mix educational methods developed, most of these issues are expected to be addressed in the future (see ▶ Chap. 25, "Mobile Education via Social Media: Case Study on WeChat"). However, social media are different in different countries due to language, cultural, and political reasons (see ▶ Chap. 25, "Mobile Education via Social Media: Case Study on WeChat"; Zhang 2012a).

To bring the technology into one of the most traditional disciplines, Economics, a mobile app, is designed and developed for both iOS and Android version (see ▶ Chap. 19, "Tutors in Pockets for Economics"). The mobile app, Tutors in Pockets, has been introduced to first year and third year undergraduate Economics students and postgraduate students in University of Wollongong from 2012 (the iOS version) to 2013 (the iOS and Android version). This project is expected to help students on their understanding of basic economic conceptions, engage students in their economic studies, correct misconception problems, and improve subject performance for Economics subject in the University of Wollongong. The project was also greatly supported by internal and external development team and business. Each version was introduced to students for one session, and the evaluation was then released and collected through online surveys and face-to-face interviews in the end of the session.

Both qualitative and quantitative studies were conducted to evaluate the result of this project to give a combined objective and subjective results on the TIPs evaluation. The results are expected to shed a light on future mobile learning system design and development. To study the different views on mobile learning from different countries, another survey was also conducted in three different universities in China. The compared results are given in the following sections.

# 3 Qualitative and Quantitative Study on Tutors in Pockets

## 3.1 Qualitative Interview for Multimedia Teaching

To assist students' learning in Economics subjects, a mobile application, called "Tutors in Pockets" or "TIPs," is designed and developed (see ▶ Chap. 19, "Tutors in Pockets for Economics"). The iOS version for TIPs is developed in 2012 and introduced to both undergraduate and postgraduate students. TIPs is designed to help reduce the learning barriers and enhance learning experience via multimedia teaching materials and mobile technology. Multimedia teaching materials with real case studies were developed first for 200 economic basic conceptions. These materials are reviewed by students and staffs (lectures and tutors) from Economics and other disciplines through face-to-face interviews. Table 1 shows the interview results from this study.

**Table 1** Interview results on multimedia teaching materials

| Interviewee | No. | Feedback | Suggestions |
|---|---|---|---|
| RA student (undergraduate) | 1 | As an RA student, I strongly believe that these cartoons would help, as I learn more from visual examples than reading big words that mean nothing to me | The disability people should be part of the labor force |
| International students (undergraduate) | 4 | These cartoons are clear and easy to understand | Add a link to RBA website for inflation cartoon would be helpful |
| International students (postgraduate) | 6 | It engaged students in class discussion | |
| Economics teachers and tutors | 4 | It is really good and I would like to adopt some of them in my lectures<br>I am sure it will touch a nerve with student's lives<br>I think it is good for engaging students<br>It may be used in different subjects and may solve the performance problems of international students | |
| Teachers from other faculties | 2 | It is very impressive<br>I wish I have the ability to develop such cartoons | |
| **Total interviews** | **17** | **17 positive feedback** | **2 suggestions** |

Source: Zhang (2012b)


**Fig. 1** TIPs poster for iOS devices in 2012 (Source: developed by the author for TIPs)

## 3.2 Survey for Tips iOS Version

With all these positive responses and supports, TIPs (iOS version) was finalized and released to students in June 2012. Figure 1 shows the poster for TIPs. To reduce the access barriers, a QR code was adopted in this project. Students can easily scan this code from their iOS mobile devices (iPhone or iPad) and download TIPs from UOW server automatically if they do not want to input the download link into the web browser in their mobile devices.

The first version (iOS version) is designed with online part only. Students can view all the text contents in this application. But for any figure or animated materials, students need to have access to mobile signal to learn from it (see ► Chap. 19, "Tutors in Pockets for Economics"). A total of 80 animated cartoons or figures were developed for 200 economic conceptions in the first version. Students can learn from the lists or search concepts in the application. Some concepts have tables, animated cartoons, formulas, or case studies. One has video linked to the server, and some of them have links to outside authorities (such as Reserve Bank of Australia or Australian Statistics websites). The update function is also available for any new contents in the knowledge database. Students can update their knowledge by clicking the "update" button in the settings page of the application. It is usually recommended that the students have a Wi-Fi connection when they update the application or view videos during study because of the high costs of mobile connection (see ► Chap. 19, "Tutors in Pockets for Economics"; Zhang 2012a).

TIPs was introduced to the first year undergraduate, third year undergraduate, and postgraduate Economics subjects in 2012. More than 500 students got access to the application. However, not all of them have iOS mobile devices, which is required for the first TIPs version. The real adoption rate is also limited by students' personal preferences, class attendance, information sharing between students, and technology issues during download and first access. A quantitative survey and qualitative face-to-face interviews were designed and adopted in the end of the session where TIPs was adopted.

Figure 1 shows the first poster designed form TIPS iOS version release. The poster was introduced in class and also posted in campus to facilitate students' access and download. This is greatly supported by ITS (Information and Technology Service) from the University of Wollongong (UOW). They have implemented an app site for all the UOW teaching and learning apps, with TIPs on the lists. The server space provided by ITS also helped on TIPs download and access. However, as the first version is required to be used as internal app, they are not allowed to be downloaded by public audience. Students or staffs from UOW must log in with their university account to download this application to their mobile devices.

A quantitative survey was conducted in August 2012 to collect the feedback from all subject students. Due to the survey, a total of 56 students attended the study online, including 22 male students and 25 female students. All of the surveyed students have mobile devices, and 64 % were using iPhone. A total 79 % of sample students have difficulties in understanding some economic concepts before.

As a result, students indicated that TIPs had positive influence on their learning efficiency (82 %), utilizing small time slots (82 %), increasing interest in economics (73 %), assisting lectures and tutorials (64 %), helping study anytime and anywhere (64 %), engaging discussion with peers and teachers (55 %), and enhancing subject performance (45 %). Due to the strong needs of Android version by students, the second stage of the project was designed and developed in 2013.

### 3.3 Survey for TIPs 2 (iOS and Android Versions)

The Android version of TIPs was developed and introduced into Economics subjects in 2013. The iOS version of TIPs was also revised with some functions improved and an online-offline strategy adopted (to achieve a real anytime-and-anywhere study). More multimedia teaching materials were developed for TIPs 2. Some suggestions from students and staffs were taken into accounts in the revision of TIPs iOS version and development of Android version. After the condensed developing and testing processes with great supports from a business partner and all team members in University of Wollongong, the TIPs 2 (both iOS and Android versions) was released to students in July 2013. Both online and offline functions were designed and developed in the second version to improve the learning anytime-and-anywhere experience. Students do not need access to mobile signal connection to learn from their mobile devices now. All text, figures, and animations are installed into the students' mobile phone in the first download. The connection with server via mobile Wi-Fi or cellular signal is only required when there are new contents that need to be updated. The real benefits from mobile learning were enhanced in the second version. The second version on Google Play is also accessible by all public audience for free. Figure 2 shows the poster for TIPs 2.

To reduce the access barriers, two QR codes were adopted in this project. Students can easily scan the codes from their mobile devices and download TIPs from UOW server and Google Play automatically. It was introduced into three tutorials of a first year undergraduate subject to compare the differences of adopted and not adopted groups. To make it available to more students (with other mobile devices or no mobile devices), the developed teaching materials are also adopted in class for these groups. Animations and figures were adopted in lecture slides. The evaluations of the use of animations were summarized in the following section.

A survey was conducted to collect the students' feedback for TIPs 2 in September 2013. A total of 54 students attended the study online, including 31 male students and 23 female students. Most sample students have one or two smartphones, and only two students indicated that they have no smartphone. There were 74 % students with iOS devices, followed by android devices (24 %), and others (7 % for Nokia, Win Phone, and BlackBerry).

As a result, students indicated that TIPs had positive influence on their learning efficiency (38 %), utilizing small time slots (32 %), increasing interest in economics (26 %), assisting lectures and tutorials (38 %), helping study anytime and anywhere (56 %), engaging discussion with peers and teachers (9 %), and enhancing subject performance (26 %). The results are different from the first year's results. One possible reason is that the sample group is first year undergraduate students only in 2013.

### 3.4 Objective Evaluation for TIPs 2

To evaluate the objective results of adopted and non-adopted groups, the tutorial tests, essay assessment, and final exam results of each group were also compared.


**Fig. 2** TIPs 2 poster for iOS and Android devices in 2013 (Source: developed by the author for TIPs 2)

**Table 2** Compare the average group performance with and without TIPs

| | Tutorial | Quiz | Essay | Final | Overall |
|---|---|---|---|---|---|
| Groups with TIPs adopted | 13.96 | 3.79 | 16.82 | 46.02 | 63.72 |
| Groups without TIPs | 13.36 | 3.22 | 13.82 | 45.60 | 59.48 |
| All groups | 13.41 | 3.30 | 14.19 | 45.57 | 59.93 |

Source: Author

The results are showed in Table 2. The marks are from the first year Macroeconomic students in spring session 2013. There are 446 students with all marks in 24 groups (tutorials). The performances were evaluated in their average marks for tutorial preparation, in-class quiz, essay assessment, final exam, and overall marks for all the previous assessments.

The results indicated that groups with TIPs adopted in class have higher performance in each of the individual assessments and overall marks. The average marks for groups with TIPs adopted were 4.24 higher than those without TIPs adopted. One of the students also indicated to anther Economics teacher: "I had no idea what economics is but now I am interested in economics." Students from the "TIPs" groups were engaged in more group discussions and provided more suggestions. They focus longer than the other groups. Some of them gave feedback during class and in the next class. Two students found few typing errors in the mobile application. Their names were also updated in the contributors' list in the settings page of the application.

It shows that TIPs has very positive influences on students' performances and increases their understanding and interests in the teaching materials. There are also positive results from the tutorial class with animated lecture slides from TIPs materials. Students were more engaged and indicated that the materials were very helpful to their studies. Although most materials are basic conceptions and case study on threshold concepts instead of solving difficult questions or practice questions for exams, students were very active in discussion. As in Table 2, the objective performance from tutorial marks, essay marks, and final marks is much higher than the groups that did not adopt these teaching materials, which shows the multimedia materials are not only useful on mobile devices but also helpful in normal class.

Figure 3 shows some cartoons adopted in the lecture slides and TIPs mobile application. They give examples of basic economic conceptions: inflation, demand curve, and monetary policies. Some misconception problems are also indicated in these figures. A picture is worth a thousand words (Larive 2008). One cartoon can present the basic conception, hypothesis of the situation, cases to help understanding, and formula for calculation in some cases. Other animated cases can be found in Tutors in Pockets application from Google Play (see ▶ Chap. 19, "Tutors in Pockets for Economics").

During the interviews with individual students and staffs in 2012, some international students and staffs indicated that multimedia teaching materials and mobile learning methods can benefit international students and assist their learning

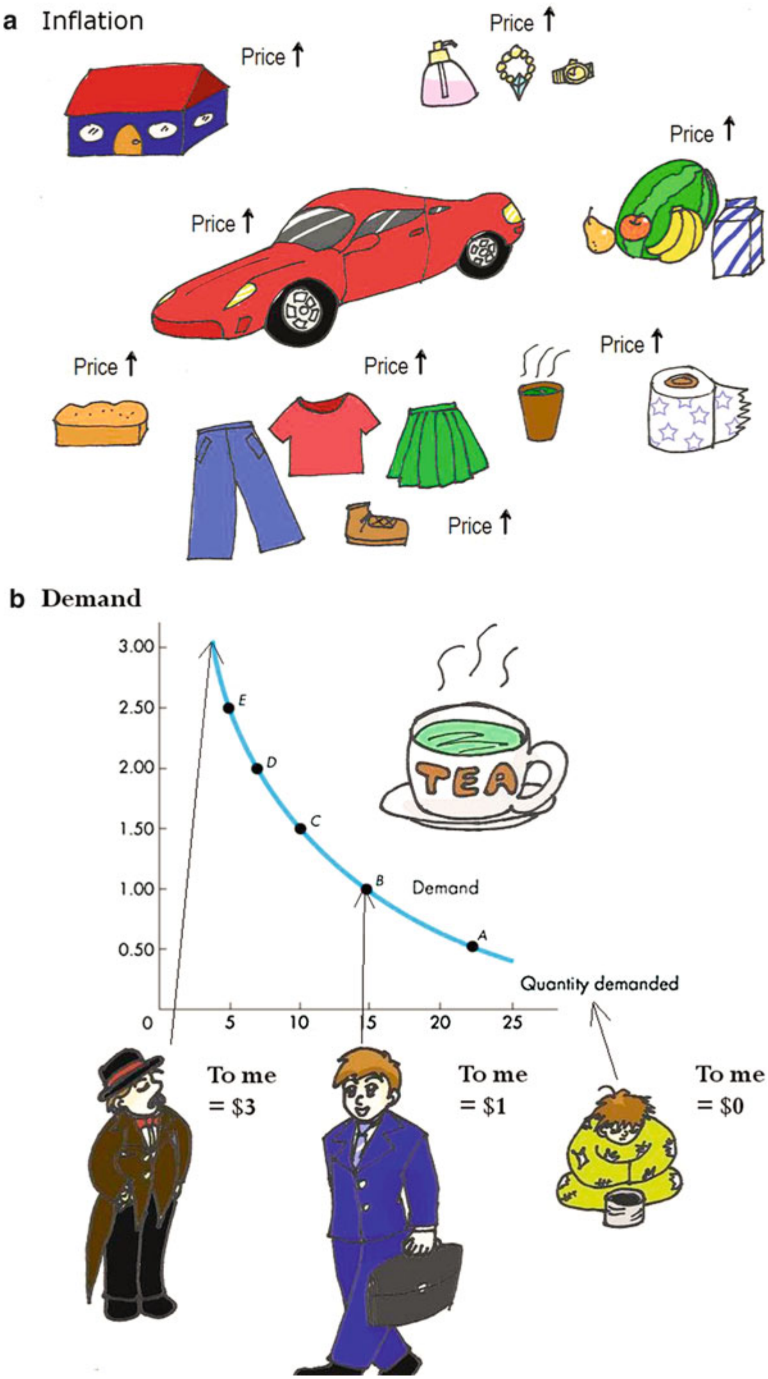


**Fig. 3** (continued)


**Fig. 3** Some animated cartoons and figures in *Tutors in Pockets* (Source: From *Tutors in Pockets* developed by the author)

with a nonnative language. To understand better the differences of local students and international students, another study was conducted in June–July 2013.

As the number of Chinese students in Australia increased dramatically in recent years, the survey was conducted in three different universities in China. They are East China Jiaotong University (in Jiang Xi province, China), Beijing Information Science and Technology University (in Beijing, China), and University of Science and Technology of China (in Anhui province, China). Both undergraduate and postgraduate students are invited to attend this study.

The result of this survey is compared with the Australian survey result collected for TIPs 2 to identify the different using patterns of mobile devices, mobile learning, and expectation of mobile learning applications from Australian and Chinese students. They are introduced in the next section.

## 4 Compare the Differences from Australia and China

To study the influence of cultural differences on mobile learning, two surveys were conducted separately in China and Australia. The Chinese survey was collected from 183 postgraduate and undergraduate students from East China Jiaotong University, Beijing Information Science and Technology University, and University of Science and Technology of China in June–July 2013. The surveyed universities are located in Beijing, Anhui, and Jiangxi provinces, which are far from north to south of China. The results are believed to represent the most general university student groups in the Chinese universities.

The Australian survey was collected from 54 first year undergraduate Economics students (majority of the students are local students) in the University of

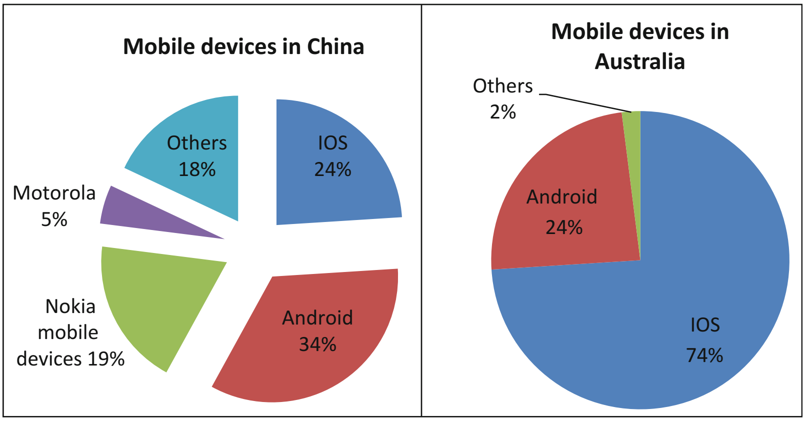


**Fig. 4** Mobile devices by learners in China and Australia (Source: Author)

Wollongong in September 2013. Instead of evaluating TIPs only, this study focuses on the different views of students on mobile device usage, how they learn on mobile, and what are their expectations on mobile educational applications. The last part of the questionnaire was designed to evaluate the results of TIPs. But some of the surveyed students did not have access to TIPs or were not using TIPs in their studies. The results show many differences from Australian and Chinese students, which also shed a light on future design and development of cross-country mobile teaching and learning systems and applications.

Firstly, the market share of mobile devices in China is different from those in Australia due to the different choices of mobile devices available in the market, preferences from different cultural backgrounds, and different prices of mobile devices in different markets. Figure 4 shows the differences from the surveys. The majority of Australian students (74 %) were using Apple (iOS) mobile devices (iPhone or iPad). The Android mobile devices (24 %) and Apple mobile devices were used by 98 % of the Australian students.

In China, Android mobile devices had the biggest market share, which was 34 % only. Students used Apple mobile devices (24 %), Nokia mobile devices (19 %), Motorola mobile devices (5 %), and other devices (18 %). Nearly half of the mobile devices in the Chinese market are not iOS or Android mobile devices, which should be taken into account when designing a mobile educational application for global market. One possible reason for this is the price difference for iPhone and other mobile devices in the Chinese market. The variety of mobile devices that supported Android system and the free mobile applications for Android devices are also the factors that improved their market share in the Chinese market.

Secondly, the usages of mobile phone in different location and scenarios are different in Australia and China. The different preferences, cultural backgrounds, and policies and rules in different countries are the major factors that influenced the usage. Figure 5 shows the differences.

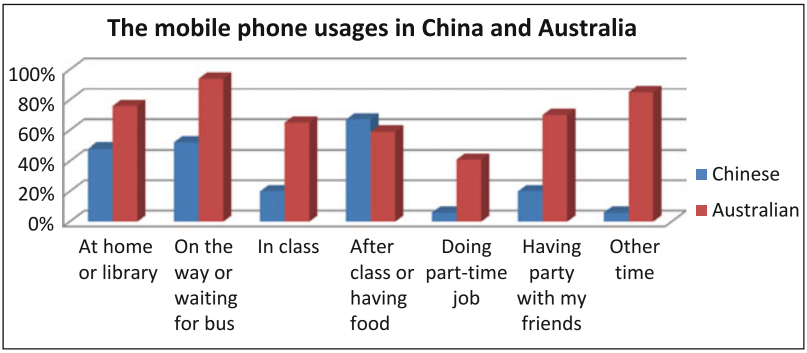


**Fig. 5** Mobile device usages by learners in China and Australia (Source: Author)

As shown in Fig. 5, the frequency of using mobile devices by Australian students was much higher than those of their Chinese peers. One possible reason is the strict restriction of mobile phone usage in classrooms in China. Most Chinese students are not supposed to use their mobile phone either for play or search information in class. The use of mobile devices in class is regarded as disrespect to the teacher or lecturer in China. Due to the cultural difference in universities and at home in different countries, the uses of mobile devices in class (restricted in most universities and schools in China) and during part-time jobs (Chinese students are not suggested to do part-time jobs during study years) in China were very rare. Chinese students usually use their mobile devices in their spare time after class. As Chinese students usually live with their parents until they finished university studies, the use of mobile devices at home is also less than those of Australian students (due to the preference of the Chinese parents on mobile phone).

Thirdly, due to the cultural differences as discussed above, mobile learning was not adopted by majority of students in China. Only 9 % of the surveyed Chinese students adopted mobile learning, and 61 % of students adopted online learning (some are required by schools). Students still prefer traditional teaching methods or online learning methods. However, in Australia, students learned from variety of mobile and online sources. They are more active in searching information, downloading learning materials, and doing assessments on mobile devices compared to their Chinese peers. They also adopted different social media and platforms in their study. Figure 6 shows the percentage of students using different sources of online and mobile learning.

Google is the first choice by 91 % Australian students. E-learning site by universities (57 %, required by some universities or subjects), YouTube (55 %), and Wikipedia (34 %) are also popular for Australian students. However, YouTube, Facebook, Wikipedia, and Google are all blocked in mainland China. Instead, Chinese students usually use local social media platforms to communicate with friends and get information, such as WeiBo, WeChat (WeiXin), or RenRen (see ► Chap. 25, "Mobile Education via Social Media: Case Study on WeChat"). The most popular video website in China is Youku Tudou. There are also many different

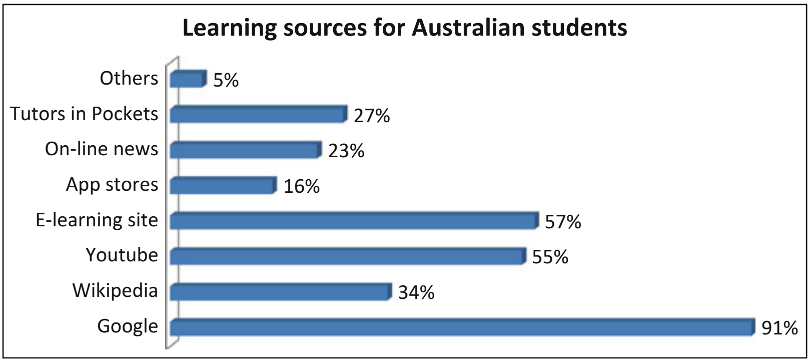


**Fig. 6** Sources of mobile learning from Australian students (Source: Author)

social media and video sites for different groups. For example, the 56 video is more popular in Chinese universities as they target on the young audience in China. Some of the on-site events, like the university film making competition and mobile sharing rewards, also increased their subscriber numbers from university students. The popular social media are expected to be different in different countries or even different regions. New replacement effect due to the development of new technology, new devices, and policies also influenced the penetration rate of mobile learning adoption in different countries. To suit the fast changing rules and technologies, educational application designer for international market should also take these differences into account.

Last but not list, the expectation of mobile learning is different in Australia and China. It could be different in other countries too. Figure 7 shows the differences in detail. Australian students appreciated more convenient functions that assist study anytime and anywhere, learning in class, and learning performances. Chinese students, on the other hand, preferred educational applications that assist learning in shorter time slots and increasing learning efficiency. One possible reason for these differences is the usages in different scenarios in China and cultural preferences in the Chinese culture. Australian students focus more on efficiency and study in short time slots. Chinese students focus more on the performance of the subject and learning in class. Students in China have higher price elasticity to mobile applications and devices. In other words, when the price increased a small amount, more students will leave the customer group from using the mobile device or mobile applications compared to Australian students. Therefore, the designers and developers should also take into account these cultural differences in their cross-country educational system design. The results also shed a light on other commercial mobile application design across countries.

Although the major results are very different in Australia and China, there are some similar answers from Australian and Chinese surveys. The average learning time lengths per day on mobile devices were similar in Australia (40 min) and China (30 min), which was only 1/8 or 1/9 of the lengths of mobile usages per day in

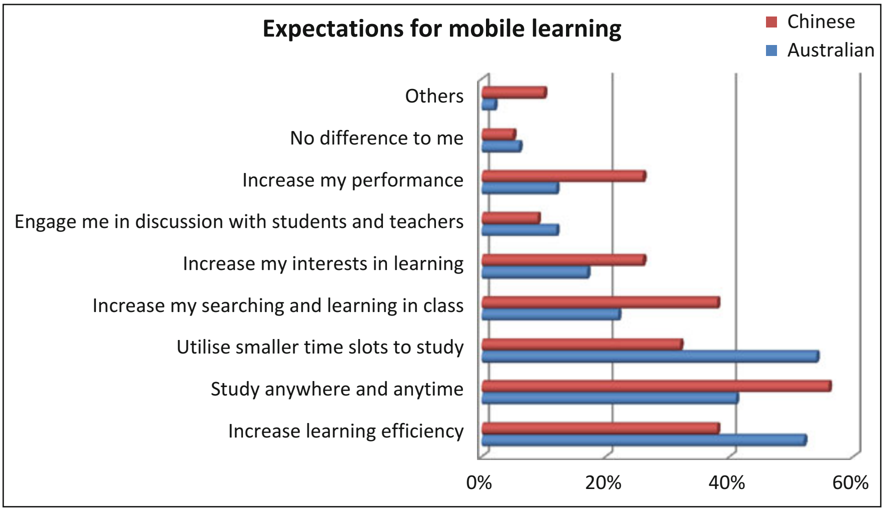


**Fig. 7** Different expectations for mobile learning in Australia and China (Source: Author)

both countries. People usually get tired after focusing on a small mobile screen or hold a mobile device for half an hour. Mobile devices are not considered as a major source for study in current stage due to the technology, ethics, and high costs of mobile learning (see ▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). But the situations are expected to change with more advanced mobile devices invented (like wearable mobile devices, new screen technology, or 3D technologies), more mobile educational applications developed, and more university-adopted mobile learning strategies (see ▶ Chaps. 19, "Tutors in Pockets for Economics," and ▶ 53, "Advanced Image Retrieval Technology in Future Mobile Teaching and Learning").

Mobile learning is regarded as a complimentary learning method to face-to-face learning than supplementary method in current stage. There are still technology, ethics, and policy limits and barriers for the adoption of pure mobile education in universities or schools. A blended learning method is still preferred by both educators and learners in current stage.

## 5 Future Directions

Mobile teaching and learning has been the trend for modern education. Although it brings many benefits to students and educators, they are still limited by current technology and ethics issues to achieve real "anytime" and "anywhere." With the development of mobile technologies and globalization, these barriers will be diminished in near future.

The qualitative and quantitative studies on mobile educational application for Economics – Tutors in Pockets (TIPs) – showed very positive results for students' learning process and performance. It corrected misconception problems, increased learning efficiency, increased understanding, increased in-class discussion and reflection, helped students with special needs, engaged students in Economics, and enhanced students' individual and final performances in the subject they studied. Staffs from Economics school and other disciplines also gave high evaluations on TIPs.

The developed multimedia materials cannot only be adopted in mobile application but also tutorial discussion, lecture slides, and exam questions to help in understanding, engage in-class discussion, and enhance students' subject performances. Students also indicated that they were interested in the subject with all these materials adopted in class.

The results from Australia and China studies showed that learners are different in terms of mobile device adoption, usage, pattern of mobile learning, and expectations for mobile educational applications in different countries. An international mobile educational application designer should take into account the cultural differences and political barriers to reach the global market and make a real international program. The results from this study combined both qualitative and quantitative results to give a more reliable evaluation on mobile teaching and learning. It also studied the influence of cultural differences on mobile teaching and learning, which shed a light on cross-country mobile educational system design and develop in the future.

## 6 Cross-References

▶ Adoption of Mobile Technology in Higher Education: Introduction
▶ Advanced Image Retrieval Technology in Future Mobile Teaching and Learning
▶ Characteristics of Mobile Teaching and Learning
▶ Cross-Country University Collaboration Barriers and Solutions
▶ Mobile Education via Social Media: Case Study on WeChat
▶ Tutors in Pockets for Economics

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# Transforming Assessments into the Digital Domain 50

Rodney J. Clarke

## Contents




**Abstract**

Transforming assessments from paper-based to digital formats is often considered as unproblematic as mere repurposing. The idea presented in this chapter is that assessments need to be transformed into the digital domain. The approach that is used here is communicative; assessments are considered as completed acts of communication. If the overall global rhetorical organization, also known as genre, of the assessment is understood, then the transformation of the assessment into the digital domain is likely to be successful for both teachers and students.

This chapter describes how assessments can be considered from the perspective of genre, how to conduct a generic analysis an existing assessments, and why it is necessary to consider and analyze all the other related texts like marking rubrics, ethics clearances, and the like that contribute to a sufficient and complete assessment. The implications of using genre as a design practice to rework and improve the assessment in the digital domain are also considered.



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An authentic assessment for an introductory first year undergraduate information systems subject is used to exemplify both generic analysis and design in transforming assessments into the digital domain.

## 1 Introduction

As this handbook amply demonstrates, many disciplines and institutions around the world are marching toward a future and in a number of cases dealing directly with it in the present, where teaching and learning are firmly planted in the digital domain. This chapter is an exploration into transforming assessments from the analog to the digital domain. The idea behind here is to try to develop methods for rigorously converting traditional written assessments into hypermedia while at the same time utilizing the capabilities provided by these new environments. There seems little doubt that assessments that are targeted for digital platforms provide additional literacies for learners as well as transforming assessments from "things" into "processes." The opportunities provided by these technologies must necessarily extend to rethinking the nature of assessment artifacts, assessment practices, and processes. In this chapter, some of the implications of this transformation outside of the immediate assessment are examined. The problem of transforming assessments into the digital domain is often considered to be analogous to the problem of "repurposing" traditional documents into information systems of various kinds, in particular web-based systems. However, in Sect. 2, conventional repurposing practices are critiqued in favor of adopting an appropriate communication theory.

Functional communication theories are considered a better choice because they can be used to reveal the structure and function of the original assessment items while having the potential to repackage the semantics into a form that is commensurate with the digital domains, learning environments, learning management systems (LMS), or delivery platforms in which they will be used. From the available alternatives, systemic functional linguistics (SFL) is chosen to derive the kind of communication resources that are needed when analyzing assessment texts for redeployment into the digital domain. Of special interest are those resources that account for the global rhetorical features of assessment-related texts. In SFL, these resources are referred to as genre. In Sect. 3, genre is used as a form of analysis, a first stage in transforming assessments into the digital domain. Generic analysis is applied to an assessment that utilizes Alter's framework to describe work systems in organizations. Typically, this assessment is in the form of a case study report, a received genre common in business contexts. In Sect. 4, the staging of the original assessment genre is used to repackage the assessment for deploying on learning environments, learning management systems, or delivery platforms. In Sect. 5, a unified workflow for generic assessment transformation is described. It is extended to incorporate other related or agnate genres that may be relevant to assessments and the assessment process.

# 2 Assessment Transformation

## 2.1 Critiquing Assessment Transformation as Repurposing

One way of looking at assessment transformation is as a kind of *repurposing practice*. Assessment repurposing is defined as the conversion of analog or legacy assessments and related documents for electronic publication generally on the web or through some Web 2.0 environment (blog, eportfolio system, or similar). The advantages to businesses undertaking digital repurposing of paper documents is that knowledge repositories can be created by hyperlinking throughout the repository and augmenting the documents themselves with additional media. It makes perfect sense to consider the affordances of these new publishing technologies when converting from legacy documents to digital ones. Unfortunately, the kinds of repurposing practices developed in the computing disciplines often relied on dubiously *orthographic* and *asemantic* views of language and media resources; these disciplines are for the most part unaware of functional language approaches.

A common computing approach to repurposing (Keyes et al. 1988) takes a legacy document and passes it through a problematic sequence of "techniques" (see Fig. 1 left hand side). These techniques become progressively more "visual" and less "textual"- hence their characterization here is orthographic. The original document is *chunked* in order to separate the page contents into smaller sections. These small sections are *queued* or sequenced on the page in order to add additional visual organization. The resulting page content is then *filtered*; parts of the document are effectively removed. The perceived monotony of the printed word is successively broken up by adding nontext media, hyperlinks, and JavaScript to the original text. The *mixed modes* stage is where additional modalities are added to break up the page, and *abstraction* is a stage where the pages themselves are organized into related areas. These repurposing techniques rely upon an unacknowledged visual semiotics (Kress and van Leeuwen 2006). This links conventional repurposing practices to an economic discourse that construes text

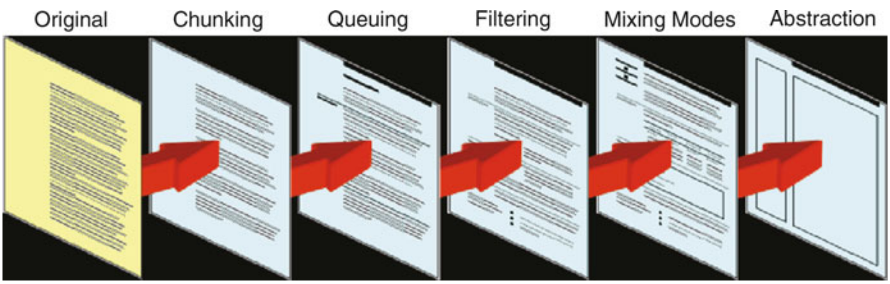


**Fig. 1** A common view of repurposing legacy documents for use in the digital domain

repurposing as "value adding." Repurposing relies on probabilistic definitions of information independent of media, naive assumptions about visual reading practices, and eliding the communicative function/s of distinct media. This is why these techniques have been characterized as asemantic.

## 2.2 Communicative Perspective on Assessment Transformation

Seeking an appropriate communication theory from which to explore the transformation of assessments involves making a decision between two major competing and mutually exclusive approaches to language itself. The dichotomy in language theories is perhaps most clearly articulated by Matthiessen (1991) upon which this brief discussion and that of the next subsection are based. The first major approach, referred to as the *formal* language approach, involves considering "language as rule." Formal theories focus on the structure of individual sentences- common IS and IT applications include computational linguistics, parsing, and compilers. From this approach, the development of an appropriate assessment would be based around the communicative competence of instructors and students. The second major approach, referred to as the *functional* language approach, considers "language as resource," specifically as a meaning-making resource and focus on language use. From this approach, the development of assessment items is based around appropriate language use for both instructors and students in educational social settings, both physical like computer laboratories as well as virtual, for example, learning laboratories. Of these two mutually exclusive language views, the latter is considered as more appropriate to assessment repurposing.

What counts as a useful approach to language is one that is comprehensive in that it can account for language use in a sufficient and complete fashion. Assessments are completed acts of communication, and so functional approaches that are based around a single language resource, and therefore only account for a single facet of language activity or use, are excluded here. This includes one of the better-known language approaches in information systems and technology including, for example, *speech act theory* (Searle 1969; Lyytinen 1985). Instead, the most dominant form of functional linguistics called systemic function linguistics (SFL) is used here. It is a comprehensive theory of language that is based on European and specifically British (Firthian) functional approaches to language. SFL was developed by Halliday (1978, 1985), who laid down the functional basis of this theory in his landmark *Introduction to Functional Linguistics*. As part of its development, Martin (1992) modularized the grammar enabling researchers to be more readily applicable to a variety of studies. In the following subsection, the example assessment is introduced, prior to describing more fully the specific SFL resources that are used in transforming this assessment into the digital domain in Sect. 3.

### 2.3 Assessment Example: Alter's Work System Framework

The example used in the remainder of this paper is an individual assessment for an introductory Information Systems subject called COMM113, a first year elective in the Bachelor of Commerce degree, University of Wollongong, Australia. This is the first (individual) assessment item and involves students selecting a real company (either for-profit or not-for-profit). The company can be one that the student either works in or one that is located close to their home. The business that a student selects is recorded by their tutor. Only one student can study any given organization during the subject. To complete the assignment, students need to analyze the company that they have selected using the so-called *Work System Framework* and *Work System Snapshots* developed by Steven Alter (2013) from the University of San Francisco. Alter (2006, 2008, 2013, 2014) developed the framework and snapshot to rapidly and effectively describe work from a systems-centric and technology-agnostic perspective. Both technology students and management students can apply the work system framework to yield valuable insights into the work that their selected organization undertakes.

A *work system* is defined as a system in which human participants and/or machines perform work using information, technology, and other resources to produce products and/or services for internal or external customers. Typical business organizations contain work systems that procure materials from suppliers, produce products, deliver products to customers, find customers, create financial reports, hire employees, coordinate work across departments, and perform many other functions. The work system concept is useful in the context of a first introductory IS assessment because it is a common denominator for many types of systems within and between organizations. Operational information systems, service systems, projects, supply chains, and e-commerce websites can all be viewed as special cases of work systems. An *information system* is a work system whose processes and activities are designed to process information. A *service system* is a work system that provides services for its customers. A *project* is a work system designed to initiate, develop, deploy, and subsequently decommission a product or service. A *supply chain* is an interorganizational work system devoted to procuring materials and other inputs required to produce a firm's products of matching more generally supply to demand. An *e-commerce website* can be viewed as a work system in which a buyer uses a seller's website to obtain product information and perform purchase transactions. The work system concept is applicable to a wide range of actual work systems. This received framework has been developed to allow business people, customers, and others to understand what a system is doing and can be used to assist analysts in developing an understanding of how these systems relate to organizations.

The work system approach for understanding systems includes both a static view of a current (or proposed) system in operation and a dynamic view of how a system evolves over time through planned change and unplanned adaptations. The static

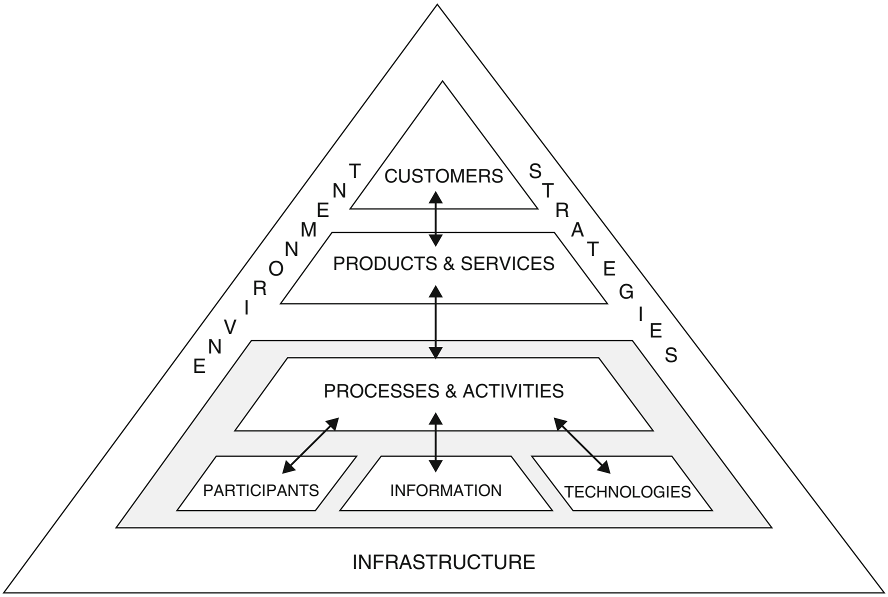


**Fig. 2** Alter's work system (After Alter 2013, p. 78)

view is summarized by the *work system framework* that identifies the basic elements for understanding and evaluating a work system. It consists of descriptions of Environment, Strategies, and Infrastructure. For our purposes, detailed definitions of, and distinctions between, each of these categories are not of concern here; the reader is referred to Alter (2013) for further clarification; suffice to suggest that these categories are very familiar to IS students and practitioners and are relatively unproblematic for the purposes of this assessment. This framework is prescriptive enough to be useful in describing the system being studied, identifying problems and opportunities, describing possible changes, and tracing how those changes might affect other parts of the work system. Figure 2 shows Alter's work system in its entirety. *Work system snapshot* summarizes a work system on a single page by identifying its customers, products and services, processes and activities, participants, information, and technology that constitute the work system. These are sufficient to provide a rudimentary understanding of a work system's operation, context, and significance. At the beginning of an analysis, creating and discussing a work system snapshot can be useful in clarifying and attaining agreement about the scope and purpose of the work system that is being analyzed. The environment, infrastructure, and strategy are not included in the work system snapshot in order to make it easier to use and to allow it to fit on one page. Those topics are considered as the analysis goes deeper. The last four components (processes and activities, participants, information, and technologies) constitute the *work system* itself; these are greyed out in Fig. 2. There may be many work systems supporting the development/production of goods and services for customers.

**Table 1** COMM113 assessment using Alter's work system framework

| Assessment 1: Essay – Information systems in business settings report | |
|---|---|
| **Graduate Qualities Assessed** | Informed<br>Innovative and flexible<br>Socially responsible<br>Connected communicators |
| **Marking criteria** | Students will be required to select a real company (can be for profit or not for profit) and will be assessed on the ability to:<br>1. analyse the company using the "work system framework" developed by Steven Alter from the University of San Francisco – available through eLearning<br>2. describe the relative importance of business strategy, market environment, IT infrastructure, company participants, customers, processes and information to create value<br>3. produce and submit a digital report that addresses (1) and (2) using the Mahara e-Portfolio system |
| **Length** | 1,000 words |
| **Weighting** | 10 % |
| **Assessment due** | 27 Aug 2014 (Wednesday in Session Week 5) |
| **Type of collaboration** | Individual assessment |
| **Style and format** | See Below – detailed information |
| **Assessment submission** | ***Submitted to Commerce Central*** (Before 5 pm, Wednesday Week 5: 28th August)<br>**For Individual Assignments:**<br>To submit the assignment, you must print an individualised cover sheet with a bar code from http://commfac.uow.edu.au/coversheets/<br>Attach this cover sheet to the front of the assignment and take it to Commerce Central to be scanned and submitted before 5 pm on Wednesday 28th August, 2013<br>The assignment will electronically be recorded as "submitted" and an electronic receipt will be issued to your University email account. Please note that you will need to print the coversheet on a laser printer (use the library or computer lab printers If necessary) because ink jet printers may not print to the quality needed to make the barcode readable by the scanners<br>**Please ensure that you have signed the plagiarism declaration and selected your tutorial information before submitting your assignment for scanning at Commerce Central** |
| **Assessment return** | In Tutorials/Labs in Week 7 |
| **Detailed information** | Report<br>Further information and marking criteria will be provided in tutorials/labs and on the subject eLearning space. |

The work system assignment for COMM113 was described in the subject outline as both an essay and a report (we will address this issue later in this chapter); suffice to say that students were obliged to create a report; see Table 1. The assignment was designed to equip students with a simple yet useful suite of tools to structure their understanding of a work system in its business context.

It is in three parts: A: Description of the Business (mandatory- no marks), B: Work System Framework and Work System Snapshots (10 % each), and C: Business Strategy, Market Environment, and so on. Part A is mandatory but trivial and so attracts no marks. The student effort is focused on Part B and to a lesser extent Part C. Students were provided with a document called the *Alter Work System Framework Handout* that describes this framework in detail as well as a *Work System Snapshot Template* to download if required from the subject's elearning site (Moodle). In the next section, we describe how to generically analyze this assessment (or indeed any other).

## 3 Transforming Assessments 1: Generic Analysis

SFL has been extensively applied in Australia to all levels of education as well as the analysis of professional and academic discourse (Woodward-Kron 2005). One of the triumphs of this particular language theory has been the association of the global rhetorical organization of texts with disciplinary knowledge (Cope and Kalantzis 1993). Knowledge not only involves understanding what counts as facts in a given discipline but also involves mobilizing the kinds of global rhetorical organization that are necessary for engaging in appropriate communication within a discipline, that is, both conveying knowledge and also unpacking it (Rose and Martin 2012). Within SFL, the global rhetorical organization of texts including disciplinary specific ones is described using the communication resource of *genre* (Martin 1992; Eggins 2008). Disciplinary knowledge necessarily requires the acquisition of genre literacy by students (Wingate 2012; Tribble and Wingate 2013). One of the ways this genre literacy can be taught to students in educational contexts is by analyzing a relevant text into its constituent genre elements (*genre deconstruction*); then teachers and students can use this knowledge to jointly construct new text that conforms to that genre (*joint construction*), and then the knowledge of this genre structure can be reinforced by having students independently create texts that conform to that genre (*independent construction*). This three-stage genre literacy cycle was advocated by Rothery (1996) and widely adopted in teacher training and curriculum design. However, our interests in using genre involve studying preexisting assessments and their ancillary materials (supplementary information documents, assessment rubrics) and converting these to the digital domain. Of primary concern here is a transformation process that can be used to create digital assessments that are usable regardless of the devices that students are employing (smartphones, tablets, or web systems on desktops). Genre can be of particular use in organizing and dynamically structuring texts so they are readable and comprehensible regardless of the interface on which they are viewed. It is possible to implement these insights using so-called responsive design practices for web systems (Peterson 2014). Here, the argument is organized starting with an analysis of existing assessments (in the remainder of Sect. 3) and then their subsequent redesign for deployment in the digital domain (Sect. 4).

### 3.1 Relevant Language Resources: Genre Elements, Structure, and Elicitation

The specific SFL resource and approach that can be used in transforming assessments, and arguably repurposing any digital document, is referred to as *canonical genre theory*. A *genre* is a conventional communication resource developed to account for the fact that language in cultural specific settings has a reproducible form. A memo or a service encounter are examples of two genres, one a written language text, the other a spoken language text. Each genre has specific stages and can be described using sequences of *genre elements* that describe routinized discourse: a greeting, a price negotiation, leave taking, and so on. *Canonical genres* are genres that appear in many different domains and are widespread in society. Considerable efforts have been made by sociolinguists to identify relevant canonical genres in society (Martin 1992). A number of families of canonical genres have been identified; the service encounter genre forms its own group, but perhaps more relevant for hypermedia applications are the factual and narrative canonical genre families. Members of the Factual canonical genre family are used to organize factual knowledge of some kind whereas members of the Narrative canonical genre family are used to organize various kinds of stories. The concept of a canonical genre can be applied in multimodal contexts- like those of interfaces or web pages. A *multimodal canonical genre* accounts for media semantics through media components and references that connect these media together. A web page would then comprise multiple canonical genres organized into a genre-based page layout. These generic page layouts can be created, reviewed, updated, and deleted and in turn can be styled through a style sheet. For our purposes, we will only consider conventional canonical genres and the effects of transforming texts into the digital domain. Some of the implications of considering transformed assessments from the perspective of multimodal canonical genre theory will be discussed briefly in Sect. 5. Another useful aspect of understanding what the generic structure of a text should be is that it is possible to ask questions in order to identify if a candidate genre element in a text conforms to its canonical equivalent. For example, a stage that is responsible for describing the technology used in a work system could be probed in order to determine if it does in fact do so. This use of so-called probes or questions that can be used to resolve the identity of the generic staging and the sufficiency of the content or information packaged in the corresponding elements is a useful aspect of canonical genre theory. Probes can also form the basis for a so-called elicitation practice. An interviewee, for example, a manager, can be asked to provide some required content or information in the form of an elicited spoken text that is subsequently used to create a written text that conforms to the required canonical genre.

### 3.2 Unpacking the Assessment's Generic Structure

In the previous subsection, the concepts of genre elements and genres were introduced. An analysis in Table 2 of the assessment item in Table 1 reveals that it is a

**Table 2** Generic Staging of COMM113 2014 Alter's Work System Framework Assessment (As Is) and three other arrangements of genre elements with increasing degrees of generic structural organisation (Alt 1, 2, 3 and 4)

| Item | Task description | Genre elements | | | | |
|---|---|---|---|---|---|---|
| | | *As is* | *Alt 1* | *Alt 2* | *Alt 3* | *Alt 4* |
| – | – | – | C P SP | C P SP | C P SP | C P SP |
| Business | Description | P | | | | |
| – | – | – | | | | |
| Work System Framework | **E**nvironment | $T_E$ | $T_E$ | $T_E$ $T_S$ $T_{IS}$ $T_C$ $T_{PS}$ $T_{PA}$ $T_P$ $T_I$ $T_T$ | $T_E$ $T_S$ $T_{IS}$ $T_C$ $T_{PS}$ $T_{PA}$ $T_P$ $T_I$ $T_T$ | $T_E$ $T_S$ $T_{IS}$ $T_C$ $T_{PS}$ $T_{PA}$ $T_P$ $T_I$ $T_T$ |
| | **S**trategies | $T_S$ | $T_S$ | | | |
| | **I**nfrastructure | $T_{IS}$ | $T_{IS}$ | | | |
| Work System Snapshot | **C**ustomers | $T_C$ | $T_C$ | | | |
| | **P**roducts and **S**ervices | $T_{PS}$ | $T_{PS}$ | | | |
| Work System | **P**rocesses and **A**ctivities | $T_{PA}$ | $T_{PA}$ | | | |
| | **P**articipants | $T_P$ | $T_P$ | | | |
| | **I**nformation | $T_I$ | $T_I$ | | | |
| | **T**echnologies | $T_T$ | $T_T$ | | | |

variant of the report factual genre, specifically a taxonomic report genre (see Woodward-Kron 1996). There are very good reasons for an assessment like this to be set in the Operations discipline and for assessments like this to be organized structurally using this specific generic resource. Taxonomic reports function to describe a number of classes of things in a system of classification. Their purpose is to report on a state of affairs, a phenomenon, or a complex entity. Consequently, they do not organize information using a timeline sequence or an expected order of appearance. A reasonably comprehensive understanding of a topic is needed prior to attempting to write a taxonomic report about it (Derewianka 1991, p. 54).

There are two main kinds of taxonomies: part-whole taxonomies and type taxonomies (Martin 1992). *Part-whole taxonomies* are used to distinguish between object controls or options (parts), for example, that relate or belong to a common group (the whole). With reference to Alter's work system framework, the types of categories used to describe the work system do not lend themselves to whole-part taxonomies though this might be inferred if more than one work system would be described in our larger case study report for instance. *Type taxonomies* are used when the objects, controls, or options being discussed do not enter into whole-part relationships. Using the COMM113 assessment example, the only thing that would link the various components within that framework is their occurrence within that framework. It is clear that these attributes do not truly have a part-whole relationship and that a type relationship is the most appropriate way of representing a work system.

The structure of genre can be described using a *directed graph notation* developed by the author and referred to as a genre digraph (Clarke 2001). The diagram is

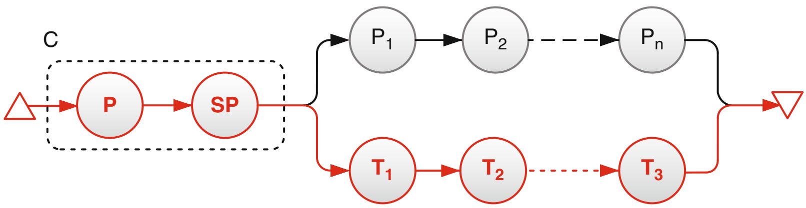


**Fig. 3** Canonical Case Study Report Genres represented using directed graph notation (After Clarke 2001). Type taxonomy is highlighted

read from left to right, genre elements are shown as circles, and arrows indicate the sequence in which these elements are normally organized. The triangle on the left of the diagram indicates the beginning or *start* of the genre while the upside-down triangle on the right-hand side of the diagram indicates the *end* of the genre. The generic staging of the part-whole and the type taxonomies are shown in Fig. 3. The *C*lassification stage is shown as a rectangular oval enclosing the two elements of *P*urpose and *S*ection *P*review required in both kinds of taxonomic reports. A part-whole taxonomy consists of one or more *P*art elements, shown as a row of elements in the top half of the stage in Fig. 3. Type taxonomies consist of one or more *T*ype elements, shown in the lower half of the stage in Fig. 3.

When applying genre thinking to this assessment, one possible source of student confusion becomes immediately apparent. Referring to Table 1, this assessment is termed an Essay while in fact what is expected of students is a Taxonomic Report. The generic staging of COMM113 Alter's Work System Framework assessment is provided in Table 2. Each of the requirements of completing the assessment is provided in the first column of Table 2 along with a description of the tasks required by the students in the second column. It is these task descriptions, based on Alter's Work System Framework, that constitute the generic staging of this assessment as a Type Taxonomy case study report. The "as is" column of Table 2 shows that each of these required genre elements for this instance (2014) of the assignment could effectively be considered as a list. Alternative configurations of genre elements are also possible, and these will be discussed more fully when genre structure is used for design in Sect. 4.

There is an expectation that each genre element has particular kinds of language features that are to some extent diagnostic of the element in question. Following Derewianka (1991, pp. 53–54), reports typically have some language features that include *generalized participants* (kinds of customers, systems of various kinds), descriptive yet factually precise language, the language of *classification* with effort spent on defining, classifying, comparing, and contrasting things and processes, an emphasis on action verbs (so-called material processes) that are necessary for describing processes and activities, and the use of linking verbs (so-called relational processes), for example, "is," "are," "has," "have," and "belongs to." These language features could in principle be used to develop resources that can provide additional information and assistance to students on completing a given assessment. Although this kind of effort was not put into specifying COMM113 Alter's Work

System Framework assessment, the significance for these language features to the assessment process is that students could use appropriate language features in order to correctly realize specific genre elements.

So far, the discussion is based on the sufficiency of the students to conform to the assessment structure, but in fact there are obligations on the teaching side as well. For example, the *S*ection *P*review stage should have a set of forward pointers technically termed *cataphoric references* that in effect "point to" successive Type descriptions. Interestingly for this assessment item, no advice is provided to students about the SP element. Some additional advice or *scaffolding* (Woodward-Kron 2007) could be and should be made available to students so that they can complete this part of the assessment's generic form. There will be students who automatically include this step regardless of the fact that no advice has been provided to them, simply because they are already literate (knowingly or unknowingly) with the requirements of the case study report structure. Perhaps these students may have had experience with this kind of professional language organization either by means of their social class or prior schooling (Cope and Kalantzis 1993). In fact, perfectly capable students with English as a second language may not be versed in the requirements of this kind of genre and without explicit scaffolding may not be able to score as highly in the assessment.

### 3.3 Including Related Genres: Genre Assemblage

The Genre Analysis required for assessment transformation starts by examining the generic staging of the original assessment and then continues by considering other subsequent texts including assessment sheets and rubrics. This kind of analysis is not limited to a single genre but to all of the genres involved in the assessment process. The collection of all the relevant genres is referred to as a *genre assemblage* (Clarke 2000); the connection between these genres is the participants. For the purposes of this assessment, the participants will be limited to the students and their instructors, although additional participants could in principle be included if warranted- for example, the client organization, an ethics committee, the organization's customers, and so on.

If, as in Alter's Work System Framework, the generic staging of the assessment is based around a canonical Type taxonomy (see Fig. 3), then from first principles the Type stages should be also evident in the assessment sheets and rubrics. There should be commensurate generic staging in assessment sheets and rubrics as there is in the original assessment. The marking rubric in Table 3 was provided to students to support their efforts in successfully completing the assignment. In the case of the COMM113 assessment, the generic structure of the rubric matched an extended stretch of elements, referred to as a *generic subsequence*, in the assessment genre itself. These matching elements are highlighted in Table 3. Not surprisingly, the marking rubric also added several other categories like overall presentation, spelling and grammar, as well as

**Table 3** The generic structure of the Marking Rubric follows that of the COMM113 2014 Assessment 1. The generic subsequence of genre elements in common is highlighted

| Assessment Item | What Your Marker Will Be Looking For... | Marker Comments | Marker Available | Marker Achieved |
|---|---|---|---|---|
| Business Description | Approx. 200 words description of what the organisation is and does. Must include at a minumum text (*4 marks*), Google Map of organisation location (*2 marks* ) and an image such as a organisation logo (*1 marks*) | | 7 | |
| Work System Snapshot | A single Mahara page set up with 6 text boxes in the layout as described in the Mahara user guide to represent the table layout of the snapshot (*2 marks*). Each text box to contain bullet points on each of the 6 key elements of the work system (customers, products/services, work processes/practices, information, technology, participants). The descriptions should be short and easy to understand, summarising each of the key elements (*3 marks each element* ). | | 20 | |
| Work System Framework | 9 separate Mahara pages, each page representing an element of the work system framework. No particular word limit, but text should be in paragraphs (no bullet points) and describe each element in sufficient detail (*4 marks each* page) | | 4 | |
| | | | 4 | |
| | | | 4 | |
| | | | 4 | |
| | | | 4 | |
| | | | 4 | |
| | | | 4 | |
| | | | 4 | |
| | | | 4 | |
| Overall Presentation | Pages are brought together in a Mahara portfolio, appropriate text size and font (no smaller than 10 point), use of formattting and images where appropriate to make the report look professional. | | 5 | |
| Spelling and Grammar | Minimal or no spelling and grammaical errors. | | 3 | |
| Referencing | Acknowledgement of all sources (both written, person and verbal). | | 3 | |

referencing. If the generic connections between the original assessment, supplementary materials, and assessment sheets/rubrics did not exist, then the elements required of students might not be assessed or alternatively the information required of students might be inadequate to the task of completing the assessment. Supplementary information on how to address parts of the assessment explicitly referenced the appropriate genre element.

Access to real organizations necessitates additional texts like *media releases* that provide organizational stakeholders with the opportunity to set the conditions under which multimedia that includes their likenesses, actions, and activities can be captured and used; related to this are permissions of various kinds including conditions of access to organizations and work places, publication arrangements of these media, *intellectual property statements,* and *ethics clearances*. Transforming assessments to the digital domain involves successively applying genre analysis to all of the relevant or *agnate* texts that constitute this assessment genre assemblage.

## 4 Transforming Assessments 2: Generic Design

In the previous section, genre theorywas described in order to analyze an arbitrary assessment. The Work Systems assessment conformed to a canonical report genre- specifically what is referred to as a Type Report. In this section, genre analysis is used to provide a starting point for creating a version of this assessment that can be transformed into the digital domain. As an alternative to repurposing, a corresponding genre design practice enables alternative navigation structures to be proposed based on the staging of the genre, described in Sect. 4.1. Using selected screenshots from an actual COMM113 student assessment, the relationship between the assessment and supplementary instruction materials and the organization of the navigation is found to be closely related to the structure of the specific assessment genre. The navigation in this example is hand built using Mahara, an open source ePortfolio system. However, it is also possible that an understanding of the constraints between the genre structure and the type of device upon which the content is being displayed could form the basis of a new kind of web system development design practice that would enable navigation systems become *responsive*, that is, to accommodate different device types and screen real estates, see Sect. 4.2.

In a design context, genre theory can be applied to developing and improving parts of the assessments themselves. An example of augmenting the assessment is through the use of other embedded genres. This transforms the assessment genre itself into a *macrogenre*. The embedded canonical genres are referred to as *microgenres*. An example of "improving" or at least expanding Alter's Work System Framework assessment is by embedding a multimodal canonical genre called a Description genre to clarify what a student needs to provide in order to better describe their chosen business, see Sect. 4.3.

### 4.1 Global and Local Navigation using Genre Staging

There are two types of navigation system used to organize and access content in web-based systems. *Global Navigation Systems* comprise large-scale categories within which content can be organized. Global navigation systems effectively complement a site structure by providing additional vertical (across levels) and lateral (within a level) links for users to be able to move around the content. However, in a nontrivial web system, the global navigation needs to be supplemented with additional navigation links to provide a more delicate classification within a content category. This additional structure is referred to as a *Local Navigation System*. These are often implemented using additional sets of links within pages that share similar content topics. The difference between Global Navigation systems and Local Navigation systems is simply one of extent. The former is hopefully applied to each and every page of the website, while the latter applies to a well-defined subset of related pages in the site sometimes referred to as a *weblet*. However, this is not universally true. Conventions exist for organizing global and local navigation systems. Some web development environments enforce the positioning of the global navigation links along the top of the page layout area while local navigation links are located on the left-hand side of the page.

As mentioned in Sect. 3.2, alternative configurations of genre elements are possible through the additional structural groupings of genre elements. With reference to Alter's case study report in Table 2, these alternative configurations of genre elements are shown as Alt 1 through to 4. In Alternative 1, the *C*lassification stage from the canonical report genre is used to organize the *P*urpose and the *S*ection *P*review stages. Examining a number of these assessments submitted by COMM113 student assessments, created within Mahara, showed that students rarely explained what information would be provided as part of the assessment (there was in effect a missing *S*ection *P*review). In fact, this information was not requested by the marker or assessed, and yet it would have assisted the readers/markers in understanding the information or content packaged in the assessment, as well as assisting the student's own understanding of the assessment. Alternative 2 retains the *C*lassification stage of Alternative 1 but organizes those elements directly associated with the Work System into their own group (*P*rocesses and *A*ctivities, *P*articipants, *I*nformation and *T*echnologies). Alternative 3 retains the organization of Alternative 2 but groups together the *C*ustomers and *P*roducts and *S*ervices elements together with the Work System to form a Work System Snapshot group. Finally, Alternative 4 groups together the *E*nvironment, *S*trategies, and *I*nfrastructure elements together with theWork System Snapshot to form the entire Work System Framework. The only difference with these alternatives is not the elements themselves or their sequencing but rather the degree of additional structuring that could possibly be used to organize the text. This structuring shown as dashed lines in Table 2 is in fact logical places in which addition navigation may be created. This kind of arrangement can be gainfully employed to show higher-level organization within genre structures. It is used here because being able to create

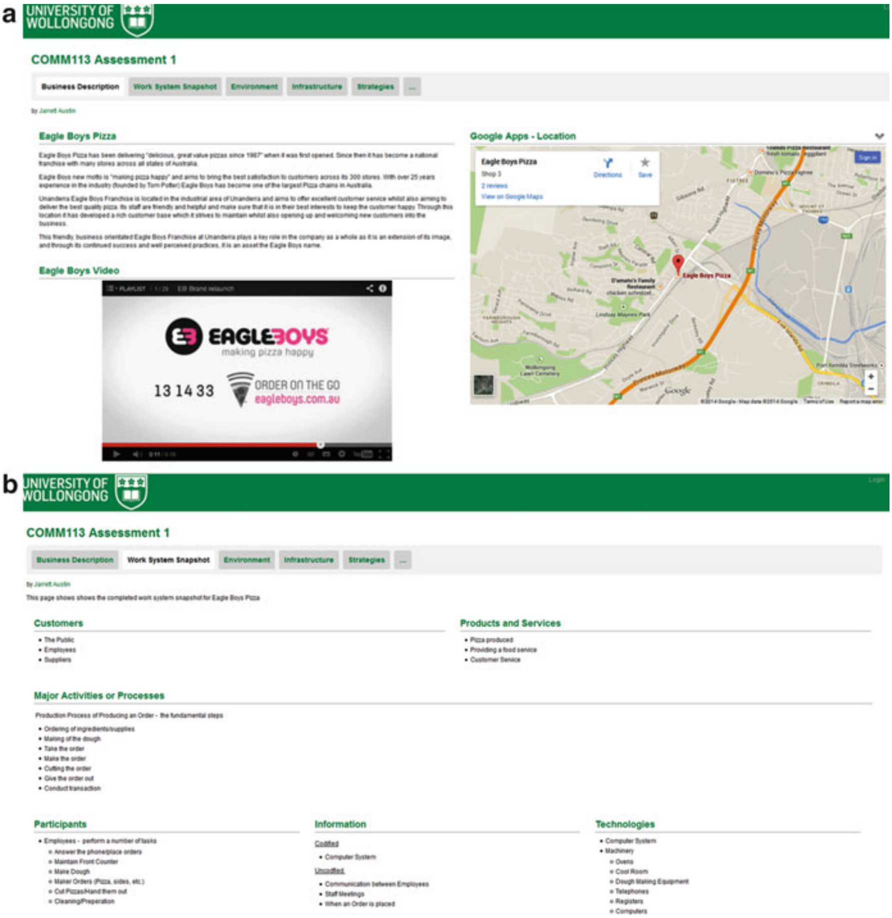


**Fig. 4** Screen shots from a COMM113 student's Alter's Work System Framework Assessment implemented using Mahara: (**a**) Business Description and (**b**) Work System Snapshot

higher levels of organization can map well to orthographic constructs within digital environments, for example, the "page" in a web system. The choice of which of these alternatives to use is a design choice based on the length and complexity of the text, the needs of the users, and the technologies on which the text is to be displayed and used.

Figure 4 shows two screenshots of a COMM113 Work System Framework Assessment implemented in Mahara. As can be seen in Fig. 4a, the student has organized Mahara pages according to the generic structure of the assessment business description, work system framework, and so on. Specifically, the global navigation is aligned to the generic structure of the assessment as per Table 2. Interestingly, the students were given explicit instruction to fit all six categories within the Work System Snapshot, including the Work System under consideration, onto one page. Supporting material included Alter's (2006) Work System Snapshot- a page of information about all six categories arranged in bullet form. Most students in the cohort copied this convention; however, the problem here is that employing the "Snapshot" gives students permission to be terse and encourages them to not look at these categories in any detailed way, see Fig. 4b. In effect, the student has adopted a form of Alternative 3 in Table 2 the navigation that might be used to organize the work system options is missing. In the future, it is likely that Alter's Snapshot will not be used as a supplementary material for this assessment. Also, students will be required to drill deeper into each option by requiring them to collect additional media to support written descriptions about these categories. Changing the amount of material required for students to satisfactorily address each of these categories will alter the navigation employed by students in this assessment requiring the addition of local navigation structure to organize the text across multiple Mahara pages.

### 4.2 Responsive Breakpoints, Semantic Constraints, and Design Considerations

Web designers have always been frustrated by the lack of design control they have over their medium. The move toward mobile technologies has problematized this state of affairs even more so as designers now have to accommodate diverse web devices. Screens are now both much smaller and much larger as well as varying in resolution and pixel density. The "solution" to this technological diversity is to design content so that it responds to the technology (desktop, tablet, or mobile phone) on which it finds itself rendered. Collectively, the development practices that provide this solution are referred to as *responsive web design*. The key to responsive web design includes the use of *fluid design grids* or layouts rather than fixed width layouts as well as a range of *breakpoints* (Peterson 2014). The effect of encountering a breakpoint in a responsively designed website is obvious when it is seen; a layout changes from one topology to another. This is usually triggered by a change in the width of the viewport through which the web page is being viewed on the device. A web page might be viewed on a desktop with a breakpoint set at greater than 750 pixels, below which it might be suitable for display on a tablet with a maximum screen width that is smaller than that but larger than mobile phone breakpoint that might have a maximum width of say 480 pixels. Web pages that are appropriately designed change their topological arrangement based on device breakpoints. Content areas that are splashed across the larger screen real estate of a desktop will probably need to be organized like a list on a mobile phone. These practices make layout responsive, and there has also been a debate, and not inconsiderable work conducted, on making images responsive as well. Here, we are suggesting that with some effort it may be possible to create on websites navigation that is similarly responsive! Changes in layout are usually triggered by changes in the width of the viewport through which the web page is observed on the device in question. It would be straightforward to include changes to navigation, just as we were able to do for the alternative designs in Table 2, by designing the content to conform to generic staging and then using the generic staging to create the navigation structure depending on different device breakpoints.

### 4.3 Expanding the Assessment: Macrogenres and Microgenres

In Sect. 3.3, an argument was made for considering all associated or agnate texts that are involved in the assessment. This was to ensure that the assessment is adequately explained to students, that supporting materials provided by instructors actually address specific problems that may be encountered by students, and that marking assessment sheets and rubrics actually reflect what was required. But the shift to primary research by students in some disciplines as a consequence of the use of blended learning, for example, also expands the number of agnate texts that need to be considered, for example, media releases and ethics clearances. Another source of genre elaboration involves the enhancement of specific elements in the assessment genre by embedding additional – often multimodal – canonical genres. When this occurs, the entire assessment is called a *macrogenre* while the embedded genre, the one used for elaborating a given element, is referred to as *microgenre* (Woodward-Kron 2005).

Two examples where this often occurred in this assessment were in the mandatory, no marks section called Part A that includes descriptive information on the business; see Table 4. One of the obvious candidates for this treatment is providing information that includes the business name, address, and location. This can be expanded through the use of a Google Map and its associated information. This kind of information could be usefully organized as a multimodal Description Genre consisting of the Google Map and its associated caption that might optionally include instructions to get to the business by car, public transport, or walking. In addition, location imagery can be provided by using the Street View function in Google Maps. Another application of a multimodal description genre involves the use of specific online resources to provide information about the company. All Australian companies have Australian Business Numbers (ABNs), and using these, students can find out many publicly available details about their selected business. The ABN site provides a useful ABN lookup feature (ABN 2014). One of the things you can do with an ABN is search out financial and other information. For example, sources like Aspect Huntley's (2014) Financial Analysis show a lot of information

**Table 4** Descriptive information for COMM113. The table shows a suggested micro-genres and content for elaborating categories of mandatory information

| | | |
|---|---|---|
| 1 | Student number, student name, e-mail | |
| 2 | Tutorial number, day, time tutor | |
| 3 | Business name, address and location | Description genre + Google map |
| 4 | Description (industry, size, etc.) | Description genre + ABN |
| 5 | Executive summary | |

from companies that are listed on the Australian Stock Exchange but also for medium-size companies that are not. For very large companies, sites like Yahoo Finance (2014) and CNN Money (2014) provide extensive financial information.

Canonical genres that are particularly useful microgenres include Descriptions and Exempla Genres. For their specific staging, see Martin (1992). Assessment should be designed in terms of microgenres as well. These fit well with the idea of organizing material so that it can be more conveniently displayed on a range of devices and also to encourage students to utilize multiple modes with which to explore the world.

Similarly, as a consequence of an evaluation of the generic analysis of texts previously undertaken, a new/improved generic design for the assessment and its ancillary materials (agnate texts) can form the basis of an improved assessment genre assemblage.

## 5 Future Directions

This chapter describes a project that involved the use of relatively ubiquitous mobile technology coupled with open-source educational technology platforms provided a means to engage students as active learners. These readily available technologies facilitate a revolution in teaching and learning and the design of curriculum, allowing the student engagement to be flipped by pushing students back out into the field. The use of these technologies enabled a blended learning strategy to be implemented that drove a case-centric engagement with, and utilization of, theory.

### 5.1 Genre and Assessment

Digital technologies are changing the nature of assessments and the assessment process. Assessments must accommodate the digital domain of learning environments, learning management systems, and delivery platforms. This requires a more nuanced approach than simply repurposing a text document. In Sect. 2, the concept of document repurposing was critiqued and abandoned in favor of considering assessments from a functional communication perspective. The approach adopted here for understanding assessment employed SFL and in particular its resources to describing text structure called genre. The genre of an authentic assessment was unpacked. The theory proved sufficient to account for the structure and semantics of this assessment. However, the assessments must also be complemented by ancillary texts in the form of supplementary materials, marking rubrics, and the like. These texts must conform to each other in terms of their generic structure and can be collectively referred to as an assessment genre assemblage. Accounting for the genre structure of the assessment and its related agnate texts constitutes the genre analysis in Sect. 3. The basis of a genre design practice was provided in Sect. 4. When moving to the digital domain, the genre staging can suggest alternative possible global and local navigation schemes. In learning environments, learning management systems, or delivery platforms that support responsive design practices, the use of genre design opens up the potential for creating not just layout and content that responds to the type of devices on which it is viewed (mobile, tablet, or desktop) but similarly provides responsive navigation. Genre theory does not only address the macrogeneric large-scale organization of texts including assessment texts but can also organize content within each genre stage to the use of microgenres.

## 5.2 Generic Assessment Transformation

A first cut at a genre assessment transformation method can be inferred from the experience of the COMM113 Assessment. This preliminary method involves genre analysis followed by genre design, see Fig. 5. The genre analysis proceeds by collecting together all the agnate texts that are relevant to the specific genre assemblage. The original assessment and its specification in the document that describes the subject outline, see Table 1, should be brought into generic alignment with each other. If the assessment is a report, then don't call it an essay! The original assessment should be analyzed to determine its closest canonical genre. Any required supplementary materials provided to students should address the satisfactory completion of one or more genre elements. It is the genre staging and

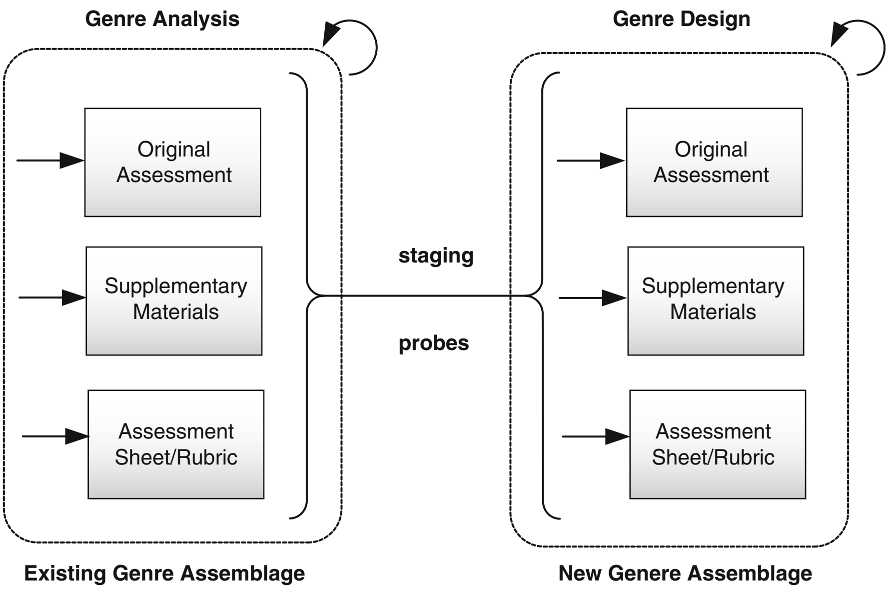


**Fig. 5** Genre assessment transformation

any appropriate questions or probes that can help students create text and that provides information about the stages that is of concern here.

A genre design proceeds by ensuring that the problems of contradictory information on the type of assessment, and inadequate information to resolve genre elements, are resolved. Genre design also involves considering how transforming the assessment to the digital domain provides opportunities for teaching and learning in the digital domain. Genre design involves considering the best combinations of microgenres to realize the generic staging in a given assessment macrogenre. Usually, these choices are left to the instructors or designers of the assessment. However, explicit student instruction in macrogenres and microgenres enables these kinds of design choices to be made by students as part of filling the requirements of the assessment. Some of the benefits of rewriting assessments generically include the ability to design appropriate navigation systems. The semantics of the genre structure facilitate the media rendering and interaction on various digital platforms. Genre structure is particularly useful in making decisions about the display of complex multimodal texts on devices with constrained screen dimensions like tablets and mobile phones. Embedded microgenres to assist in resolving elements provide students with the possibility of more engaged research. The use of genre structure to propel changes to navigation on the use of embedded microgenres to support assessment macrogenres changes the nature of the assessment process.

## 5.3 Deployment and Use

The genre assessment transformation described above not only changes the assessments but also the assessment process as well. The method described in Sect. 5.2 could be considered the initial stage of a larger deployment and use workflow shown. With reference to Fig. 6, procedures must be developed for (student) collection of the assessment [1], conducting the field work as a representative of the institution [2], completing the assessment including training and documentation in the delivery platform (Mahara in this case) [3], submitting the assignment [4], and providing any necessary Media Release and Copyright forms [5].

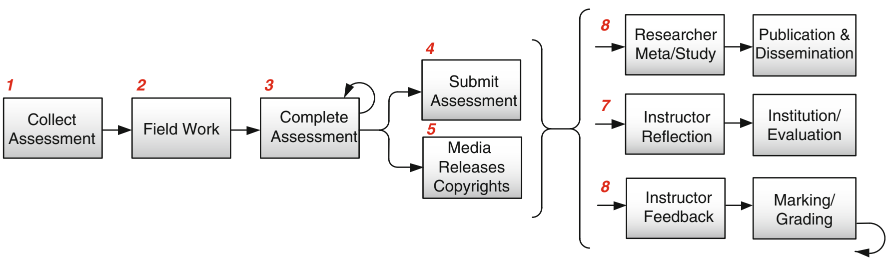


**Fig. 6** Deployment and use workflow

As it happens, Procedures are another very useful canonical genre (Clarke 2001). The opportunity here is to apply a genre design practice to the entire process of assessment and deployment. Outside of the interactions with students that also involve instructor feedback as well as marking and grading [6], digital assessments can be conveniently used to provide instructor reflections on performance (something that tools like Mahara were in fact designed to provide) as well as provide responses to formalized Institutional Evaluation [7]. But these assessments, their feedback, and reflections and evaluations can form the basis of a second-order "repurposing," that is, the conversion of multimodal content originally devised to address a student assessment can become a storehouse or repository of potential research data for use by students and academics alike. In this context, this multimodal content can be used in researcher metastudies and be published and disseminated [8] like other research materials (with appropriate permissions and acknowledgments).

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# Internet Based Peer Assisted Learning: Current Models, Future Applications, and Potential

51

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## Contents



**Abstract**

Peer Assisted Learning (PAL) is recognized as an effective academic support program designed to assist students' learning needs. At the tertiary level, universities in Western countries have developed and implemented various

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forms of PAL programs catering for students across disciplines, commonly targeting transitional subjects which are perceived to be difficult. Studies have demonstrated that PAL programs positively contribute to better student performance and higher student retention rates.

However, there has been relatively little discussion on how new technological trends can be applied to extend the PAL platform in order to suit the evolving student lifestyle and changes in learning behaviors. In this chapter a number of models for internet-based PAL are discussed and evaluated. The chapter also outlines some of the technological and other requirements for the establishment and maintenance of these internet-based PAL programs. Finally, an evaluation of the potential outcomes is presented. The discussion highlights that internet-based PAL programs can be used as an instructive complement to existing face-to-face PAL programs, further extending the benefits of student peer learning and social exchange with the convenience of mobile technology.

## 1 Introduction

Catering for students' educational needs is a key success factor of higher education institutions (Wingate 2007; Molesworth et al. 2009; Stokes and Wilson 2011). For Western universities, the provision of learning and pastoral care to international students is even more important for the institutions' financial and academic performance (Sawir 2005; Arkoudis and Tran 2010). Driven by the marketization of the education sector, universities are now facing challenging ethical dilemmas when safeguarding academic integrity whilst at the same time protecting their own managerial business interests (Hemsley-Brown and Oplatka 2006; Newman and Jahdi 2009; Ross et al. 2013). In other words, universities are faced with decisions regarding the amount, scope, and access to academic support to aid students in their study. As a result, providing high quality supportive programs to students is an important step towards enhancing their learning experiences and addressing some of the pastoral issues that international students might experience in higher education institutions.

Peer Assisted Learning (PAL) is a student academic support program utilizing collaborative learning to enhance individual learning experiences and skills. PAL can be viewed as an alternative terminology (commonly found outside the USA) of the Supplemental Instruction (SI) model firstly developed by Dr. Martin at the University of Missouri-Kansas City (e.g., see Blanc et al. 1983; Arendale 1994). At present, various disseminations of PAL programs and models are implemented in higher education institutions across Western countries as an essential part of teaching and learning management, including the USA, Australia, Canada, UK, and South Africa. Traditionally, PAL programs often use face-to-face study sessions/workshops as the main delivery channels. With advances in technology and evolving student lifestyles, some institutions have begun to develop and implement internet-based PAL programs as supplements to face-to-face study sessions (e.g., UMKC's Video-Based Supplemental Instruction approach).

This chapter provides a review of PAL programs and proposes some examples of internet-based PAL models to extend the educational benefits of PAL programs. It aims to enrich the current understanding of PAL philosophy, highlighting some of the potential benefits and trade-offs that internet-based and future mobile PAL programs could bring to the higher education sector. Case studies of both formal and informal internet-based PAL programs are investigated and evaluations of the pros and cons of possible models are provided.

## 2 Background

### 2.1 The Philosophy of Peer Assisted Learning (PAL)

The PAL program utilizes a peer-led group to provide additional academic assistance for students in addition to formal face-to-face teaching hours (lectures, tutorials, workshops, or seminars), aiming to assist students achieving positive results. Facilitated by senior students (commonly referred to as Leaders) who have excelled in the subject during previous semesters, PAL provides opportunities for participating students to strengthen their knowledge by actively being involved in group learning focused on material review and practical problem solving (Sole et al. 2012). The recognized benefits of participating in the PAL program for students include better engagement with the university (van der Meer and Scott 2009), better connections with other students (van der Meer and Scott 2009; Longfellow et al. 2008), improved self-concept and enhanced learning behavior (Ginsburg-Block et al. 2006), and the notably observed improvement in academic performance (McCarthy et al. 1997; Parkinson 2009; Malm et al. 2011; Devine and Jolly 2011). The program hence benefits the institution facilitating the PAL program via positive impacts on student retention (Etter et al. 2001; Hensen and Shelly 2003).

PAL programs traditionally target challenging subjects, commonly observed in the discipline of Engineering (Malm et al. 2011), Mathematics and Chemistry (Parkinson 2009; Devine and Jolly 2011), and Medical Studies (Knobe et al. 2010; Yu et al. 2011; Sole et al. 2012). In current development, PAL has incorporated commerce subjects as the commerce subjects can be challenging for students (Minnaert et al. 2011; Zraa et al. 2011; Calkins 2012). For international students, the major benefits of participation in a PAL program include more opportunities for engaging and interacting with domestic student peers and consequently become more accustomed to the host country culture and learning environment (Leask 2009).

The PAL philosophy draws from behavioral and social learning principles (e.g., Skinner's radical behaviorism and Bandura's social learning theory). For instance, Bandura's social learning theory is used to explain the rationale that high-achieving peer students are used as PAL leaders in study sessions. Benefits of being a PAL program leader include enhanced academic knowledge, improving interpersonal qualities, development of leadership and teamwork skills, networking opportunities, and added in curriculum vitae. Student leaders in PAL program are very sought after by employers across many industrial sectors. PAL program participants are expected to imitate the leaders' behavior in learning that may lead to favorable outcomes. Thus, engaging in close contact with a role model (face-to-face) is considered an important influence on new learners' adoption of relevant learning behaviors and hence assists them to improve academic performance. However, Bandura (1977) states that observation of a live model is not always necessary for the behavior change stimuli to take place. Rather, verbal instruction and symbolic messages (including use of media and internet) can also be considered as vehicles for delivering modeling stimuli. As a result, a question arises as to whether the change from a face-to-face PAL model to a web-based non-contact PAL model will cause dilution of PAL programs' educational benefits.

## 2.2 Face-to-Face PAL Models

### Traditional Model

Among the various dissemination forms of PAL programs implemented in higher education institutions, the most common model is face-to-face, regularly scheduled study sessions in which English is predominately used. In Australia, known universities which currently have implemented PAL (commonly referred as PASS – peer assisted study sessions) programs include the University of Wollongong, Monash University, Macquarie University, and the University of Sydney. These programs can be both institutionally funded and implemented, where the PAL leaders are employed and remunerated, or based on altruistic activities where students are recruited as voluntary contributors.

An archetypical PAL program is built on a peer-mentoring engagement between peer leaders and student participants. Using a "super group" approach, PAL study session aims to enhance students' learning by integrating course content focused study techniques and successful assessment/exam skills in a casual and relaxed atmosphere. The open dialogue engagement and social exchange between PAL leaders and students as well as between students studying in the same course are both influential factors to individual learning behavior change. The communication exchange between PAL leaders and participating students is considered to be less formal than in formal teaching contact hours, thus students commonly find themselves feeling more comfortable to interact and ask questions (Zaccagnini and Verenikina 2013). The PAL program provides opportunities for participating students to ask the questions they really want to get help on without the pressure of feeling their academic credibility is being put on the line. The intention being that, students can work in a positive, supportive, and productive team environment which enhances their communication and critical and creative thinking abilities. Of course, these positive attributes can be carried into other aspects of students' university life beyond PAL study sessions, or even further into their future career workplace.

However, it should be noted that the quality of actual academic content delivered in PAL study sessions are equally, if not more important than the positive influences on learning behavior change. Students who have experienced PAL study sessions often comment that the revision of lecture and tutorial materials, recap of important theories/concepts, and more clarifications on assessment expectations make PAL programs very appealing to them. Although direct re-teaching is not the purpose of PAL programs, and PAL facilitators often emphasis that re-teaching in PAL study sessions should be strictly avoided, it has been stated that sometimes re-teaching cannot be avoided. In fact, in extreme circumstances deliberate re-teaching is needed to ensure the effectiveness of PAL programs (Cui et al. 2015).

### Other Forms of Disseminations

In addition to traditional PAL programs, there are also learning support programs which embrace PAL philosophies operating in higher education institutions. These different forms of dissemination of PAL programs may or may not explicitly include PAL as part of the programs' title, but their management and operation are largely similar to traditional PAL programs.

Cui et al. (2015) discuss a Bilingual Peer Assisted Learning (B-PAL) program, which has been implemented in an Australian regional university as a means to assist the teaching of Chinese international students. Under the B-PAL program, bilingual workshops using Mandarin and English conducted in the end of each session across more than 20 subjects including accounting, finance, economics, and management in business faculty. Unlike traditional PAL programs that strictly avoid re-teaching, this B-PAL program deliberately includes re-teaching of academic content covered in lectures and tutorials in the workshop. The use of Chinese students' first language is an effective element influence their learning, as the bilingual instruction can enhance students' learning of academic content in a secondary language context by helping convey meanings (Cook 2001). It has other benefits including using first language to motivate students and scaffold learning (Turnbull and Arnett 2002), facilitating communicative features in group learning and enhancing student/teacher interactions (Ghorbani 2011), as well as helping to establish constructive social relationships and communicating complex meanings (Littlewood and Yu 2011).

The results of a qualitative analysis of Chinese students' experiences of the B-PAL program show that in addition to the recognized benefits of traditional PAL programs on students' learning, the bilingual approach provided extra value such as conveying meanings, sense making, and reducing exam/assessment anxieties. It should be noted that Cui et al. (2014) also reveal that students equally value the peer-teaching process and the actual academic content delivered in the B-PAL workshop, considering both as effective influential factors enhancing their learning experience and academic performance. In addition, the majority of Chinese students state that the academic content is extremely important. In fact they prefer for teaching materials to be distributed online pre or after the workshop. However, they also acknowledge that the face-to-face contact and two-way communication is necessary for them to make better use of the materials and gain a better understanding of the subject.

PAL programs were originally designed to target struggling subjects, not struggling students (Arendale 1994). However, there are also learning support programs that utilize the PAL model to provide educational support to students with genuine learning difficulties (also referred to as students-at-risk). As an example, the Australian Department of Education, Employment and Workplace Relations administrates and financially supports the Indigenous Tutorial Assistance Scheme (ITAS), which is a program providing supplementary tuition to support eligible Indigenous students to study university award level courses (2010). The purpose of the ITAS program is to accelerate education outcomes for Indigenous Australians beyond those which could reasonably be expected from the mainstream and the providers' own financial resources alone. By offering regular face-to-face learning support delivered by a student leader, ITAS aims to improve the academic efficacy of Indigenous students in tertiary courses to the same levels as those for non-Indigenous Australians. Unlike traditional PAL programs where study sessions are often conducted in a one leader to many students format, ITAS programs generally rely on one to one peer-teaching to achieve its objectives. In this sense, the level of direct face-to-face contact and engagement is more significant in ITAS model.

## Process or Content?

By examining both the traditional PAL model and the alternative forms of assisted study support, multiple benefits have been observed from different forms of PAL programs particularly on improving self-concept and learning behavior (Ginsburg-Block et al. 2006), hence notably improvement on academic performance (McCarthy et al. 1997; Parkinson 2009; Malm et al. 2011; Devine and Jolly 2011). Then it can be observed that a key question needs to be addressed before considering the development of an Internet based PAL program. This question is, *what is more important/valuable towards student learning, the peer mentoring/teaching process or the actual content/materials used in PAL study sessions*? It is obvious that an internet based PAL platform can have tangible advantages in connectivity and content distribution, but can internet based PAL programs offer similar environments for peer-to-peer communication and engagement which is needed for social learning to occur?

The key benefits for students to participate in a PAL program are two-folds. In addition to the engaging and collaborative learning environment, the distribution of PAL study session material should not be overlooked as well. Often there are some participants in the traditional PAL program remain quiet during the session and have no engagement with leaders. These participants' main motivation to join a PAL study session is to collect the teachings material distributed by the student leaders, rather than treat PAL program as an opportunity to interact with peers to enhance their knowledge and improve their individual study skills. Such passive learning behaviors result the "silent group" exist in PAL study sessions which merely follows the instruction of the PAL leader and seldom express their opinion or communicate with other student peers. In a face-to-face PAL session, these "silent group" sometime are forced by leaders to engage with others using various PAL teaching techniques. Now, with the development of information technology, Internet as an intermediate has been broadly used in higher education section with the implementation of students' E-learning system, learning platform such as blackboard and mass email system. These developments allow students to access their students' profile and information at any time and any places as long as they connected to the Internet. The PAL program are under transition to Internet based PAL program. However, the techniques PAL leader often use in face-to-face study sessions will be hard to apply online.

The idea of using Internet based PAL program to assist teaching is still appealing. Unlike the traditional PAL programs have well developed and designed, Internet based PAL programs are often implemented as a trial. Similarly to the traditional PAL program rely on face-to-face peer mentoring, the key features of successfully implementing an Internet based PAL program are interactions and engagements of students. Then another question should be asked is to what extent the interactions and engagements are sufficient? Distributions of material or illustrations of examples do not count for interactions or engagements, particularly in the online environment. For instance, if the leader would like to demonstrate a step-by-step solution, it would be easier for a face-to-face PAL session to illustration, but difficult for an Internet based PAL session. The interactions and engagements require in-depth communications and real-time feedbacks between leaders and participants. In face-to-face PAL sessions, it is relatively easier easy to maintain a friendly learning atmosphere through casual conversation among leaders and participants, using body languages or other teaching facilities like white board or PowerPoint slides. It takes more time to for participants and leaders to know each other and further build up a friendly learning environment over an Internet based PAL session. This chapter goes on to discuss existing Internet based PAL programs, identifying current trends and commonly found issues.

## 3 Internet Based PAL Programs

At present, internet based PAL programs are run on a much smaller scale compared to face-to-face PAL study sessions and could be considered to be at a testing/pilot phase of development. A number of studies have reported on the schemes, implementation and preliminary results observed in pilot PAL programs (e.g., see Beaumont et al. 2012; Beckmann and Kilby 2008; Armstrong et al. 2011; Huijser et al. 2008). A variety of terminologies have also been used to describe the internet based PAL programs, including PAL-Fleximode, Off-Campus PAL Program, or Online PAL Scheme.

Initially, in order to cater for the growing needs of PAL programs from students off-campus or unable to attend scheduled PAL study sessions, video-based PAL programs are designed and implemented. For example, the University of Missouri-Kansas City (UMKC) initiated one of the earliest versions of Video-based Supplemental Instruction (VSI), which combines remote teaching of course content with SI study sessions (UMKC, n.d.). Teaching academics capture video recordings of their lectures. Trained facilitators, using the recorded lectures and the SI model, guide students through the learning process while emphasizing critical thinking and study skills. Assessment is provided by the academics keeping the facilitator in the role as a peer supporter and not an evaluator. Although for such video based PAL programs, the presence of a peer leader is still needed in a face-to-face learning environment, it opened the potential for PAL programs to be shifted into cyber space.

Beaumont et al. (2012) establish some of the evaluation criteria for a successfully implemented Internet based PAL program, including the suitability of synchronous communication, student interests, and whether the standard PAL principles and approaches can be carried across to the online platform. Based on their case study of a pilot Internet based PAL program implemented in an Australian university, there are observable benefits such as flexibility, convenience, and higher students' confidence to contribute. These benefits are perceived by students who find it difficult to attend campus due to other commitments and perceive studies as their non-priority. Internet based PAL program benefit these students by offering opportunity to access the same study information as those on-campus students. The internet based PAL program also provides a platform for those generally shy students to unveil themselves online without any concerns of embarrassment in a high-contact study sessions.

In contrast, a number of drawbacks were experienced, such as poor content coverage, causing of distractions, and most importantly, leading to an impersonal nature of delivery which contradicts the philosophies of PAL program. The software and connections lag issues lead to longer waiting processes when leaders presenting the materials and providing feedback to participants. Finding also suggests that participants' responses towards questions were procrastinated due to the lack of visual clues and the online environment actually hindered leaders' ability to observe participants' reactions (Beaumont et al. 2012). In additional, for International students who are from non-English speaking country, they are reluctant to express their opinion cause of lacking proficient language skill. It takes more time for them to post a response, which make the student leader's control of session time more difficult. The "invisible-to-each-other" relation between leaders and participants may also become a discouraging learning environment, as the communications are found to be impersonal, and it is difficult for the students and leaders to build trust and friendship. One of the benefits perceived in PAL program is that percipients can observe or connect role model students who have demonstrated their learning behavior through PAL program and are motivated through ego-enhancement. The effect of role models underpinned by the social learning theory can promulgates to participants to model, imitate, and adopt the behavior themselves (Bandura 1977; Wenger 2010). Based on the limitation identified, the effectiveness of using peer leader as role models to influence students' learning behavior may be reduced when programs are delivered online.

Similarly, other studies also state that although student responses were generally positive on internet based PAL programs using online communication and collaboration tools (such as Google Docs, MSN Messenger, and Virtual Classrooms), researchers found that participation was hard to maintain and peer leaders often felt high pressure to moderate online group discussions (Beckmann and Kilby 2008;

Armstrong et al. 2011; Huijser et al. 2008). Thus, the recruitment, training and development of peer leader for internet based PAL programs is essential for the future success of such programs. The success of enabling students to gain multiple benefits from PAL programs depends the teachers' own proficiency in languages, experiences, and cultures (Skalicky 2008; Cui et al. 2015). In addition to these qualities, other positive characteristics are expected from an effective online PAL program leader, such as the ability to remain an authoritative figure to regulate communications and discussions as well as good interpersonal skills to deal with unfavorable student online behaviors (such as causing distraction and inappropriate language use). In relation to the selection of online platform, it appears that the use of multi-people chatting software is not a favorable option as it is highly likely participating students will start an irrelevant/distracting discussion. Use of discussion forums is a better alternative, as the leaders can better keep in track with the posted discussions and the program coordinators have opportunity to study the communication process at a later time to identify potential issues for improvement.

It needs to be clearly stated that the relatively low participation/attendance rate in internet based PAL programs recorded in the aforementioned studies is of significant concern. In earlier studies regarding PAL programs, results indicate that some PAL program participating students use the program as an alternative to formal teaching hours, hence causing the institutions and faculty members to express a certain degree of concern. At the same time, in many scenarios the academics do consider that PAL programs provide the "last threshold" for some students who have very low study motivation and whose academic performance will likely drop even further without access to a PAL program. If a PAL programs' switching from a face-to-face model to an online model cause lower attendance/participation, then the value of a PAL program will not be fully realized, and the students' performances are at risk. Consequently, if an institution plans to establish an online PAL program, it is important that an enduring online learning community must be established and maintained among the faculty, PAL leaders, and students. The key features necessary to achieve such an online learning community identified in earlier studies include making learning interactive and collaborative, creating student-centered approaches, focusing on reflective thinking, and stimulating learner interest through the use of multimedia techniques (e.g., see Maor 2003; Wang et al. 2003; LaPointe and Reisetter 2008; Liu et al. 2010). It can be seen that in addition to the technological requirement, humanistic qualities in teaching and learning are also important criteria for building an online learning community and hence realizing the potential of internet based PAL programs.

## 4 Future Development of Internet Based PAL Programs

Although the current status of internet based PAL Programs is far from being an effective learning support program due to the aforementioned issues, there is promising future development potential with the advancement of web communication technologies and applications. For instance, Friedrich et al. (2011) illustrate the characteristics and learning behavior of a student living in a not-so-far future year of 2020, stating that the student "can attend lectures, browse reading materials, do research, compare notes with classmates, and take exams – all from the comfort of his apartment," all of these functions are utilized through his primary digital device (PDD). The student in this story represents what the author refers to as "Generation C," who are always "connected, communicating, content-centric, computerized, community-oriented and clicking" (Friedrich et al. 2011, p. 3). In the not-so-distant future, Generation C will constitute the major cohort of service consumers, including education. At present, organizations like the Open University Australia offer more than 100 degrees for students to choose from, although in most cases the teaching is delivered through the internet, students still have to sit formal exams in selected venues in order to complete subjects and degrees. What Friedrich et al. (2011) described can be considered as the next stage of virtual universities, where collaborative research and assessment can also be included in the online activities rather than just teaching content distribution.

Another key feature associated with the "Generation C" cohort of students is their inseparable relationship with social media. In addition to sharing information, ideas and things people discovered, social media platforms have also become the main broadcast channel by which many people learn about products and services (Anderson et al. 2011). Core elements such as community-based marketing and tailored applications are now widely used by both businesses and non-for-profit organizations to stay connected with customers in order to achieve higher sales expansion and customer retention. In previous studies, the issue of distraction is often observed when social media is used as a platform enabling online PAL sessions. However it can be expected that in the future, more study focused social media applications will be developed. Unlike an ordinary social media platform, PAL program specific social media applications require more administrative and management effort to ensure that content sharing and communication are study related and meeting the required standard of teaching quality. Any form of distraction should be controlled and minimized in order to obtain better learning experience. Once again, this requires comprehensive training provided to leaders facilitating the internet based PAL programs, including how to introduce ground rules in the early stages of a program, establishing authority and clearly outlining students' responsibilities during online PAL programs. Mutual respect between the online PAL program leaders and participants is necessary to achieve more teaching and learning outcomes from the online PAL program.

Along with the development of web servers and broadband infrastructure, virtual worlds have now become widely used in education. The interactive nature and game-like characteristics of virtual worlds has strong appeal to students who are interested in online video gaming, whilst at the same time, they are capable of delivering rich and dynamic social interactions and collaborations between vast numbers of users (OECD 2011). Games such as *Second Life* have been used as a platform for online teaching, showing strong potential in the visualization of academic content and demonstrating its effectiveness (Burgess et al. 2010).

Now with more than 200 universities establishing a presence in *Second Life* it can be seen that a much larger scale of collaborative online teaching and learning program can be realized through the application of virtual worlds. However, other issues such as content ownership, privacy, as well as addiction must be taken into consideration.

In order to control and maintain the quality of online PAL learning and avoid issues such as digital data ownership and privacy, it is recommended that education institutions should maintain their own online PAL programs to complement their formal teaching and on-campus face-to-face PAL programs. As previously discussed, the two important criteria for successful implementation of online PAL programs are establishing an online learning community and training of online PAL leaders. If these conditions are met, the online PAL program can help enhance students' learning, especially for those who have limited study time on-campus and need to access learning support via the internet during self-study time. It is important for the institutions to see the benefit of providing internet based PAL programs, as the initial cost of technical requirements and leader training appear to be higher when compared to a face-to-face PAL program. However, if what Friedrich et al. (2011) described becomes reality in the near future, whereby online teaching and learning becomes the core function of education institutions, earlier investment in online programs can provide the institutions valuable experience and accumulation of both technical and human capital to provide effective online learning programs.

## 5 Structure of Implementation

The implementation of PAL programs and internet based PAL programs in a higher education institutions can have a number of structural arrangements. Figure 1 illustrates some of the arrangement can be made to utilize an internal based PAL program to enhance students learning. The use of online or mobile teaching and traditional on-campus PAL program to support formal contact teaching are well discussed in literature and other chapters of this book; this chapter focuses on discussing how internet-based PAL programs can provide additional educational benefits to suits different student learning needs.

The first possibility is to implement an online addition to the existing on-campus PAL programs to support formal teaching (A + B in Fig. 1). As discussed earlier, some students find attending on-campus PAL programs can be difficult due to timetabling issues or work conflict as these traditional PAL programs are often scheduled in regular school hours. In this scenario, including an online session will benefit these students, particularly the part-time students who also are employed. For the institution, integrating on campus and online PAL programs offers learning potential for both the program coordinators and the PAL program leaders. This structure is suitable for large education institutions with its own PAL program coordinating unit and are interested in the research and development of PAL

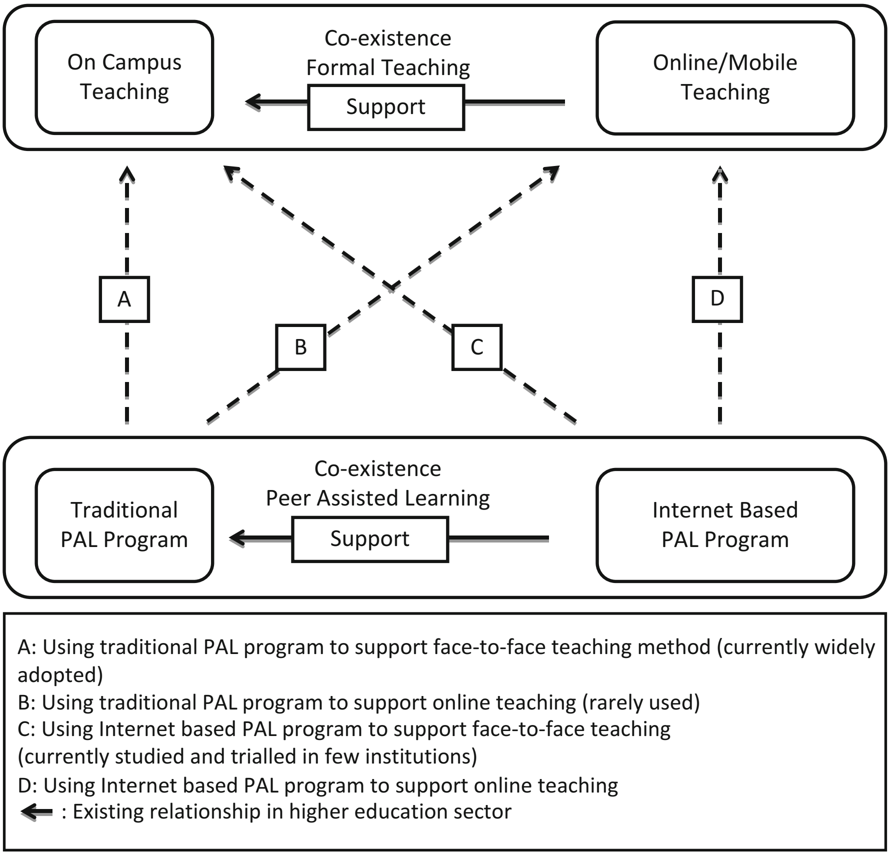


**Fig. 1** Implementation structure

programs. What is important for the PAL program is to identify the transferability of the content and teaching style when the program is conducted online, actively seeking feedback from leaders and participating students to accumulate know-how and expertise.

In contrast, for smaller campuses or satellite campus where it is less cost efficient to establish on-campus PAL program, starting with an online PAL program can be a useful strategy to identify whether PAL approaches enhance students learning in a smaller campus environment and reduce the perceived learning gap between students in remote campuses and students in main campuses (D in Fig. 1). This implementation will be more useful when online teaching is the main education offered in these campus (lecture and tutorials are delivered through video conference or recorded media), as it is often found that remote campus students do require additional learning support due to less connectivity and engagement with teaching personnel in the main campus. Therefore, the internet based PAL programs used to support off-campus students or satellite campus students need to embrace effective online education pedagogies, ensure the program is relevant, interactive, collaborative, and most importantly, give learners the flexibility to control over their own learning (Bonk 2006).

## 6 Evaluation of Effectiveness

As discussed in the previous section, the application of internet based PAL program potentially enables higher education institutions to further narrowing down the learning quality gap between on-campus and online/off-campus students. However, the quality management and assurance of the online PAL programs can be a challenging issue, as the evaluation of online educational program effectiveness is more complicated than the already difficult process of evaluating on-campus programs.

Studies concerning the effectiveness of traditional face-to-face PAL programs often focus on measuring the improvement of students' performance, claiming that by participating in PAL programs students generally perform better in struggling subjects (McCarthy et al. 1997; Parkinson 2009; Malm et al. 2011; Devine and Jolly 2011). Similarly, Cui et al. (2014) also reveal that students who attended Bilingual PAL workshops obtained better average marks than those non-attenders. In addition, other studies use student feedback to reveal how their learning behavior changed under the positive influence of PAL programs. The impact of other factors (such as the subjects' difficulty, students' own learning efficacy and self-selection bias) are yet to be comprehensively investigated to evaluate to what extent PAL programs alone can contribute to better students' academic performance. Therefore, it is suggested that PAL programs are used as supplementary learning support rather than a standalone teaching delivery model.

The evaluation of effectiveness for internet based PAL programs has additional challenges and difficulties. Unlike a face-to-face PAL study session, students' attendance and participation in an internet based PAL program cannot be physically observed and recorded at ease. As a result, the correlation between program participation and academic performance may be misstated. Moreover, if the online PAL program focuses more on content distribution rather than teaching and learning engagement, issues such as spill overs may impact the program's overall effectiveness evaluation as there will be difficulties in distinguishing the positive contribution resulting from content and from the learning process. It is hoped that with more technologies enabling better synchronized communication and visualization there will be improved monitoring of students learning behavioral change during internet based PAL programs. The development of degree curricula, including teaching and assessment will also impact the future of internet based PAL programs.

## 7 Future Directions

To conclude, in this chapter the philosophy of PAL programs and its current offline and online models are discussed and the potential future development of internet based PAL programs are explored. Based on these discussions, successful implementation and effective use of an internet based PAL program requires the establishment of a genuine and enduring online learning community and provision of online PAL leaders who are capable of regulating and facilitating online study focused peer communications and engagement. Lastly, a comprehensive framework is needed for evaluating the effectiveness of internet based PAL programs in improving students learning.

The benefits of implementing an internet-based PAL program seem less appealing at present with the identified technical and nontechnical issues such as causing distraction, lagged response times, and an inability to obtain real-time feedback, hindering the full potential of internet based PAL programs to be fully realized. However, with future technological advancement and evolving students' online learning behavior, it is expected that the model can be further enhanced in order to cater the learning needs of "Generation C" students. Education institutions need to consider the associated cost and value contribution of implementing an internet-based PAL program and must endeavor to better understand students' attitudes with online teaching and learning in order to provide better support to their learning experience.

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# Part VI

# Expectations from Future Technologies in Higher Education

# Expectations from Future Technologies in Higher Education: Introduction

52

Kshama Pandey

**Abstract**

Globalization, justified as the flow of technology, economy, people, values, and idea across borders, is having a reflective impact on most facets of society and is a noteworthy factor influencing the nature and function of higher education. ICT improved higher education (open and distance learning, virtual universities, e-learning, open educational resources) is likely to become the most considerable driver of cross-border provision. The development of innovation and technology in higher education to meet the world's rapidly changing needs emerged as the center of attention of higher education. The sphere of communication has expanded significantly. Nowadays, students are leveraging mobile devices both to be more efficient in their day-to-day tasks and to transform their own learning processes. There is a desperate need for flexible, innovative learning approaches and delivery methods to improve quality and relevance while expanding student numbers. In this chapter, we have a variety of approaches to enhancement of teaching and learning with digital device. Out of all digital leaning devices, mobile phone has more possibility for easy and effective learning. Mobile technology has a potential to access education for all. Empirical studies, chronological evolution of technological learning devices, graphical presentation of technological evolution, and mapping case studies and emerging trends with technology has made this chapter more relevant. Recommendations of emerging technology like smart lab are an imperative approach that may accomplish the future expectations of higher education. These various approaches must be landmark for educators, learners, administrators as well as policy makers.

Higher education is all about imagination and sharing. This is the nucleus of education we can impart into youth. High-quality and relevant higher education is

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able to train learners with the knowledge, skills, and integrated transferable competencies they need to succeed after higher education, with a skyscraping quality of learning environment which recognizes and supports excellent teaching. The European Commission supports EU countries and higher education institutions in modernizing education programs to provide graduates with high-level, employable skills, as well as the market. The new digital technologies have infused economy markets, politics, our workplaces, the ways we communicate with each other, our home activities, as well as operation of all levels of education from kindergarten to doctoral studies. The new technologies challenge higher education institutions worldwide to redefine their student constituencies, their partners, and competitors and to redesign their research infrastructures and teaching practices. The development of innovation and technology in higher education to meet the world's rapidly changing needs emerged as the main focus of higher education.

There is a desperate need for flexible, innovative learning approaches and delivery methods to improve quality and relevance while expanding student numbers. Millions of student that give up school every year are heading toward individual crisis, by restricting their personal ability to get ahead in their careers; their experiences writ large have the potential to impact the economy as a whole. In this regard, technology can be an excellent alternative for making pedagogy more relevant to the lives of students and reaching those dropouts who want to go back and continue the further education that they previously abandoned. Technology offers unprecedented opportunities to improve quality, access, and equity in education and training. It is a key lever for more effective learning and to reducing barriers to education, in particular social barriers. Individuals can learn anywhere, at any time, following flexible and individualized pathways. New ways of learning, characterized by personalization, engagement, use of digital media, collaboration, and bottom-up practices, where the learner or trainer is a creator of learning content are emerging, facilitated by the exponential growth in OER available via the Internet.

The expectations of students and the demands of the education community are changing radically in the twenty-first century. Necessarily, the role of the teacher is changing along with those. At present, more and more introduction of technological tools has renovated the way teachers deliver instructions to students. Teachers promote "safe, legal, and ethical use of digital information and technology," promote manners, and work to foster a global perspective in students. According to the latest data of Speak Up Survey from Project Tomorrow, Evans (2014, Speak Up Research Project, speakup@tomorrow.org) revealed three major trends: video for homework is on the rise; mobile computing is "beyond the tipping point"; and most kids don't use traditional computers to connect to the Internet at home. Students overwhelmingly have access to personal mobile devices. For Evans, this was an interesting set of statistics showing the ways students generally connect to the Internet when at home. According to the study, 64 % of students enabled 3G or 4G devices as their primary means of connecting to the Internet, with another 23 % stating that they connected through an Internet-enabled TV or Wii console. Video is another tool that has been on the rise in recent years. While her presentation focused on students, Evans noted that 46 % of teachers are using video in the classroom.

Nowadays, students are leveraging mobile devices both to be more efficient in their day-to-day tasks and to transform their own learning processes. Majority of students are using mobile devices for anytime research, some for educational games and collaboration with their peers. The students also use mobile devices for reminders and alerts related to their academic lives, taking photos of their assignments, and in-class polling. Surprisingly, they use mobile devices to text questions to their instructors while in the classroom. We witness that they use video, social media, and cell phones for communications; they use e-readers for reading texts and articles; they write, take notes, and do research on laptops. Tablets are also the preference device for completing many of the academic tasks for students.

In this epoch of social media, our networks are bigger than ever as we have many ways to stay connected. The sphere of communication has expanded significantly. The perception of the social media platforms like Twitter and Facebook are not good as schoolteachers believe these are platforms for time wasted in meaningless conversations, but there are many ways in which schools and teachers can harness the power of these free resources to improve communications and hence improve overall effectiveness. It is trustworthy that the explosion of so many tools, it isn't astonishing students are designing "best-fit" solutions for their very specific needs. Rather than using one or even a few ventures for various tasks, students are increasingly savvy about taking advantage of the tools available. But students are more focused on using the right tool for the task at hand," and many times, mobile phones seem to fit.

In this section, we have a variety of approaches to enhancement of teaching and learning with digital devices. Out of all digital learning devices, a mobile phone has more possibility for easy and effective learning. Mobile technology has a potential to access education for all. Empirical studies, chronological evolution of technological learning devices, graphical presentation of technological evolution, mapping case studies, and emerging trends with technology have made this section more relevant. Recommendations of emerging technology like SmartLab are an imperative approach that may accomplish the future expectations of higher education. These various approaches must be a landmark for educators, learners, administrators, as well as policymakers.

► Chapter 53, "Advanced Image Retrieval Technology in Future Mobile Teaching and Learning" by Wang and Aimee Zhang has introduced an emerging concept in advanced retrieval technology in mobile teaching and learning. The image retrieval technology can improve learning efficiency, improve memory by providing similar learning contents, and engage students in learning. In this chapter, an effort is made to exhibit the operations and functioning process of retrieval technology. And also illustrated is an image retrieval system based on the bag-of-features model. They suggested that various advance features of mobile phones support learning in various disciplines, i.e., content-based image retrieval has been used in outdoor ecology learning, MedSearch Mobile is one of the good examples in medical teaching and training. At the end of the chapter, authors have discussed the advantages and disadvantages of image retrieval technology in education. The study has recommended that the advance of image retrieval technology will not only expand the scope of its applications to mobile teaching and learning but also help to boost the quality of these applications to a new level.

Dr. Cardoso, Coimbra, and Dr. Mateus have examined the importance of three-dimensional contents by ▶ Chap. 54, "Augmented Reality and 3D Technologies: Mapping Case Studies in Education". They have enumerated the evolution of 3D technology, particularly in the application of AR and 3D contents to teaching, and presented a synthesis of practical cases. This study has also presented a chronological perspective of technological evolution of equipment and software, which currently translated into unique conditions for the effective implementation of three-dimensional technologies supported by AR and ICT in the field of education. For justifying their work, they have given related studies and applications from the last 20 years. This chronological-historical mapping has suggested that AR, as well as mobile learning, is a breeding ground for education. Study recommended that this technology will be beneficial for mathematics in higher education.

▶ Chapter 55, "Expectations from Future Technologies and E-Learning in Higher Education in Albania" by Nikaj has expressed some developments and characteristics of digital changes into the Albanian Higher Education today and intended a better future for Albanian students in the framework of this perspective. The study was based on the survey of a group of students from Faculties, Economics, and Education. This study has revealed that there is amazing growth of ICT users in Albania. It also concerned some future challenges for Albanian Higher Education, i.e., institutional autonomy and good governance of Higher Education institutions; the curriculum reformation in accordance with strategy of Higher Education and national priority; assuring quality assurance and a fair accreditation system as a guarantee to the service rendered to the society; integration of the teaching process via scientific research; preparing the conditions for lifelong learning; increasing student mobility and participation; and providing the higher education system a better dimension through new technology and e-learning.

▶ Chapter 56, "How Irish Postgraduate Students Use Mobile Devices to Access Learning Resources" by Marcus-Quinn and Cleary is an endeavor to explore the background of m-learning, focus on its advantages and potential disadvantages, its use in online and distance courses, and its use with a VLE. In the review of literature; authors examined the advantages and disadvantages of m-learning, discussed its use in online and distance education, and explored m-learning in the context of a university VLE. The objective of this chapter was to explore how postgraduate students are taking technical communication courses through a mix of on-campus and distance delivery modes exploiting mobile technologies in their learning. The results of this study indicated that there is a gap between students using mobile devices and instructors requiring students to use mobile devices. It suggested if instructors are more aware of the devices and mobile applications that students are currently using to engage in mobile learning, then perhaps mobile learning could be exploited to a greater degree.

Kayode, Alabi, Sofoluwe, and Oduwaiye explained the concept of mobile teaching and learning and features and benefits of mobile learning in the university system in ▶ Chap. 61, "Implementation of Mobile Teaching and Learning in University Education in Nigeria: Issues and Challenges". Further, they discussed the issues and challenges toward a successful implementation of mobile teaching and learning in universities in Nigeria. Some recommendations were also focused on issues and challenges which include the training of both the students and the academic staffs on the benefits of some of the networks like LinkedIn, Facebook, etc. to enhance teaching and learning in higher education.

Kshama Pandey in ▶ Chap. 58, "M-Learning: Visible Approach for Invisible World" made an effort to reveal the neglected Indian population deprived from education. The people are as abandoned as they are invisible to the mainstream. She has discussed the educational status of higher education. Even though India has achieved almost 100 % access to school for its children at the primary level, still it has a high 40 % dropout rate at the elementary level, according to a new study released here in 2014. These students belong to jobless population, but majority of them access mobile phones. The chapter suggested how m-learning could be beneficial to enhancement of their education as well as survival. The chapter also suggested how these people can access education and improve their well-being and quality of life.

▶ Chapter 57, "M-Learning and U-Learning Environments to Enhance EFL Communicative Competence" has expressed the work of EFL learners at the Universidad de Las Palmas de Gran Canaria. Mobile and wireless technologies have produced new ways of interacting with the world, away from the limitations of desktop computers. Authors Soraya García-Sánchez and Carmen Luján-García have suggested an innovative approach to enhance learning with the combination of technology. If m-learning and u-learning approaches are intertwined, the skills of a foreign language can be positively enhanced. The outcomes revealed that the communicative competence and the foreign language skills have been improved by using the appropriate technology, content, and tasks that were especially adapted to today's digital students.

In ▶ Chap. 60, "Mobile Technologies and Learning: Expectations, Myths, and Reality," Lina Petrakieva discussed the myths and real expectations of mobile learning. Now technology is increasing as the rate of new learners. With the ubiquitous access to mobile devices now, most institutions are also keen to implement a BYOD (bring your own device) strategy, as this is usually seen as a very cost-effective way to reduce the money spent on technology. Most of the universities and colleges have included the notion of creating digitally literate graduates in their policies, mostly with emphasis on employability, but the strategy to achieve that is usually simply relying on the teaching staff to be able to do that as part of their subject teaching and not recognizing the need for specialists on digital literacy to teach both the educators and the learners. However, a lot of them are still struggling to understand and utilize the potential of true mobile learning, not just mobile access or mobile services. What is usually lacking is a proper m-learning and m-teaching strategy, with support for both educators and learners to fully benefit from m-learning. The chapter also focused on the real background of advancement of mobile technology and its practical uses and effectiveness in the teaching and learning. The author strongly advocated the paradigms of m-learning. The chapter recommended that the vigorous learning with mobile devices required a more developmental pedagogical approach from the educators' perspective and more engagement and positive attitude from the learners.

Stoller-Schai has started ▶ Chap. 59, "Mobile Learning Beyond Tablets and Smartphones: How Mobile and Networked Devices Enable New Mobile Learning Scenarios" by presenting the decadal evolution of mobile and networked devices, which can be used to design, develop, and implement mobile learning scenarios in schools, enterprises, and public institutions such a museums and libraries. The chapter has also illustrated the paradigm shift of m-learning. In this chapter, mobile learning technology has been assumed beyond smartphones and tablets. To implement this learning possibility here, pedagogy for m-learning has been discussed. To expand learning possibilities, he has presented various concrete examples. The chapter was concluded with concrete and fruitful suggestions for future possibilities of smart learning with and beyond mobile learning.

▶ Chapter 62, "Smart Lab Technologies" was introduced by Hu Yin. She started her chapter with the need and importance of Smart Lab for students, teachers, as well as administrators. The author suggested that this emerging concept is imperative for those students who would like to become a professional software developer; he/she needs to take enough practice within the life in University. In this chapter, we can expect vast possibilities for quality higher education. A smart laboratory will provide more types of IOT nodes and development platforms to students than any traditional network laboratories. With a certain set of communication protocols, a university could build a smart environment campus; therefore, it may need UI utilities to access and control smart devices. It was suggested that a mobile phone would be the best equipment to run UI software. Smart Lab design was also introduced in this section. Most of the applications of this Smart Lab would be developed on mobile platforms such as iOS and Android. Thereafter, benefits of Smart Lab were recommended, and lastly were discussed the prospects of a Smart Lab system in this chapter.

# Advanced Image Retrieval Technology in Future Mobile Teaching and Learning

# 53

Lei Wang and Yu (Aimee) Zhang

## Contents




**Abstract**

Advanced image retrieval technology has been widely adopted in many industries and areas. This technology is also adopted in higher education by some educators and researchers in recent years. With the introduction of mobile technology, it has been adopted in mobile teaching and learning in different disciplines. The image retrieval technology can improve learning efficiency, improve memory by providing similar learning contents, and engage students in learning. However, it is also limited by some software and hardware barriers on mobile devices, such as computing capability, screen size, and quality of wireless connections. Although it is believed to have both advantages and disadvantages in mobile learning, the adoption of the advanced image retrieval technology greatly enhanced the capability of image searching and learning



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experience by students and educators. The advanced image retrieval technology is believed to play a more important role in future mobile teaching and learning in different industries and businesses as well as in higher education.

## 1 Introduction

Image retrieval technology is widely adopted in business and industries. With the fast development of image retrieval technology in the last two decades, image retrieval has opened a new dimension for conveniently and efficiently obtaining visual information. However, the adoption of image retrieval technology in education is lagged behind the game and still in its prototype stage. Some educators have designed and implemented mobile learning application with image retrieval technology to help learners identify the names and types of different birds and butterflies. The evaluation of these projects shows significant positive results in learning process and engagement of learners. The use of image retrieval technology in learning is not limited by images only. It can be adopted in health, creative arts, art design, data analysis, and many other disciplines. It is believed as one of the trends in future mobile teaching and learning. The following section linked the literature in mobile learning and image retrieval technology. Section 3 studied the advanced technology in image retrieval and its empirical results. Section 4 compared the advantages and disadvantages of the image retrieval technology. The last section summarized the findings of this chapter and shed a light on the future image retrieval technology in mobile teaching and learning.

## 2 Literature and Empirical Studies

The mobile telecommunication industry has evolved rapidly in the last decade (Zhang 2012a). The traditional mobile voice communicating service has been expanded into great various multimedia services and social communicating services, such as take and send pictures, listen to music, record video, watch TV, play games, surf the Internet, check email, manage personal schedules, browse, and create documents (see ► Chap. 2, "Characteristics of Mobile Teaching and Learning"). The growth of the telecommunications not only provides the users with a way to communicate but also brings significant profits for the value-added services including learning anytime and anywhere (Vogel et al. 2009). The development of 3G (third-generation networks) and 4G (next-generation cellular wireless access standards) creates new markets and new opportunities in the market. Nonetheless, surveys of mobile phone users show that consumers view the benefits of mobile sectors as saving money, saving time, and providing useful information, which are also benefits for mobile learning (Zhang 2012). Mobile technology is changing the way people work and learn.

Mobile learning has been introduced into education from the first generation of mobile devices (with only three lines black and white screen). However, it developed very fast with the development of new technology and equipment in mobile telecommunication industry. Many designers, educators, and developers worked together to bring new technologies into universities, high schools, and primary schools (Alley 2009; Cheon et al. 2012; Fraga 2012). In 2013, the education applications were the second-most popular category in Apple store and shared 10.55 % of all apps (Statista 2013). There were more than 65,000 educational apps in Apple Store in 2013. They benefited teachers and students all over the worlds (see ▶ Chap. 19, “Tutors in Pockets for Economics”). The adoption of mobile technology in education also increased self-learning and lifelong learning (see ▶ Chap. 25, “Mobile Education via Social Media: Case Study on WeChat”). In the Australian Mobile Telecommunication Industry report, mobile telecommunication contributed indirectly to business efficiency and cost-saving by more than one billion per year (Zhang 2012).

## 3 Advanced Image Retrieval Technology

Image retrieval aims to find the images from a large database that can meet the requirements set by a user. Excellent reviews on image retrieval can be found in Smeulders et al. (2000) and Datta et al. (2008). This technology becomes important and indispensable with the wide use of images, because users need to have efficient access of the visual information in image databases, as well as searching for a specific image. The application of image retrieval in mobile teaching and learning can be intuitively understood, because visual aids such as graphs, diagrams, illustrations, and pictures have become an essential component of modern teaching and learning. And the use of these visual aids is becoming more and more extensive with the popularity of multimedia tools, wireless communication networks, and mobile computing platforms. This trend has also been well seen in mobile teaching and learning (Fig. 1).

Image retrieval systems can be generally categorized into text-based image retrieval (TBIR in short) systems or content-based image retrieval (CBIR in short) systems. These two kinds of systems can largely be differentiated through the queries that they accept. In a retrieval system, a user submits queries to the system via an interface to express the information need. A query can usually be submitted in two different formats. The first format, which is also the most commonly used one, is in the form of free text queries, which consist of a small number of keywords or textual description about the images to retrieve. A system working with text-based queries is often called a TBIR system. In such a system, each image in the database has been associated with keywords or textual annotation. The relevance of an image to a given query is measured by the similarity between its textual annotation and the query. In this case, image retrieval is essentially converted to text retrieval that has been well studied in the literature. The second query format is to provide an example of image to retrieve. A system accepting such a kind of query is often called CBIR system. In this case, the relevance of an image to a given query is measured by the similarity of visual content of the two images, for example, the similarity of their color, texture, or shape information.

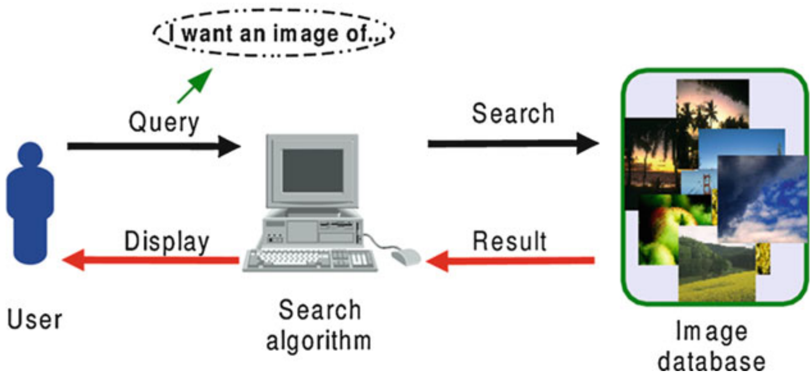


**Fig. 1** An illustration of an image retrieval system (Source: From the author)

Since its early days, image retrieval has been treated as an application of text retrieval, and an image retrieval system is often developed upon a database management system. This leads to the TBIR system mentioned above. Until now, most of the commercial image retrieval systems are still based on TBIR due to the great success and wide use of database management and information retrieval techniques. CBIR started attracting attention in 1990s, and it is mainly motivated by to the following three issues. Firstly, with the wide use of digital imaging equipment, the volume of image databases becomes increasingly large. As a result, it is time-consuming and labor-intensive for annotators to manually add keywords for each image. Secondly, simply using a small number of keywords is difficult to give an accurate and comprehensive description for an image, which is especially true for the images in a broad domain such as the Internet. Lastly, due to the issue of human perception subjectivity, different people may have different descriptions about the same image. As a result, the keywords given by annotators may not necessarily be same as the queries given by users. In this case, it becomes difficult to retrieve relevant images by using text-based image retrieval.

To handle the above three issues, CBIR has received intensive research during the past two decades. CBIR does not need human annotators anymore and uses computer to extract visual features to represent an image. The visual features are usually based on the color, texture, or shape of an image. In this way, each image associates with a set of visual features, which are conceptually comparable to the text annotation used in TBIR. The similarity of two images is evaluated by comparing the associated visual features. Two images having similar visual features are deemed as relevant images. CBIR can effectively address the three issues previously mentioned. Nevertheless, CBIR also suffers from a critical issue called "semantic gap." As human beings, we used to describe image content with high-level concepts such as "desk," "car," or "airplane." However, when describing image content, computer can only use low-level visual features. The semantic gap leads to a problem that two semantically related images do not necessarily have the similar visual features, and vice versa. How to reduce this semantic gap has been the central issue in CBIR research, and many works have been done in this area. In addition, the TBIR and CBIR approaches are not contradictory but complementary with each other. In practical applications, as long as images have been annotated with textual information, the two approaches can be integrated to effectively improve retrieval performance. In the literature, how to combine the two retrieval approaches is also an active research topic.

Generally speaking, the applications of image retrieval can be categorized as narrow-domain-based applications and broad-domain-based ones. In the former case, the images in a database are related to a specific application or restricted to a specific scope, and they often have less diverse image content. For example, the search of medical images, trademark images, or astronomy photos often belongs to narrow-domain-based image retrieval. Comparatively, the latter case has much less or no restriction on image content, and the images in a database can relate to arbitrary topics, scopes, and applications, resulting in very diverse image content. Searching for images on the Internet is a good example of broad-domain-based retrieval. Both types of image retrieval can find their applications in mobile teaching and learning.

As previously mentioned, TBIR only deals with text-based queries. Comparatively, CBIR can handle more flexible query modes. The most common query mode in CBIR is query by example. As indicated by its name, users can directly submit to the system an example of the images to be retrieved. Also, users can delineate a region of an image to request the system to search for the images having this specific region. In some CBIR systems, users are even allowed to submit a line-sketch or color composition to search for images (Rajendran and Chang 2000). In addition to the query modes, advanced image retrieval systems allow users to interact with the systems to improve retrieval performance, which is called "relevance feedback." The relevance feedback mechanism was originally used in TBIR. In 1990s, it was introduced into CBIR and has received much attention since then. Through this mechanism, users can label the retrieved images as relevant or irrelevant and feed this evaluation back to the system. By analyzing user's feedback, the system will refine the retrieval in the next iteration. Making a good use of this mechanism can often effectively improve retrieval performance. This mechanism is an effective means to deal with the notorious "semantic gap" problem by introducing human users into the loop of image retrieval. These flexible query modes and the interactive relevance feedback mechanism can bring great benefit to the users of mobile teaching and learning to acquire information and knowledge.

Many image retrieval systems have been developed in the past decades. The QBIC (short for query by image content) is among the earliest content-based image retrieval systems. It was developed by IBM in the middle of 1990s. This system allows users to find images from a large database that meet their information need in terms of color, shape, texture, etc. It accepts the queries including example images, sketches and drawings, and designated color or texture patterns. In addition to QBIC, famous pioneering image retrieval systems include the VisualSEEk and WebSEEk systems by Columbia University and the Photobook and PicHunter systems by MIT.

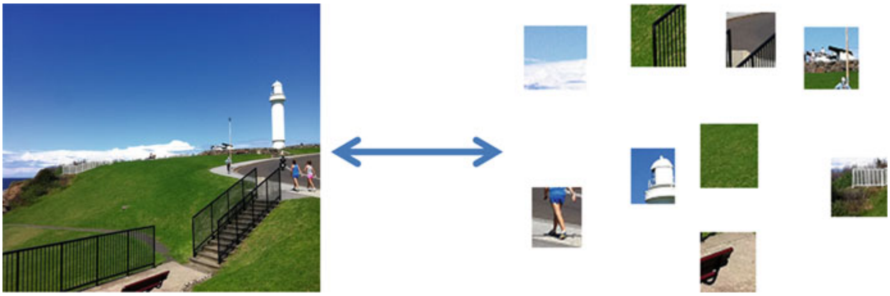

**Fig. 2** An image is a "document" consisting of many "word" (small image patches) (Source: From the author)

CBIR was initially focused on developing effective visual descriptors to describe image content, for example, its color, texture, or shape information. Typical visual descriptors can be found in the MPEG-7 visual standard for content description (Sikora 2001). During the last decade, with the advance of computer vision and machine learning technology, more sophisticated visual descriptors and retrieval algorithms have been proposed, significantly boosting the performance of content-based retrieval. The state-of-the-art retrieval model is built upon the bag-of-features model borrowed from text analysis. This model describes the visual patterns of local image patches and uses the distribution of these visual patterns to characterize an image. It can effectively support both whole image- or region-based retrieval. The following provides a brief introduction to this powerful retrieval model and discusses the requirements of implementing such a system.

As previously mentioned, the bag-of-features model is transplanted from the field of text analysis. The core idea of such transplantation is illustrated in Fig. 2. As seen, each image is viewed as a document and each patch cropped from the image is treated as a word. In text analysis, the topic of a document (e.g., politics, sports, finance, etc.) can be modeled based on the number of occurrences of different words. Following this idea, the bag-of-features model characterizes an image based on the number of occurrences of different visual patterns of image patches. Typical content-based image retrieval with the bag-of-features model is illustrated in Fig. 3. Given an image database, many small-sized image patches are extracted from each image and described by visual features. A key difference between text and image is that there is no concept of "words" for image. To mimic text analysis, the patches extracted from all the images in a database are analyzed, and a set of common visual patterns across these patches are identified. These visual patterns are usually called "visual words," and they collectively form a "visual vocabulary," which can be compared to a dictionary used in text analysis. After that, each patch from an image will be categorized as one of the visual words. In doing so, an image is characterized by a histogram that counts the number of occurrences of different visual words in this image. This step can be compared to characterizing a document based on a given dictionary. Since each image is now associated with a histogram, image retrieval can then be carried out by evaluating the similarity of the histograms. To

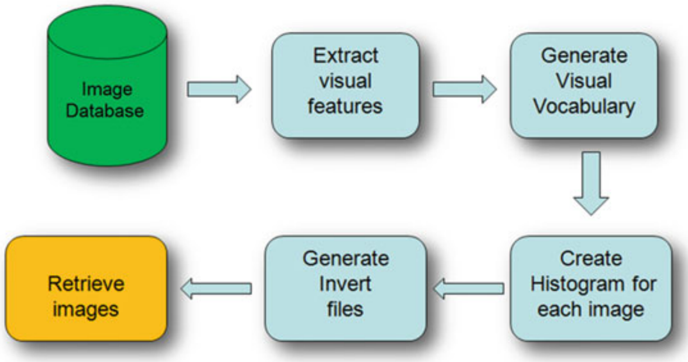


**Fig. 3** An illustration of an image retrieval system based on the bag-of-features model (Source: From the author)

speed up retrieval process, an invert file is often employed. This bag-of-features model is able to achieve promising retrieval performance. During the last decade, many advanced variants of this model have been developed, and they effectively improve retrieval accuracy and computational efficiency further.

A successful implementation of this system requires sufficient hardware and software support. The following gives a brief discussion on this aspect, and it will help the understanding of the advantages and disadvantages of this state-of-the-art model when it is applied to mobile teaching and learning. This retrieval system generally consists of a server and a group of clients. The image database, visual vocabulary, histograms of the images in the database, and the invert files are usually stored on the server side. When conducting retrieval, a client needs to send the query information to the server and then receive the retrieval result. In this case, the computational power of a mobile platform, as a client, and the bandwidth between client and server become critical. In specific, when a query image is submitted by a user, a straightforward way may be to send this query image to the server and process it there (e.g., extracting visual features and generating the histogram). This leads to relatively low computational requirement on a client, and it could be quite important for mobile platforms. At the same time, this approach puts high requirement on the bandwidth between the server and client and the computational capability of the server. The other way round is to process the query image, as much as possible, on the client side and minimize the information to be sent to the server. Although this can reduce the requirement on bandwidth and remove burden from the server, it will expect more on the computational capability of the client, which could become an issue for low-end mobile platforms. The above two ways generally correspond to the "centralized" and "decentralized" approaches commonly encountered in distributed computing systems. Which one of them fits a specific mobile image retrieval system better shall be carefully evaluated by considering all the factors related to this system.

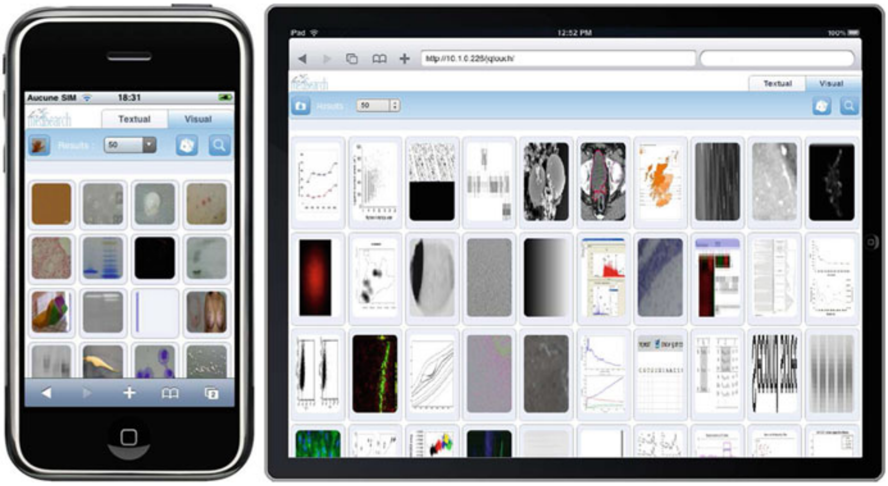

**Fig. 4** The MedSearch Mobile system on iPhone and iPad (Source: Duc et al. (2011))

With the fast development and popularity of mobile computing platforms, image retrieval has been applied to all kinds of mobile teaching and learning tasks. The following shows three examples in the fields of medical practice, outdoor ecology learning, and archival research, respectively.

It is well known that image plays an important role in medical teaching and training. This fact has stimulated the development of mobile medical image retrieval, and a system called MedSearch Mobile is one of the good examples (Duc et al. 2011). It is a mobile search system built upon an existing MedSearch system. This system is a web-based one that can work on a variety of mobile platforms, with the focus on iPhone and iPad, as shown in Fig. 4. It can conduct both text- and content-based retrieval of medical images from medical open access literature. Users are allowed to type in free text queries or take pictures with phone's camera to conduct retrieval. In addition, this system tests different screen layouts to investigate which one can utilize the display space in the most efficient way. This is an important issue for mobile image retrieval systems, because mobile computing platforms usually have limited space for users to interact with the system. As discussed in that work, by addressing these potential issues, such a system will be able to provide efficient access to medical information and expect to improve the performance of medical teaching and learning.

Content-based image retrieval has been used in outdoor ecology learning. Taking advantage of wireless transmission technology and wireless handheld devices, a mobile firefly-watching learning system was developed (Chen et al. 2004). This system allows students to take pictures of the firefly in an outdoor environment and transfer the picture to the server side. This picture will be matched with the images in a database and the similar ones are retrieved. By cross-referencing the retrieved images and the captured image, students will

**Fig. 5** A mobile firefly-watching learning system (Source: From Chen et al. (2004))

be able to identify their commonness and differences on site and can also access textual information associated with the retrieved images. With such a system, students will have more opportunities to perform independent learning and are less constrained by time and place. Figure 5 shows the interface of this image retrieval system. The left panel shows the query image and the right panel displays the retrieval result.

Image retrieval has also been used to retrieve photos from large archival photographic collections. Most of existing archival photo search systems are based on text annotation and use text-based image retrieval to find relevant photos. However, with the fast increasing volume of archival photo collections, text-based retrieval becomes less efficient due to the need of manual annotation and the limited expressive power of keyword. Taking advantage of content-based retrieval techniques, a system was developed to reduce the dependence on the text annotations and provide public users with efficient access to visual information to conduct research, teaching, and learning (Wang 2014). This system is built upon the state-of-the-art bag-of-features model for image retrieval. Figure 6 shows a snapshot of this system. For example, when a user is interested in an archival photo, he/she can click that photo (indicated with a red box) and the system will retrieve more relevant ones from the database. In this way, all the information associated with the retrieved images will be passed to the user. This retrieval system is going to be extended to mobile platforms considering the importance and efficiency of mobile teaching and learning for archival studies.

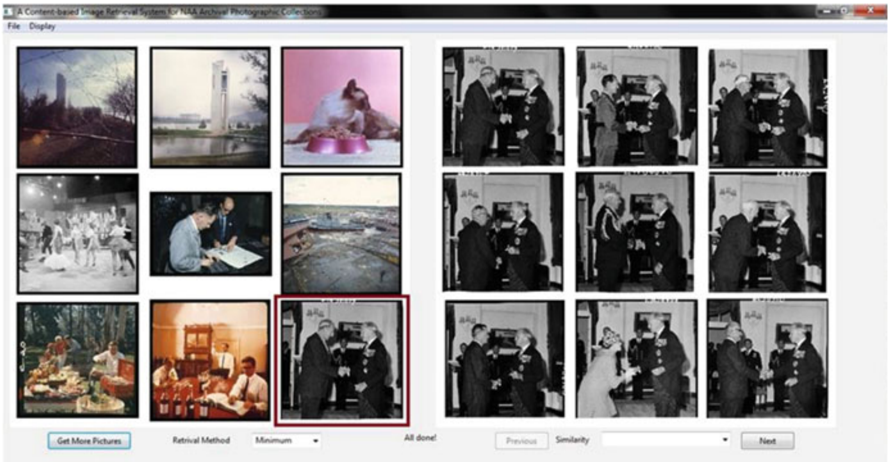


**Fig. 6** A retrieval example of archival photo search system (Source: From Wang (2014))

## 4 Advantages and Disadvantages

The advantages of image retrieval technology in education are improving learning efficiency, improving memory by providing similar learning contents, and engaging students in learning. Some prototype products and their evaluation showed that the image retrieval technology helped students in their learning and increased their interests in learning and discussion (Chen et al. 2004; Datta et al. 2008). A picture is worth a thousand words (Larive 2008). Ten or twenty similar pictures benefit students more. The searching ability, linked memory (Zhang 2012), and group discussion can not only enhance learning but also lead to lifelong learning.

Although many empirical studies showed that image retrieval technology in mobile learning had positive influence on learning process and good evaluation in qualitative analysis as discussed above, there are some disadvantages or barriers for this technology that should be taken into consideration for future design and development.

Firstly, mobile devices, compared to personal computers, have limited computing capability due to the limitation of their hardware. Although it is developing very fast and the gaps between them are becoming smaller, they still have less computing capability in current stage. Therefore, the image retrieval application should fit into mobile devices by designing for better algorithm to speed up. Otherwise, the customers will not stay for 10 min for one searching results.

Secondly, mobile devices are limited by their screen size and image resolution. Images with many contents or small size words are not suitable for mobile devices. High-resolution images also took a long time to be loaded and transferred. Smaller-sized images with simple contents can fit mobile devices better.

Thirdly, the network connection via 3G is costly on mobile devices. Some mobile devices are easily to transfer the WIFI connection to 3G anytime, which may cost the customer a lot when they did not notice it. In Australia, a video transfer via 3G connection may cost 200 AUD within one hour. Therefore, the image retrieval technology should be used properly to reduce the size of transferred files and messages.

Last but not least, the mobile users are more willing to learn with smaller time slots instead of watching mobile devices for more than one hour. They are interested in applications with convenient and simple functions, more colors, and interactive or social communication functions. A well designed mobile application should meet these requirements too.

## 5 Future Directions

Mobile teaching and learning has been the trend for modern higher education. The advanced image retrieval technology can add value to this field due to the wide use of image and video in modern teaching and learning. With the fast development of image retrieval technology in the last two decades, image retrieval is not a simple extension of text retrieval anymore but has essentially opened a new dimension for conveniently and efficiently obtaining visual information. This is of great importance for mobile teaching and learning which calls for free, flexible, and efficient ways to acquire knowledge. The extensive use of image retrieval technology in all kinds of areas related to mobile teaching and learning can be expected in the very near future.

At the same time, we can see that a variety of issues need to be resolved in order to make mobile image retrieval more reliable and efficient. One of them is related to the computational capability of mobile computing platforms. With wide application of mobile image retrieval systems, more sophisticated image processing algorithms and graphical user interfaces could be implemented at the client side. They will lead to more computational overhead and memory and storage usage. In this case, it may not be wise and effective to simply pursue high-end mobile platforms. Instead, better design of systems, algorithms, and communication protocols shall be paid more attention in order to make mobile image retrieval a light-weighted system. This is especially important for making mobile teaching and learning affordable for everyone.

Another issue, which is more critical, is the development of image retrieval technology. Although content-based image retrieval has made significant progress, its performance is still far from being satisfied. The effectiveness of image retrieval fundamentally depends on the development of image understanding, a central issue in computer science and artificial intelligence. In addition to the previously mentioned bag-of-features model, recent years have witnessed new progress in the line, for example, the introduction of deep learning, one of the ten breakthrough technologies in 2013 identified by MIT Technology Review, into the area of image understanding. It is believed that the advance of image retrieval technology will not only expand the scope of its applications to mobile teaching and learning but also help to boost the quality of these applications to a new level.

## 6 Cross-References

▶ Characteristics of Mobile Teaching and Learning
▶ Mobile Education via Social Media: Case Study on WeChat
▶ Tutors in Pockets for Economics

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# Augmented Reality and 3D Technologies: Mapping Case Studies in Education

# 54

Teresa Cardoso, Teresa Coimbra, and Artur Mateus

## Contents



**Abstract**

Learning anywhere, anytime is becoming ever more a daily routine, due to the increasing and recent growth of information and communication technologies. In the last 5 years, their key characteristic and specifically in the use of mobile equipment and software have been their portability, mobility, and network access. The technological development, including software applications available for the implementation of three-dimensional contents, has been following this trend. Hence, it is important to know whether and how these three-dimensional contents are being integrated in educational situations, namely,

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regarding augmented reality and mobile learning. Thus, a synthesis of Portuguese and international research works and case studies on the use of three-dimensional augmented reality is chronologically presented along with the evolution of information and communication technologies. The main goal of this knowledge mapping is to contribute to the state of the art in three-dimensional augmented reality technologies in education. In addition, it is aimed at framing the creation and implementation of three-dimensional content in higher education, specifically in the field of mathematics.

## 1 Introduction

Three-dimensional (3D) technologies, based either on tangible perception, such as the case of 3D printing, or on intangible perception, such as augmented reality (AR), are currently mature enough to be accessibly and efficiently applied and put to advantage in the field of education. Combining 3D technologies with information and communication technologies (ICT) increases the flexibility of their on-site or remote access and use. We are thus part of an ecosystem with optimal conditions for advancing teaching and learning through the development of contents that leverage resources available to us. In this regard, there is a great international exploratory momentum with the development of several research projects, which is also beginning to grow in Portugal.

This chapter aims at mapping the evolution of 3D technology, particularly in the application of AR and 3D contents to teaching, and presents a synthesis of practical cases. Therefore, it begins by setting the context for the insertion of (intangible) three-dimensional technologies in the various sectors of society. Then, some international and Portuguese works are described which are being developed by applying 3D technologies, mainly in education and teaching. To this end, and in line with Cardoso et al. (2007, 2010, 2013), a thorough literature research was conducted, with particular focus on recent years (between 2010 and 2014, with regard to the application to education), although the technological framework includes some facts and milestones from the last 80 years. Finally, part of the research work that is being done on intangible three-dimensional technologies, in particular the implementation of AR, is described, as well as how these technologies can be capitalized on on-site and remote educational situations.

For this study, Google was searched using keywords and Boolean markers, including terms such as "augmented reality," "tridimensional," "teaching," "mathematics," and "m-learning." Using the same descriptors, the literature search was complemented with a more focused search on b-on, the Online Knowledge Library, where the journals *Computers and Education*, *Computers in Human Behavior*, *Journal of Systems and Software*, *Computer Science*, *Advances in Engineering Software*, and *Social Behavior Sciences* were consulted. The research was carried out mainly during 2013, with an update made until the start of the last quarter of 2014.

It should be noted that this study presents a chronological perspective of technological evolution of equipment and software, which currently translates into unique conditions for the effective implementation of three-dimensional technologies supported by AR and by ICT in the field of education. Therefore, the selected works, mainly papers, were conducted between 1997 and 2014 and reflect the developments from 1961 to the present.

In addition, the search was not restricted to research work in Portugal, in part because the first finding of the mapping is that there is a reduced amount of work in this field being implemented in this country.

A corpus of 33 references was therefore created, mostly composed of international peer-reviewed scientific journals, accessed via b-on, giving priority to papers that present a chronological evolution of augmented reality technologies, their relations with the evolution of ICT and, finally, to studies of three-dimensional content implementation of AR in higher education, in particular in mathematics courses.

## 2 Augmented Reality and Its Evolution

When talking about three-dimensional technologies, such as the ability to print three-dimensionally (3D printing), to capture 3D shapes (3D scanning), and to integrate virtual elements (AR) into the real world, it becomes apparent that 3D technologies advance alongside technological computer developments and are linked to the integration of ICT in our daily lives. An analysis of computer development will show some similarities to 3D technology development, as can be seen below.

Intangible content 3D technologies, such as AR, are closely linked to computer capacity, and calculation and thus their availability is related to the development of personal computers. AR is the integration of virtual images into the real world; this integration is performed using ICT. Reality is augmented with virtual elements: a mobile device with a camera, such as a tablet, a cell phone with Android or iOS operating system, or a computer, enables anyone to access content provided with AR. The development of AR contents has been following computer and ICT technological developments. Figure 1 presents a chronological summary of the main events that contributed to the current stage of development in these areas (see also Table 1).

For example, in 1961, the cinematographer Morton Heilig registers the patent of an innovative system, the *Sensorama*, which allows the user to experience an immersive cinematic session. In 1968, Ivan Sutherland develops a computer-controlled immersive helmet (Carmigniani et al. 2011; Sutherland 1968). This was the first virtual reality and AR system; it was developed at Harvard University in Utah, USA. In the 1970s, this technology became known as *Artificial Reality* (Zhao 2009). Later, Myron Kruger, at the University of Connecticut, develops the *Videoplace*, which consists of a living room for human-computer interaction. This system uses information from a camera that is transmitted to a computer and then projected on a screen, allowing interaction with *Artificial Reality* (Nagler 1994).

In 1993, Feiner and collaborators publish the first paper in the field of AR. The application they developed, named KARMA, was validated in technical staff training for printer maintenance. Two years earlier, Feiner et al. (1993) had

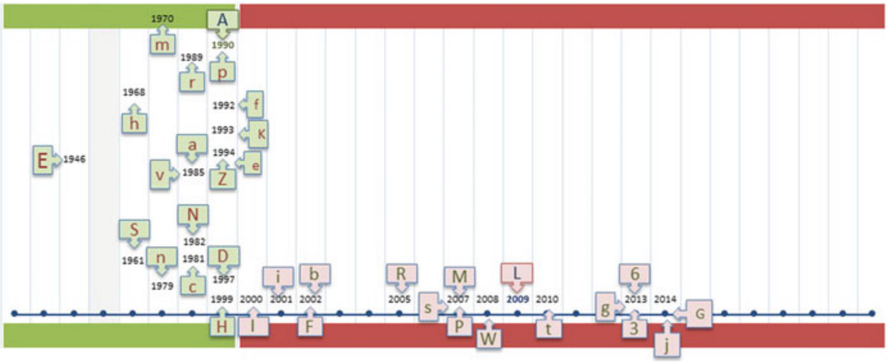


**Fig. 1** Historical evolution of AR and technological evolution milestones in computers, ICT, and image display systems (Source: Data collected for this study)

**Table 1** Historical evolution of AR and technological evolution milestones in computers, ICT, and image display systems (Source: Data collected for this study)

| Year | Iconic letter (cf. Fig. 1) - milestones |
|---|---|
| 1946 | E – 1st Computer: ENIAC |
| 1961 | S – Heilig invents a system that enables immersion in a virtual world through images: SENSORAMA |
| 1968 | h – Ivan Sutherland invents the 1st image display helmet |
| 1970 | m – Cooper develops the 1st mobile phone |
| 1979 | n – NTT opens a mobile phone network in Tokyo |
| 1981 | c – The 1st cellular phone system in the world is implemented in Denmark, Finland, Norway, and Sweden |
| 1982 | N – Nokia introduces car phones |
| 1985 | a – NASA develops multisensory systems for pilots and astronauts<br>v – Myron Krueger develops a computer-controlled interactive laboratory without helmet mediation |
| 1989 | r – Jaron Lanier creates the term virtual reality; his company, VLP Research Inc., becomes the pioneer in the virtual reality market |
| **1990** | p – Personal computers (PC) become widespread<br>A – Tom Caudell establishes the term augmented reality (AR) |
| 1992 | f – L. B. Rosenberg creates “virtual fixtures” |
| 1993 | K – The 1st paper on the application of AR in training, through the KARMA application, is published |
| 1994 | e – Milgram puts forward a continuum relating real and virtual environments, positioning AR as a mixture of reality and virtuality in the continuum<br>Z – Zimmerman and Lanier develop a digital glove, thus introducing an easier way to interact with the virtual world |
| 1997 | D – Azuma describes the differences between virtual reality and AR, underpinning the latter’s main characteristics: it combines the real and the virtual, interactive in real-time, registered in 3D |
| 1999 | H – Hirokazu Kato develops the ARToolKit |
| 2000 | I – Desktop Internet becomes widespread |

(*continued*)

**Table 1** (continued)

| Year | Iconic letter (cf. Fig. 1) - milestones |
|---|---|
| 2001 | i – The iPod is launched |
| 2002 | b – Bruce Thomas launches the 1st outdoor game in AR: AR Quake<br>F – Steven Feiner publishes "Augmented Reality: A New Way of Seeing," in which he predicts how AR will be used in the future and says that "computer scientists are developing systems that can enhance and enrich a user's view of the world" |
| 2005 | R – Prediction of the New Media Consortium, in the Horizon Report, on the great impact that AR will have on teaching |
| 2007 | s – Smartphones are launched (1st iPhone)<br>M – First marketing applications in AR<br>P – Application of AR in medicine; use of helmets with AR content in the treatment of Parkinson's patients |
| 2008 | W – Wikitude develops AR browsers for Android mobile phones: Wikitude AR Travel Guides |
| **2009** | L – Layar, a Danish company, introduces an AR-based browser for mobile phones = a turning point that allowed AR to reach the general public |
| 2010 | t – Mobile Internet becomes widespread; tablets are launched (1st iPad) |
| 2013 | g – Google Glass is launched<br>6 – The MIT Media Lab introduces the "Sixth Sense"<br>3 – The future of AR education: textbooks containing high 3D interaction AR contents |
| 2014 | G – Google markets AR glasses<br>j – Jeff Powers and his team develop the Structure Sensor, which allows for the recognition of real-world shapes in AR |

Source: Data collected for this study

concluded that AR-based content would have an important role in training and that increasing its use only required a reduction in display system sizes and a more flexible usability. Indeed, viewing/display systems were relatively large, inflexible, and uncomfortable 23 years ago. Research and development into this new perspective of the real world continued, mainly in military applications of NASA (*National Aeronautics and Space Administration*) for the training of pilots, astronauts, military, and in the medical field.

Many of the innovations and developments in *Artificial Reality* never came to be applied successfully until Zimmerman and Lanier introduced the "Dataglove," a more user-friendly way to interact with the virtual environment (Sturman and Zeltzer 1994), in which users could manipulate objects in the virtual world through a glove. At that time, in 1989, Jaron Lanier coined the term "virtual reality" and was the first to bring the technology to the public, selling "datagloves" as a way into the virtual world (Zhao 2009).

Finally, in 1990, the designation "augmented reality" is attributed to Tom Caudell, who created the term while working for Boeing to develop a head-mounted display system to help with wiring instructions for planes via the projection of plane schematics on boards at the factory (Vaughan-Nichols 2009). In 1994, this juxtaposition of virtual and real objects is explained by Milgram et al. as a continuum between real and virtual environments (see also Milgram 2006), as can be seen in Fig. 2.

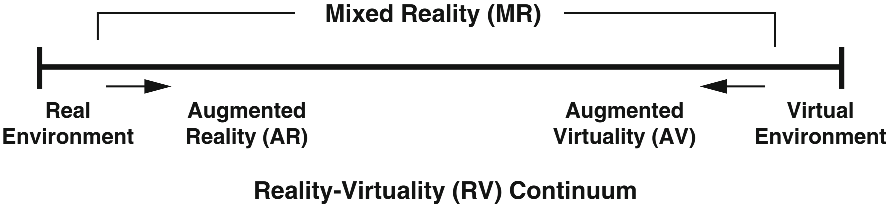


**Fig. 2** Virtuality-Reality continuum (Source: Milgram et al. 1994)

In 1997, Ronald Azuma wrote a report defining the scope of AR and listed three important criteria to define it, separating AR from "artificial and virtual realities." Azuma's three criteria to define AR are: it combines the real and the virtual, interactive in real-time, and registered in 3D. From this moment, the development of AR grew, and in 2002 the first AR outdoor game, called "Quake," was presented (Thomas et al. 2002). In 2005, the Horizon report describes AR as a key technology for the 5-year development of applications. In fact, the popularity and the development of smartphones have brought AR to users. At that time, two different forms of AR were identified and defined: one based on location and another based on markers or patterns. In the case of location-based AR, the use of the mobile's GPS determines the location, and thus a layer of information is added on top of what we are seeing with the camera (Billinghurst 2011; Carmigniani et al. 2011). Two examples of location-based AR applications are: the *Wikitude* application, released in 2008, and the *Layar* application, released in 2009. Both are available for mobile devices.

In the case of AR based on marks or patterns, the mobile device (mobile phone, tablet, or laptop camera) recognizes markers that give information or three-dimensional elements. The HITLab in New Zealand was the first to produce markers in AR printed in newspapers, serving, for example, as a means of advertising for Wellington Zoo. As soon as readers registered the marker on their mobile device, a 3D animal appeared on the page (Schmalstieg et al. 2011). Another example of technological advancement is the Google's glass, which was launched in 2012 for testing and released to the public in 2013, when they began to be marketed in the United States. Although the patent has been registered by Google, other applications have already been developed by other companies and are emerging and preparing to appear on the market.

The incorporation of virtual elements into the real world now gains a new dimension. One example is the integration of technologies such as AR and three-dimensional noncontact scanning, which enabled Jeff Powers and his team to develop a system which, in addition to allow viewing the real world through the "window" of a tablet, can scan the same real world so that the geometric boundaries of real-world elements are recognized in real time by overlapping AR virtual elements. An example of the integration of noncontact scanning technology with virtual content, namely, a sensor visual field scan identifying objects and their forms, can be found in http://structure.io, whereas an example of an application of the integration of noncontact scanning technology with virtual content can be seen on video on the Internet in http://youtu.be/39v5OoBJFDk. This new feature opens an even greater field of applications and ways of displaying contents. It represents the interaction between a set of balls that fall on a bench and its surroundings (Structure sensor 2014). In this case, the effect of gravity and of object borders is apparent. Many different applications are being developed with the expansion of ICT and accessibility to mobile devices. The potential application areas of AR cross all subjects. Several examples of these applications are presented below, especially those in education.

## 3 Augmented Reality in Education

Three-dimensional technologies are still at a very early stage of application in teaching and learning. Nonetheless, there are several fields of knowledge in which they have been recently implemented and studied by several authors (among others: Bujak et al. 2013; Fonseca et al. 2014; Kamarainen et al. 2013; Wojciechowski 2013; Wu et al. 2013; Di Serio et al. 2013; Martin-Gutierrez et al. 2012; Nee et al. 2012; Kaufmann and Schmalstieg 2003). However, in order to have a historical and broader perspective of the application of AR contents and technologies in education, training, and teaching, some studies and applications from the last 20 years are presented. The abovementioned case of Feiner and collaborators is resumed: as stated, in 1993, they implemented the application KARMA to speed up the training process in laser printer maintenance. In the late 1990s, Kancherla et al. (1995) described the application of virtual reality and AR technologies to the kinematic and dynamic analysis of body motion applied to anatomy seminars.

In 1997, Inkpen presented a study in which specific contents were developed to stimulate learning via a computer. These contents were not developed in AR. However, they were precursors in analyzing the effect of technology-based learning. In addition to the specific development of applications and software to stimulate learning, Inkpen (1997) examined the possibility of simultaneously working on computers with two mice. The results showed that motivation and learning were increased with group work in comparison with the individual use by each child. In 1993, Lu and collaborators presented a study at the opening session of the CIRP (*Collège International pour la Recherche en Productique*), a major worldwide engineering academy, in which he stressed the importance of AR in the development and manufacture of products.

In 2000, Weidenbach and his team developed a system with AR content for the medical field, in particular for training two-dimensional echocardiography analysis. One year later, Taxen and his collaborators developed virtual environments by immersing an AVATAR (graphical self-representation of the Internet user intended for virtual environments) to teach mathematics, in the context of learning content. Still in 2001, Billinghurst also developed mathematics content displayed in AR under the name "MagicBook." In 2003, still in mathematics, Kaufmann and collaborators described the implementation of the "Construct3D" system.

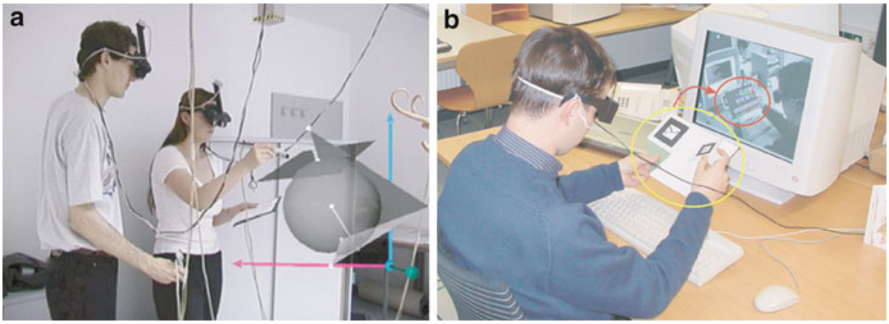


**Fig. 3** *Construct3D* System for collaborative learning (**a**) face-to-face and (**b**) remote (Source: Kaufmann and Schmalstieg 2003)

This allowed an evaluation of the importance and flexibility of AR even in collaborative environments, as well as underlining the importance of such environments in student-student and student-teacher interaction. This system consists of three-dimensional mathematical content supported by display equipment and collaborative work, either on-site or remote – see Fig. 3a and b, respectively.

In other areas, and still following a chronological evolution, Liarokapis et al. (2004) and Nee et al. (2012) studied the implementation of AR in manufacturing projects and processes in engineering. Moreover, Quirós et al. (2008) and Maier et al. (2009) developed chemistry-oriented applications, thus enhancing the visualization of atoms and molecules as well as that of chemical reactions. Martin-Gutierrez et al. (2012) studied the application of AR in teaching and in the spatial perception of mechanical engineering students. Later, in 2012, they studied the applicability of AR to electrical technical engineering, while Fonseca et al. (2014) examined its applicability to architecture. In the same year, Salinas et al. (2013) developed specific software for three-dimensional modeling of mathematical functions and conducted a study highlighting the important role of these technologies in group motivation and in reinforcing collaborative work.

Some interesting advantages of AR application were observed in the works that were analyzed. In the study of Martin-Gutierrez et al. (2012), the increase in students' self-learning ability was highlighted, giving teachers more time to focus on explaining more complex issues. The study of Fonseca et al. (2014) outlines the advantages of AR tools for increasing spatial perception, providing in situ views of hypothetical scenarios for future construction, thus allowing an exploration and analysis of several solutions.

In an earlier study on m-learning systems, Ismail et al. (2010) describe high user satisfaction with additional mobile learning tools. The users felt supported and motivated to use mobile applications with an accessible language. Indeed, systems usually used in m-learning, such as these mobile communication systems, can enhance field observations and explorations when including AR content, because observed reality can be explained with the (augmented) addition of virtual content (explanatory videos, schematics, and three-dimensional designs, among others).

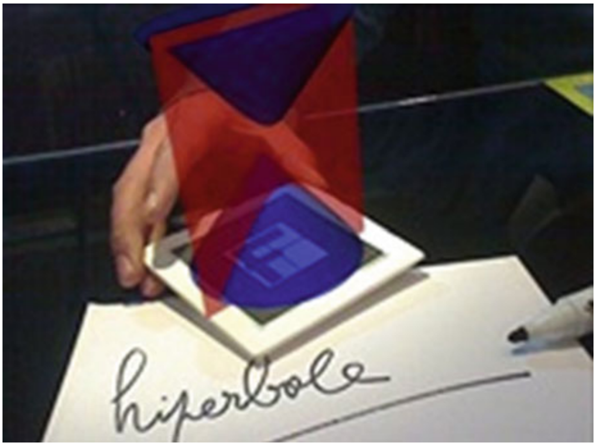


**Fig. 4** Three-dimensional representation of a hyperbola by intersection of a plane in a geometric solid (Source: Centre for Rapid and Sustainable Product Development (CDRSP)©)

This interaction contributes to greater autonomy in the learning process. It should be borne in mind that content made available and developed using AR technology can be accessed anywhere from *m-learning* support systems, such as mobile phones or tablets.

AR enables the development of conventional contents (e.g., books, lecture notes, presentations) but adds specifically programmed graphics which are recognized by an AR application and then activate additional explanations when displayed (such as three-dimensional, files explanatory videos and/or images). Figure 4 represents an example developed in AR to support the teaching of mathematics.

The contents of teaching and learning, in this particular case of mathematics, can be designed as usual based on an explanation on paper and complemented with a description of equations based on two-dimensional images. Content such as 3D files, videos, and explanations of intermediate steps can be added to these standard elements. This provides an integration between a traditional mode of visualization of content on paper and the use of a complementary AR technology.

As mentioned above, AR facilitates the integration between the real world and the virtual world, allowing the simulation and visualization of contexts and situations that could not be implemented otherwise. There are many areas of study and learning in which AR technology can be useful. Furthermore, AR technology brings a significant added value to areas that involve hands-on and experimental practice, such as science and engineering courses. In addition to the integration between the real world and virtual contents in the classroom, it is also possible to create contents combining several other environments. In addition to the most common environments (at home, at the office, in the living room), AR facilitates the development of contents in various contexts and environments for each individual. This enhances the interaction between in situ observation of the real world and the addition of theoretical and explanatory contents. The flexibility of AR tools allows for further experimentation and exploration of the real world by introducing real-time virtual explanations. One example is the project "EcoMobile," described by Kamarainen et al. (2013). This project assessed the implementation of AR to learning by using mobile devices in contexts in which students are exposed to real situations. In this case study, the influence of AR content was assessed during study visits, and it was concluded that students showed an increase in interpretation flexibility when exposed to real situations and obtained explanations about their actual, real-time observation. In this way, learning is focused on the individual and each one can have access to explanations and support in the form of differentiated AR content at the moment that learning takes place.

## 4 Future Directions

The chronological-historical mapping above shows that AR, as well as mobile learning, is a breeding ground for education. The mapping also shows that application of AR to educational situations has benefited from technological development, in particular mobile devices and m-learning. Therefore, it is believed that three-dimensional technologies, more specifically intangible technologies (such as AR), will continue to be included on the educational agenda. Finally, part of the joint work which is being developed in mathematics in higher education is presented. For example, this work aims at assessing content produced through three-dimensional, tangible (3D printing), and intangible (AR) technologies. This work is included in an ongoing project at the Portuguese Open University and at the Polytechnic Institute of Leiria, which will result, for example, in a PhD thesis in education, in the specialty of distance education and e-learning.

The broader, international, ongoing project, 3D4εDU – Three-Dimensional Interactive Contents in Higher Education, is a strong challenge and a strong commitment to create three-dimensional content that can be democratized and made accessible. Besides including intangible 3D content accessible through AR, the project also focuses on the democratization of low-cost 3D printing to provide blind students with a three-dimensional perception of even more abstract concepts like mathematical functions. This is an example of inclusion which could take place in other sectors of society. In general, contact with new technologies during the course of a student's training will allow them to learn to apply similar technologies to different sectors and moments in their future professional and personal life, in a lifelong learning rationale.

The 3D4εDU project intends to develop contents in other areas beyond mathematics, such as chemistry, life sciences, and optoelectronics. Furthermore, the ongoing work in mathematics in Portuguese higher education will be extended to other disciplinary and international situations, with the involvement of researchers and collaborators from Brazil, China, England, India, and Thailand. Involving different intervention areas and locations will boost the internationalization of teaching in Portugal in terms of defining, implementing, and assessing three-dimensional contents applied to learning.

The abovementioned innovative research work (three-dimensional technologies as a contribution to the learning of mathematics in higher education), which includes an experimental and analytical branch, has been further developed up to


**Fig. 5** (**a**, **b**) Implementation of 3D AR content in a mathematical analysis seminar of the ESTG-IPL (Source: Teresa Coimbra©)

the design-based research (DBR) current second iteration of the implementation of three-dimensional content. This means that in the first semester of the academic year 2014–2015, a system is being implemented to provide 3D AR content in the cloud (unlike tangible content, which can be provided in the classroom). This implementation was subject to previous validation, both remotely and on site, during an exploratory phase which took place in the second semester of the academic year 2013–2014. Professors of mathematical analysis (AM) of the Technology and Management School (ESTG) of the Polytechnic Institute of Leiria (IPL), Portugal, were involved in the creation of 3D AR content which has been used to supplement mathematics teaching, particularly in engineering courses. Figure 5 illustrate a validation moment in the classroom during the first DBR iteration. There were technical constraints that are expected to be solved, but which did not compromise the excellent reactivity of students who accessed and tested this 3D AR content.

In previous studies supporting the current one, projects were specifically developed to introduce new technologies and content at different levels of vocational education and training (primary education, secondary education, higher education, continuous training, and advanced training). The results were evaluated and their advantages and disadvantages carefully analyzed to define best practices for a proper implementation. Therefore, contents were developed in the *Metaio* application, which can be accessed through the *Junaio* application, available on several mobile devices. These contents have been created for an exploratory analysis of the visualization of medicine and biology elements (see Figs. 6 and 7).

These two case studies show that AR technologies can integrate both theoretical knowledge into real situations and real contexts into theoretical presentation forms. Bringing together and integrating both information formats can provide important leverage if contents are appropriately developed. In short, the integration and use of AR-based applications for content development, including formal access, is an asset which it is expected to be confirmed in mathematics, as stated above, at a time which is conducive to the democratization of, increasingly portable, more personal and more social technology.

**Fig. 6** Three-dimensional representation of a human heart (Source: CDRSP©)

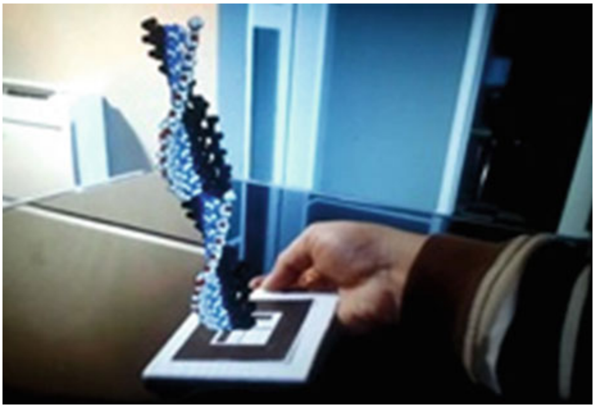

**Fig. 7** Three-dimensional representation of the DNA double helix (Source: CDRSP©)

**Acknowledgments** AMCUBED, LDA. LANSYS, LDA.

## 5 Cross-References

- ▶ Adoption of Mobile Technology in Higher Education: Introduction
- ▶ Advanced Image Retrieval Technology in Future Mobile Teaching and Learning
- ▶ Designing Mathematical Tasks Within Mobile Learning Environments
- ▶ Development of Mobile Application for Higher Education: Introduction
- ▶ Expectations from Future Technologies in Higher Education: Introduction
- ▶ Framework for Design of Mobile Learning Strategies
- ▶ Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom
- ▶ Mobile Learning and Education: Synthesis of Open Access Research

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# Expectations from Future Technologies and E-Learning in Higher Education in Albania

# 55

Irena Nikaj

## Contents




**Abstract**

Mobile devices and applications are changing the way people are studying and learning. Meanwhile, E-learning can reduce costs and improve quality and relevance of higher education. Standardization of curricula in higher education can improve quality for a lower price. A paradigm of learning together can lead to transdisciplinary challenges. Thus, E-learning and technologies can provide multiple opportunities to learners of the entire world and also to the Albanian learner. The study tries to express some of the developments and characteristics of digital changes into the Albanian higher education today and hopes for the better future for Albanian students in the framework of this perspective. This work is based on the survey of a group of students to faculties, economists, and educators, who responded to the questionnaires.



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> It must be obvious to any intelligent person from the plethora of serious problems facing the world today that our very survival in the twenty-first century will depend on a quantum leap in real understanding of science and technology by anyone in a position of any responsibility.
>
> *Professor Harold Kroto, Nobel prize-winning chemist*

## 1 Introduction

Higher education in Albania, as in all developed countries, is considered a public service and a public good, and therefore, one of its main goals is to maintain the basic principles of this education such as the principle of equal opportunities, the principle of free competition, and, above all, being a public service, to which all have access on the basis of merit.

The reforms of higher education systems are necessary in a world that is rapidly changing and require expansion of the access to education, the development of a knowledge and information society, internationalization of education, mobility, collaboration, competition, and interdependence. At the core of this change, it is always the need for teachers to produce, possess, and transmit knowledge.

Albania became a signatory to the Bologna Declaration during the Berlin Conference in 2003. The Bologna Declaration is considered for Albania and its national institutions an important instrument in implementing good practices in higher education at the national level. The Ministry of Education and Science (MES) of Albania, the responsible institution in this field, voluntarily commenced the implementation of the major instruments of the Bologna Declaration. Albania's main aim was to integrate the Albanian higher education system into the European system. For many of the Bologna Declaration signatory states such as Albania (2003), its main instruments have been earlier approached by the universities (based on the Ministerial Decree No. 164 dated 19.06.2001). This approach was more related to the European Credit Transfer System (ECTS). The implementation of the Bologna Declaration for Albania aimed for the following: the organization of university curricula of credits (ECTS), teaching workload, and standards of the quality assurance (QA) system (Education, Audio visual and Culture Executive Agency (EACEA P9 Eurydice) (2010)).

## 2 About Higher Education in Albania

Starting from 1990, higher education has gone through several significant stages with their positive and negative sides for its development.

Period 1990–1994 is characterized by the years of creation of universities, after the years of change, where the state dominated and the university autonomy was at a nonsignificant stage. The status "university" initially was enjoyed only by two universities, which were followed by the Polytechnic University after its separation from the University of Tirana. Also, there were existing in Tirana three academies (of Arts, of Sports, and Military), and there were still functioning Pedagogical Institutes in three regions (Shkodra, Elbasan, and Gjirokastra) which were forming teachers, while in Korca, the Higher Institute of Agriculture has been functioning for years. During this period, scientific research was partly accomplished by universities, or the Institutes of Academy of Sciences and the Institute subordinate to the Central Institutes located in Tirana and other districts.

In 1992–1993 with the decision of the Ministry of Education, higher education institutions (HEIs) outside Tirana became universities, respectively, the University of Elbasan, the University of Shkodra, the University of Gjirokastra, and the University of Korca. Hereinafter, in 1994, the Technological University in Vlora was created. Changing their status in universities was a political decision, without undergoing an evaluation and academic standards. This decision was the first step toward fading of the identity and tradition of these institutions and to the further expansion followed by their programming profiles. Since this moment, these HEIs developed all programs in different academic fields without any significant difference. This marks the first stage toward profile leaving, so necessary in the conditions of a market economy and a radical transformation of the structure of the economy in the country. 1994–1999 was characterized by further expansion of the system and especially the expansion of university profiles in one hand and regional universities on the other, losing so in a gradual manner their identity and their specific profile. At that time, the private system still did not put pressure on the public system gap which, in terms of both academic diversity and the student's admission, was met by the public system that was growing and expanding, but uncoordinated with the economic development and the demand for certain professions.

In 1998, the System of Higher Education subordinate to the Ministry of Education and Science consisted of eleven institutions of higher education (of which eight are universities): three in Tirana, five in other districts, and three high schools in Tirana (Academy of Arts, College of Nursing, and Institute of Physical Education).

The new law on higher education, in 1999, came as a necessity to allow and regulate the development of higher education system and all its constituent components, particularly in terms of the necessity to update it with new elements and mechanisms that were imposed (The law of Higher Education No.8461, 1999).

The years 1999–2007 marked the years of redesigning the system, the reaccommodation of institutions and curricula according to the Bologna system, and the opening of the first private institutions of higher education. In 2001, Albania signed the Lisbon Agreement for the recognition of the degrees and initiation of the system of the recognition of foreign diplomas within the country according to European standards and criteria provided in the framework of the Bologna Process. In the same year, the Ministry of Education and Science ordered implementation of ECTS (European Credit Transfer System) in all curricula of HEIs in Albania (National periodical reports 2004–2005, 2005–2007, 2007–2009).

During 2003, Albania officially adheres to the Bologna Process. This year marks the organized initiation of the review and adjustment of higher education curricula according to this system, the ECTS conception, and their implementation.

This was and is a difficult process, still incomplete, especially in terms of the harmonization of curricula, according to university cycles and profiles in the national and European level. During this period, starting from 2002, the first private institutions were licensed. Until 2005, there were only five private HEIs functioning in almost all specialized (New York, Marubi, Luarasi, Our Lady of Good Counsel, and the Faculty of Dentistry UFO).

It should be emphasized that in all these years, there was not a complete legal framework, all covering and with complete standards for the process of permitting the opening of private institutions, though the process was somehow responsible and cautious and consequently gradual. The institutions created during this time were run mainly by academic figures (The law of Higher Education" No. 9832, 2007). They were created in the framework of well-handled cautious agreements regarding quality and in professional and complementary fields covered with more difficulties by public institutions. It is important to note that these private HEIs were created as complementary to public HEIs. It's worth mentioning the fact that the process was well controlled by the MES, while the accreditation system was still in the early stages of creation and functioning. During this period (2005–2006), AAHE first undertook the first process of evaluation and analysis of existing programs and the institutions of higher education, although this process was not followed by a decision making or impact on the subsequent policies of higher education. In this period, the review, streamlining of the existing programs and the creation of new programs under the Bologna Process, and the opening of private institutions were done in a constructive cooperation between the MES and the accreditation agency, including the recognition of degrees with joint committees.

Until 2009 the system was expanded mainly under political willingness and in schemes, where MES had more competence in the opening of the system, while the pressure on the accreditation after the aperture moved over to the Agency and Accreditation Council. This made possible that while, until 2009–2010 had had a large number of institution creation (11), in 2010–2013, there was the facing with processing of the extension and expansion of the existing private HEIs and accreditation with and without standard criteria. Despite efforts often in isolation and left alone, under the pressure of the accreditation institutions to assess and ensure the quality, even through the commitment of foreign experts and members of the Accreditation Council, it was not able to hinder this avalanche. This led to the present situation where the quality suffered in favor of massive access in one side and abuse under habiliment of the application of this principle, on the other. The Ministry of Education and Sports, in this period, has had a passive role, toward the legal obligations stipulated in the law of higher education, as the institution responsible for the implementation of legal obligations in higher education and undertaking the necessary policies in order to ensure quality in higher education (National Strategy on Higher Education 2008–2013, 2014–2020).

From 1992 to 2013, gradually, there have been 59 higher education institutions (HEIs) functioning in Albania, of which 15 were public, while 44 of them were private institutions. In total, 1,560 study programs were offered by these institutions, of which 725 programs were offered by public HEIs and 835 programs by private

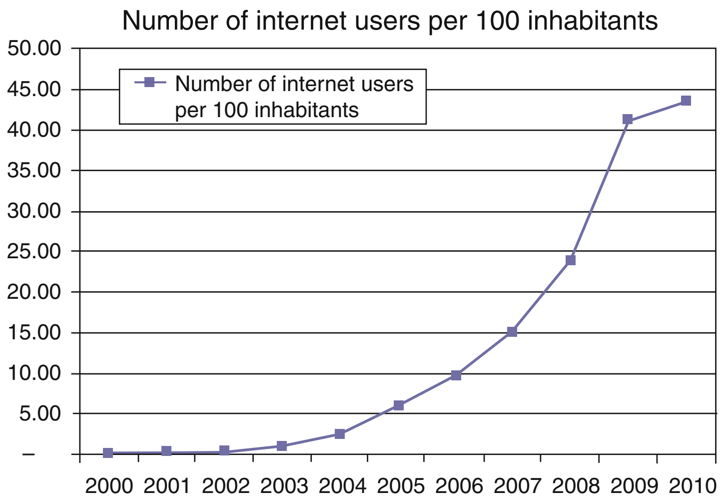



**Fig. 1** Change of number of Internet users per 100 inhabitants in Albania (2000–2010) (Public Source: Open Data Albania)

HEIs. Of these, only 13 were 2-year nonuniversity diplomas (nine from public HEIs and four from private HEIs). Of the 1,560 study programs, 582 of them were offered in the first cycle (of which 271 in public and 387 in private HEIs), 850 programs were offered in the second cycle (463 in public and 387 in private HEIs), and 128 programs in the third cycle (of which 101 in public and 27 in private HEIs; the latter were made possible in the last 3 years). In the second-cycle programs, one can notice that the "Research Master" programs dominate in number as compared to the "Professional Master" programs, in the public, as well as in the private sector.

Divided according to the areas of study, the programs related to economic studies have dominated the landscape (304 such programs), followed by the programs in Teaching and in Medical Sciences (172 each), Social Sciences (161), Law (141), Linguistics and Mathematics-Informatics (93 each), Engineering-Technology (97), Arts and Design (65), Agricultural Science (60), Natural Science (43), Architecture-Urban Planning (31), Geography-Geology (35), Human Sciences (40), Communication Sciences (30), and diverse others, where the 2-year programs (23) are also included (see KALKSH 2014).

The 2014–2015 academic year comes with many changes in higher education, and first of all, there will be some changes in the numbers of HEIs (whether public or private), as well as in their study programs and their way of functioning. There have already been notifications on these changes and what is expected to change at the macro level in the Albanian HEIs. The most tangible change is the closure of tens of HEIs (most of them private, rather than public), the accommodation of those students left without a possibility to study at their chosen universities by means of reselection of another alternative in the market and, if possible, through the government's intervention.

**Table 1** The use of mobile phone

| | | Female | | | Male | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | City | Country | Total | City | Country | Total | City | Country | Total |
| **1.** | **iPhone** | 4 | 3 | **7** | 2 | 2 | **4** | 6 | 5 | **11** |
| **2.** | **Mobile phone** | 13 | 18 | **31** | 7 | 8 | **15** | 20 | 26 | **46** |
| **3.** | **iPod** | – | – | **–** | – | – | **–** | – | – | **–** |
| **4.** | **Others** | 3 | 3 | **6** | 2 | 6 | **8** | 5 | 9 | **14** |
| | | 20 | 24 | **44** | 11 | 16 | **27** | 31 | 40 | **71** |

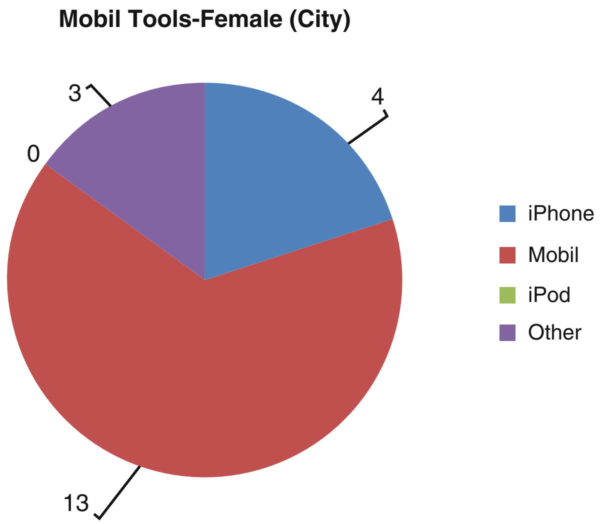



**Fig. 2** Mobile tools used by females in the city

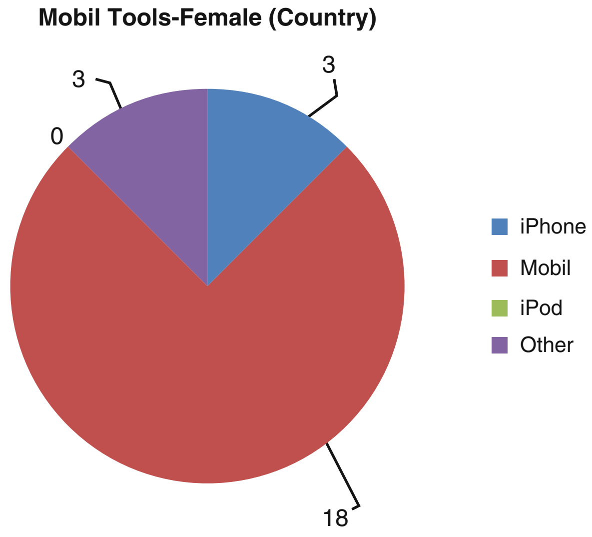



**Fig. 3** Mobile tools used by females in the country

## 3 University of Korca in Albania

Complying with requirements that pose the implementation of the Higher Education Law of the Republic of Albania, as well as the Bologna declaration, all branches of the "Fan S. Noli" University are restructured in this way. Moreover, Korca region is known for her strong educational traditions and needs for teachers of different branches. The Faculty of Education, since 1992, has been the main source of providing the schools of the whole region with teachers of different profiles.

**Fig. 4** Mobile tools used by females in total

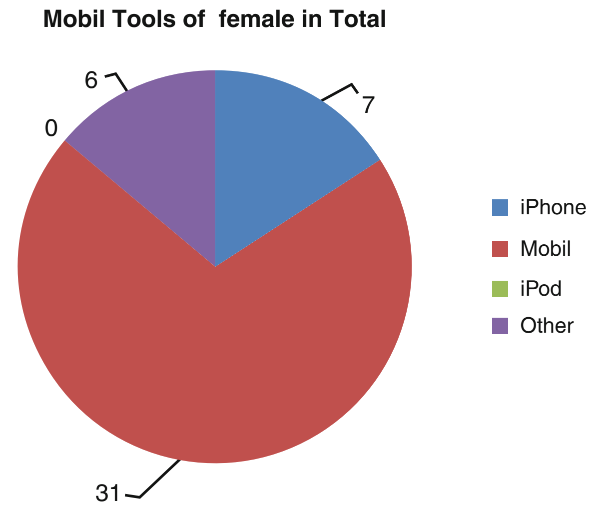
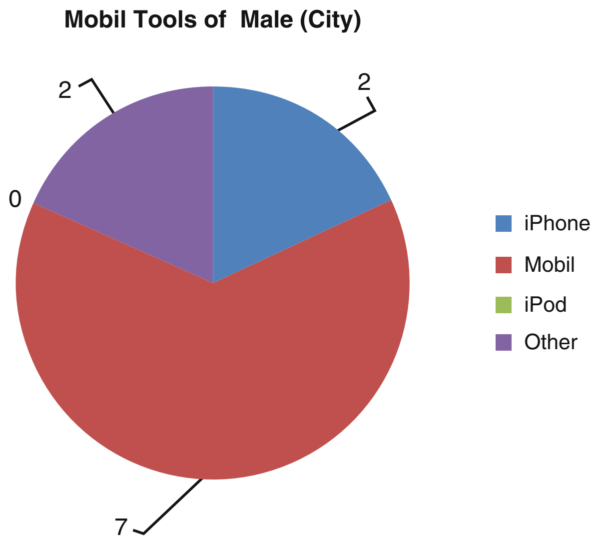



**Fig. 5** Mobile tools used by males in the city




The "Fan S. Noli" University was created on January 7, 1992, on the basis of High Agricultural Institute of Korca (1971–1992) and actually consists of four faculties: Agriculture, Education and Philology, Natural Sciences, and Humanities and Economics. In 1994 it was given the name "Fan S. Noli."

There are approximately 7,000 students that study at this University. There are 150 regular pedagogues who teach in this university, many of whom are with titles and degrees, as well as125 part-time pedagogues.

The studies, at F. S. Noli University, are organized at full time and part time in three cycles: the first, second, and third cycle, based on the Bologna declaration.

**Fig. 6** Mobile tools used by males in the country

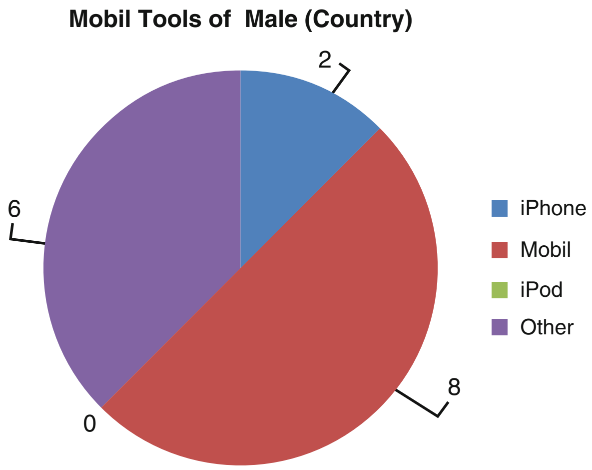
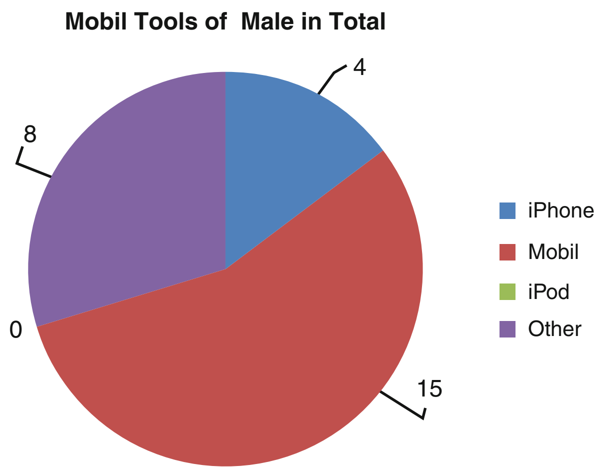



**Fig. 7** Mobile tools used by males in total




This university cooperates with many educational and scientific institutions within the country and abroad. Since 1996, it issues periodically its "Scientific Bulletin," which publishes studies of university professors and associates and reflects its scientific and pedagogical life.

At this university the central library functions and has about 30,000 different titles of books in Albanian and foreign languages, as well as faculty libraries.

## 4 How to Escape Education's Vicious Circle

That which routinely minimizes the effectiveness of education in general and of higher education, in particular, is the intensity of information reception, processing, and stratification, which causes the anxiety of time limitation to work it all out and,

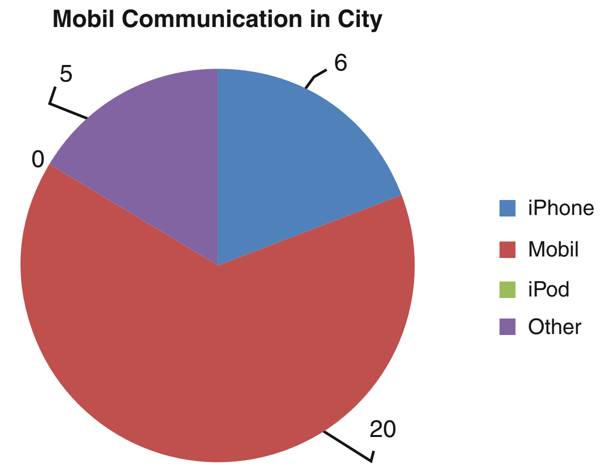



**Fig. 8** Mobile communication in total in the city

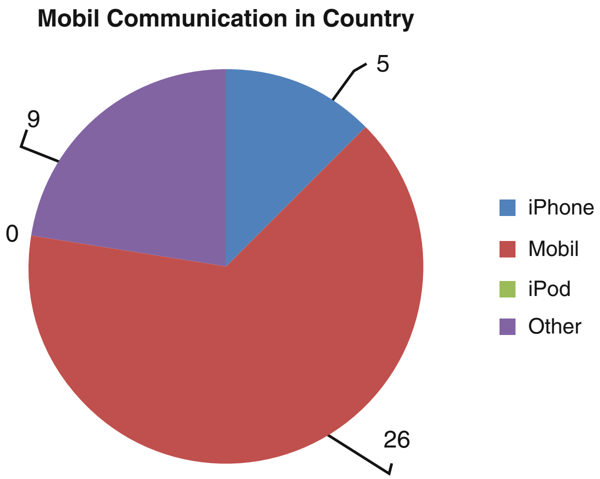



**Fig. 9** Mobile communication in total in the country

as a result, has raised a large group of students who are continually in contact with sources of information but who are unable to process it in an efficient way as knowledge, work (or usage) skills, ability, and competency.

In a democracy, the goal of education is to make students active and creative, to stimulate them to communicate, try new ways, and be as professionally prepared as possible as citizens and as a generation, in order to face tomorrow's challenges successfully (Robinson, K. in www.ed.ted.com).

Based on Einstein's dictum that the school's outcome appears when what has been learned at school is forgotten, the study may try to reflect on the changes that must be faced in the long term in order to change the finalities of education, particularly of higher education.

**The first issue** that the current Albanian society faces is the relatively high and constant number of the unemployed, which is the result of, firstly, the social and

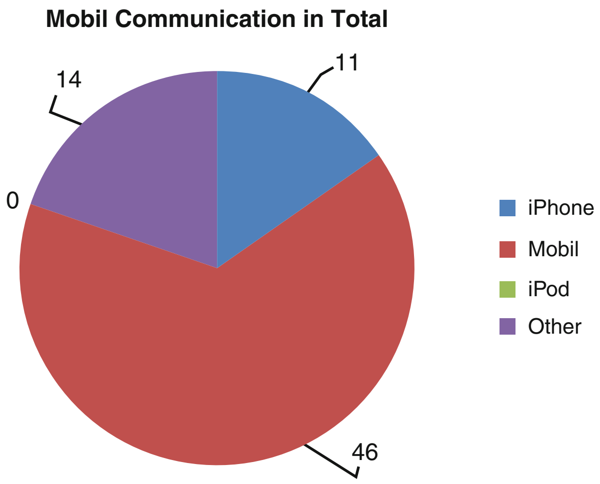



**Fig. 10** Mobile communication in total (city and country)

cultural capital's lack of adjustment to the market's requirements. This issue is extremely complex; most of them lack trained flexibility, since education has not been able to create such cultivation in them. This reflects the incompatibility between the general, the particular, and the local, the impossibility of not yet creating a symbiosis between general formation within a wide basis and the specializations. This has caused the impossibility of the social capital to react reflexively toward what the market requires at a given moment.

**The second issue** relates to the economy's demand for professionals in a relative number that changes for the very special and specific fields, which requires a reorientation of the study curricula with the same flexibility as the students. Nonetheless, the private and the public universities, which are clearly distinguished from one another in Albania, represent (as a heritage and reality) institutions that are relatively independent and conservative, which endeavor to survive by trying to attract a maximum number of students and do not devote much attention to quality; that is why, there are more information and fewer research projects, creative activities, and social trainings for group work, while, from a methodological viewpoint, it is tended toward personalized learning (Zhang 2012). For this reason, the Albanian higher institutions must, of necessity, lean toward a transformation that will be both essential and strategic for the future of the younger generations; they must be widely involved with all their social and cultural capital to be more prepared for the global and national endeavor in order to specify how the "knowledge society" will function at the microsocial and capillary level, so that the Albanian society may overcome this state of anxiety related to its education and goals, which it is often called "crisis of education," a crisis within education, a crisis related to the regulation of the supply-and-demand aspect of the market with education, a crisis at the macrosocial level, a socio-moral crisis, and so on.

**Table 2** The application use for study purposes

| | | Female | | | Male | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | City | Country | Total | City | Country | Total | City | Country | Total |
| **1.** | **Google** | 14 | 23 | **37** | 9 | 14 | **23** | 23 | 37 | **60** |
| **2.** | **Wikipedia** | 10 | 8 | **18** | 8 | 3 | **11** | 18 | 11 | **29** |
| **3.** | **YouTube** | 8 | 11 | **19** | 5 | 4 | **9** | 13 | 15 | **28** |
| **4.** | **E-learning site from university** | 4 | 6 | **10** | 6 | 7 | **13** | 10 | 13 | **23** |
| **5.** | **iTunes U or Google Play** | 1 | 2 | **3** | 1 | 1 | **2** | 2 | 3 | **5** |
| **6.** | **Online news** | 3 | – | **3** | 1 | 3 | **4** | 4 | 3 | **7** |
| **7.** | **Tutors in pockets** | – | 3 | **3** | – | – | – | – | 3 | **3** |
| | | 40 | 53 | **93** | 30 | 32 | **62** | 70 | 85 | **155** |

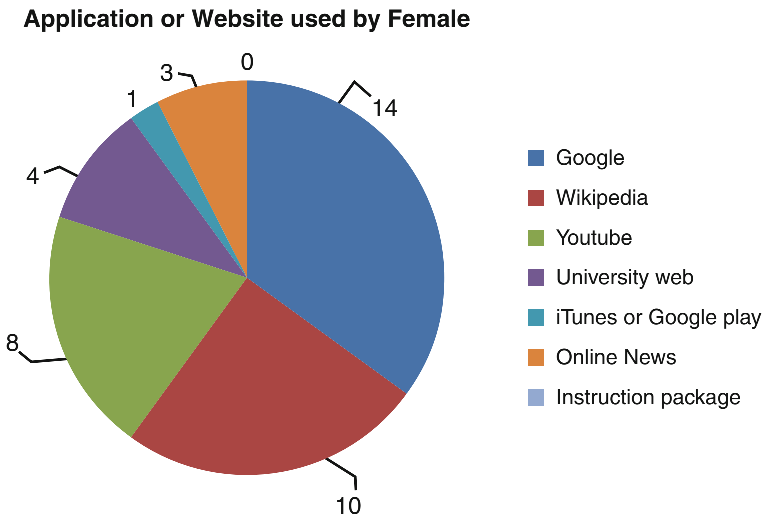



**Fig. 11** Application or Web site used by females

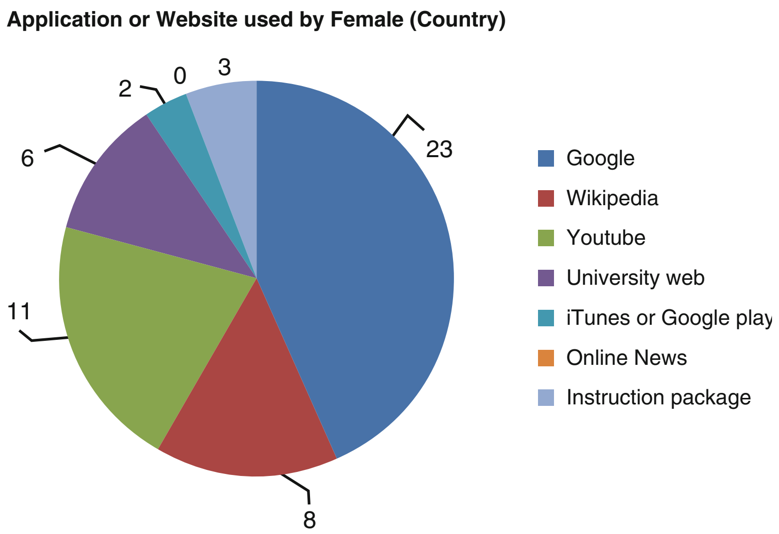



**Fig. 12** Application or Web site used by females in the country

## 5 Use of Technology: Developments and Innovations

The developments in the last 20 years, partly in the former century and partly in this present century, the twenty-first, have, first of all, changed the meaning of knowledge and its role in bringing to the fore the students' skills. In a knowledge society,

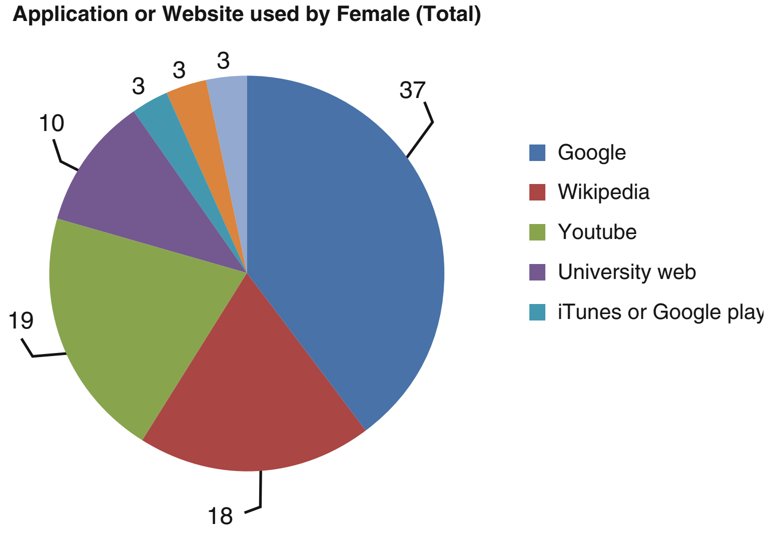



**Fig. 13** Application or Web site used by females in total

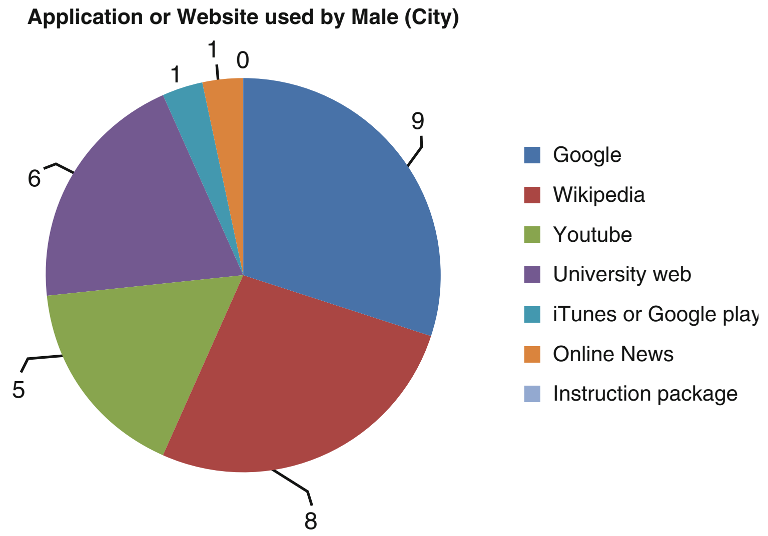



**Fig. 14** Application or Web site used by males in the city

knowledge has exhibited the nature of a system of networks, a mental energy that enables the realization of objects or events. For this reason, it does not represent a condition but a chain of conditions that are made possible by the integration of intelligences or by the interaction of competent people who integrate their competencies in order to achieve goals or conditions. This has caused the boundaries

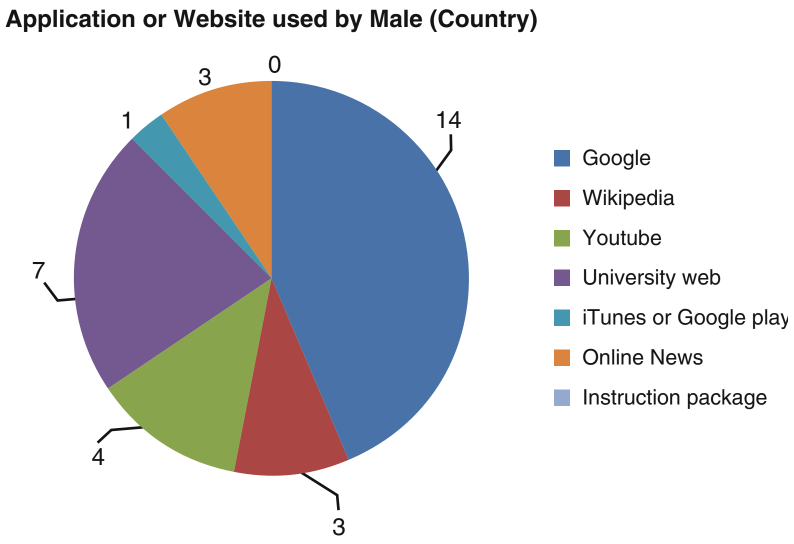



**Fig. 15** Application or Web site used by males in the country

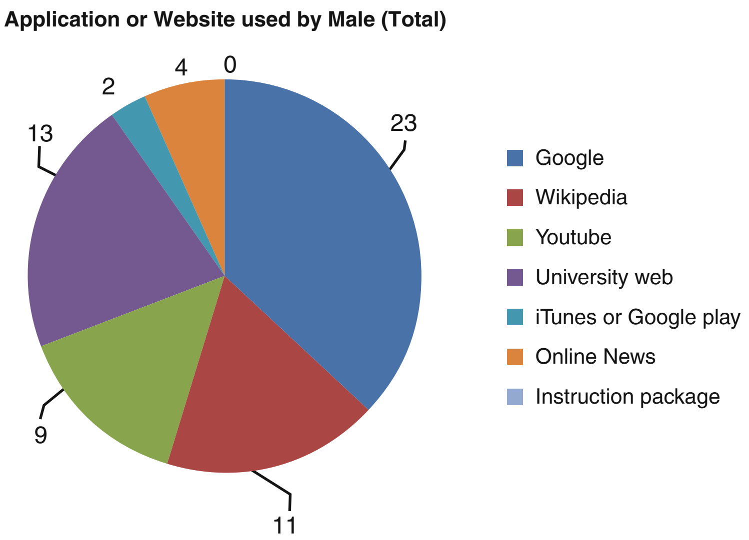



**Fig. 16** Application or Web site used by males in total

between the diverse fields of knowledge to become increasingly more virtual and in the created complementary spaces there is no more room for the traditional static standards, but there is increasingly more need for knowledge in motion, in innumerable implementations and applications.

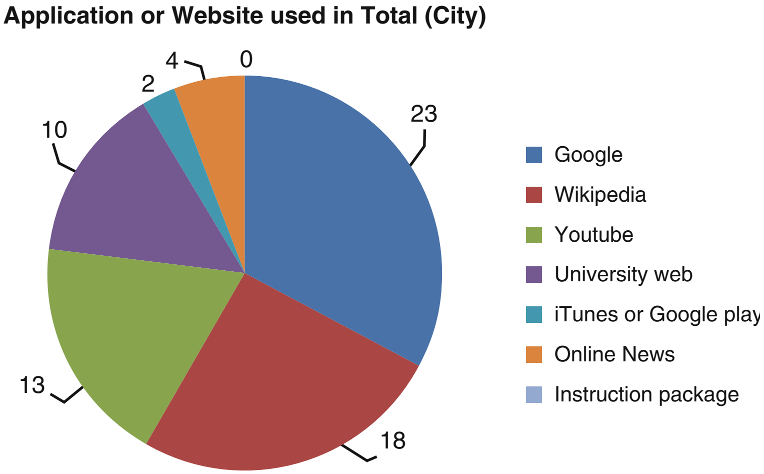



**Fig. 17** Application or Web site used in the city in total

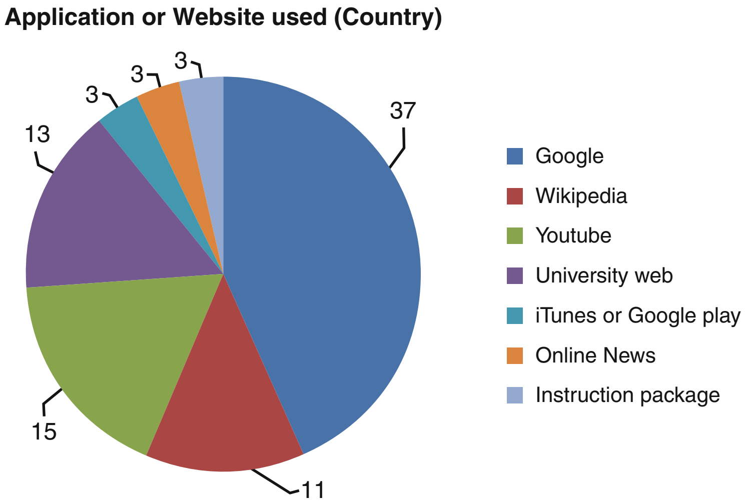



**Fig. 18** Application or Web site used in the country in total

Digitalization has increased the temporality of historical truths and the further relativism of knowledge; it has rendered today's knowledge insufficient and has rendered tomorrow's knowledge indispensable. In this manner, knowledge appears as a process, as energy, as coordination, without frozen boundaries of scientific disciplines; it meets social needs and is replaced very speedily. As a result, the learning process emerges as a generation of knowledge, not as a placement of

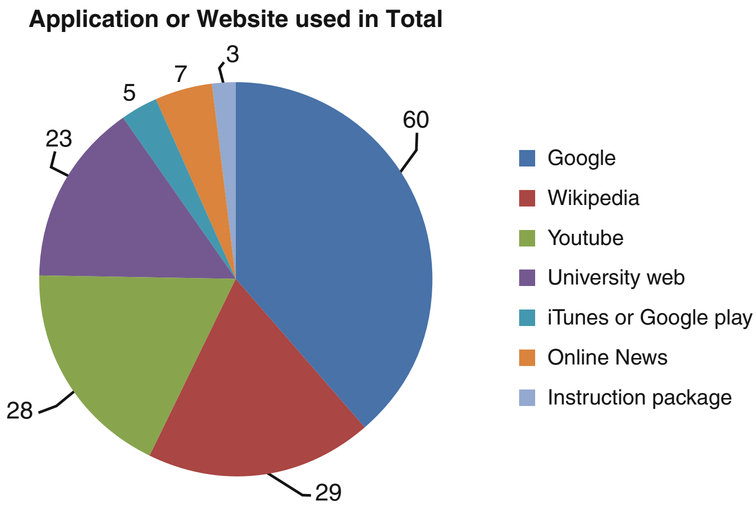



**Fig. 19** Application or Web site used in total (females and males, country and city)

information and new discoveries in the shelves of our minds, as a process of a deeply coordinated nature, in real conditions, when the individual or social needs appear, according to the individuals and the circumstances where they find themselves.

The present changes have widened our understanding of intelligence, within a definition that leaves room for adjustment: in other words, at present, intelligence is the totality of mental expressions that may be learned and cultivated (Oblinger and Oblinger 2005).

This changing condition has prioritized the need for a more qualitative use of technology in the learning process, because the use of technology and networks is more of an entertaining and verifying nature than an active part of learning in the framework of the developments, dimensions, and needs of the society and education in our time (Sharples 2000).

In Fig. 1, the study has identified a variation of the data in time that shows a change in the number of Internet users in Albania.

In the case of ICT and of the learning associated with it, the numeric indicators demonstrate the flexibility of the demographic structures in the framework of societies with high and explosive rhythms of developments.

From the data published in 2014, it can be seen that Albania is at the 101st place among countries in terms of number of Internet users, the spread in relation to its population, and its increase (World Data 2014). The position that Albania occupies relatively shows that the pace of the Internet, the spread, and the increasing number of the users are low and do not reflect the real needs that the Albanian society and the economy actually have in order to renovate technology and changing rates of growth and the necessary change in social welfare and sustainable development.

**Table 3** The mobile use for different purposes

| | | Female | | | Male | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | City | Country | Total | City | Country | Total | City | Country | Total |
| **1.** | **In lectures** | 11 | 18 | **29** | 9 | 11 | **20** | 20 | 29 | **49** |
| **2.** | **Meeting friends** | 12 | 10 | **22** | 9 | 7 | **16** | 21 | 17 | **38** |
| **3.** | **Waiting** | 3 | 2 | **5** | 2 | – | **2** | 5 | 2 | **7** |
| **4.** | **Walking or on transportation** | 3 | 6 | **9** | 2 | 3 | **5** | 5 | 9 | **14** |
| **5.** | **Having food** | 5 | 1 | **6** | 6 | 3 | **9** | 11 | 4 | **15** |
| **6.** | **Working** | 4 | 6 | **10** | 3 | 3 | **6** | 7 | 9 | **16** |
| | | 38 | 43 | **81** | 31 | 27 | **58** | 69 | 71 | **140** |

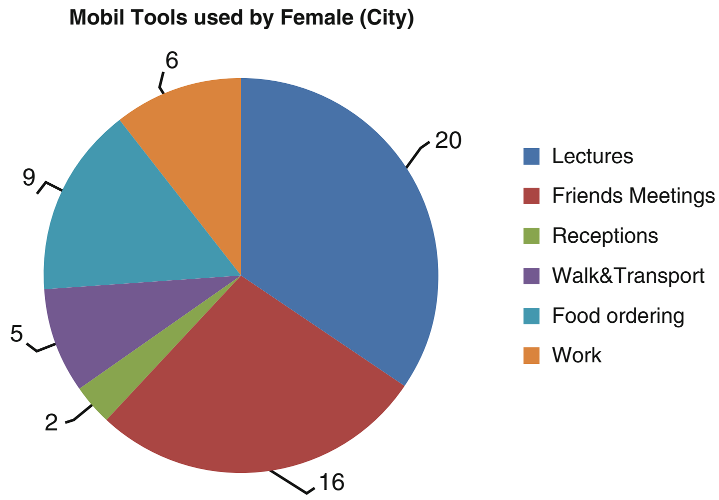



**Fig. 20** Mobile tools used by females in the city

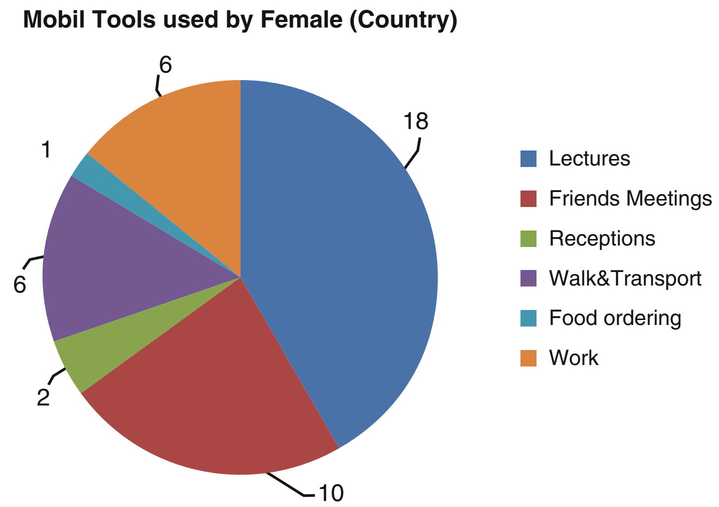



**Fig. 21** Mobile tools used by females in the country

## 6 Technology and E-Learning: Data and Perspectives

In the framework of this study, there are interviewed students from the Faculty of Economics and Education and Philology, in order to collect data on the place that occupies the use of technology and mobile learning in their everyday work. It was defined for two profiles, one dynamic-oriented study and the other longer study, but

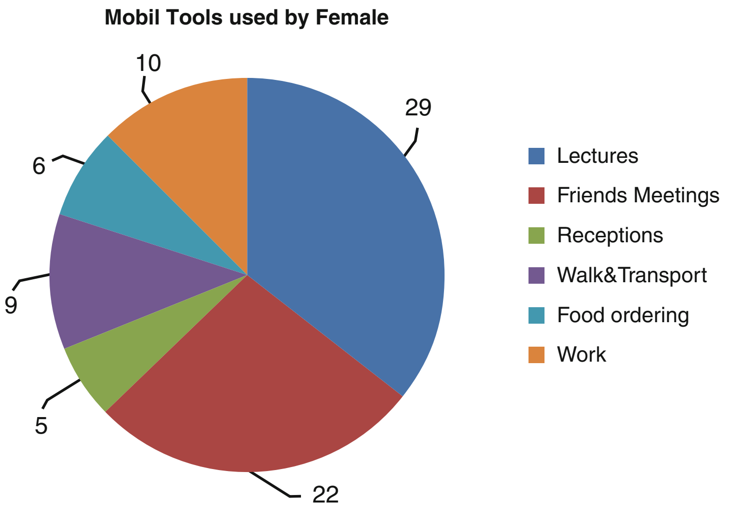



**Fig. 22** Mobile tools used by females in total

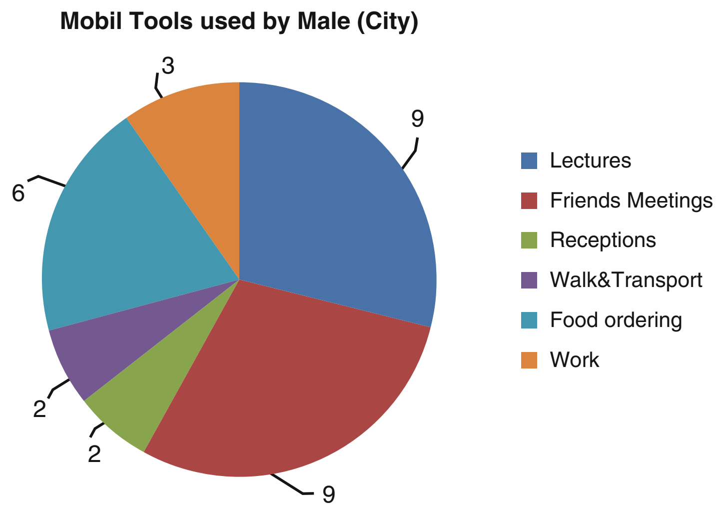



**Fig. 23** Mobile tools used by males in the city

less dynamic. The number of valid interviews was 44 females and 27 males, divided according to their origin and residence.

In the survey, the following questions are presented:

| | | |
|---|---|---|
| *Student* | 1. Full time | 2. Part time |
| | 1. City | 2. Country |

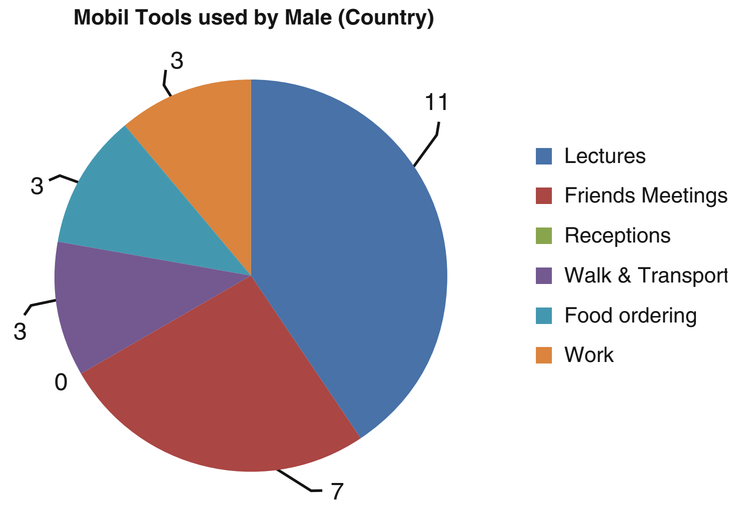



**Fig. 24** Mobile tools used by males in the country

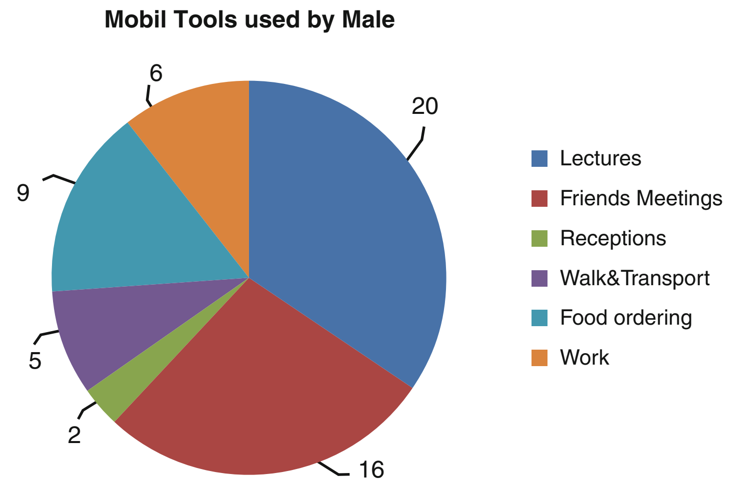



**Fig. 25** Mobile tools used by males in total (country and city)

1. **What mobile phone are you using?**
   1. iPhone
   2. Mobile device
   3. iPod
   4. Others
2. **Which application or websites do you usually use for studying?**
   1. Google
   2. Wikipedia

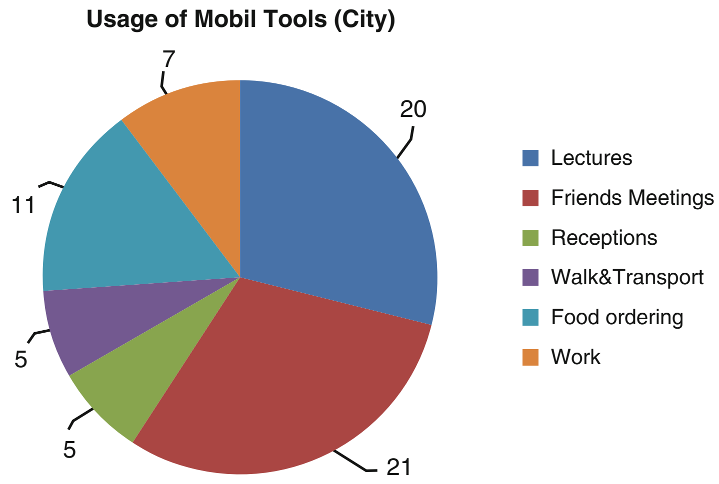



**Fig. 26** The use of mobile tools in the city in total

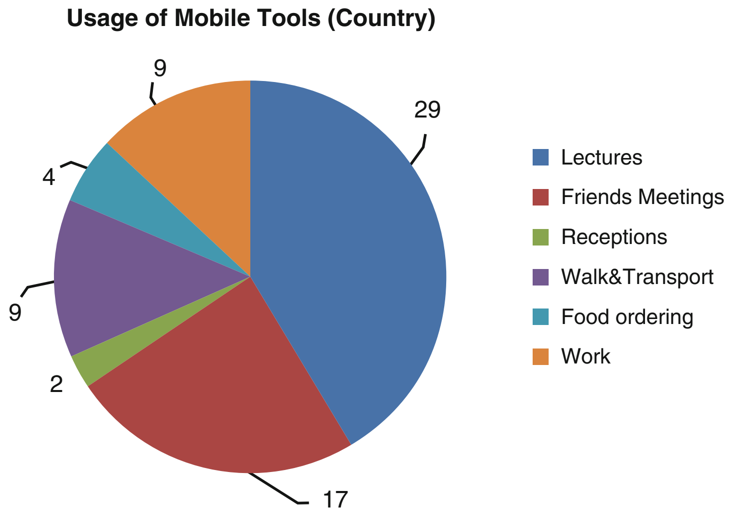



**Fig. 27** The use of mobile tools in the country in total

3. YouTube
4. Learning Internet Web pages of universities
5. Applications on iTunes U or Google Play
6. Online news
7. Instuctions package
8. Others

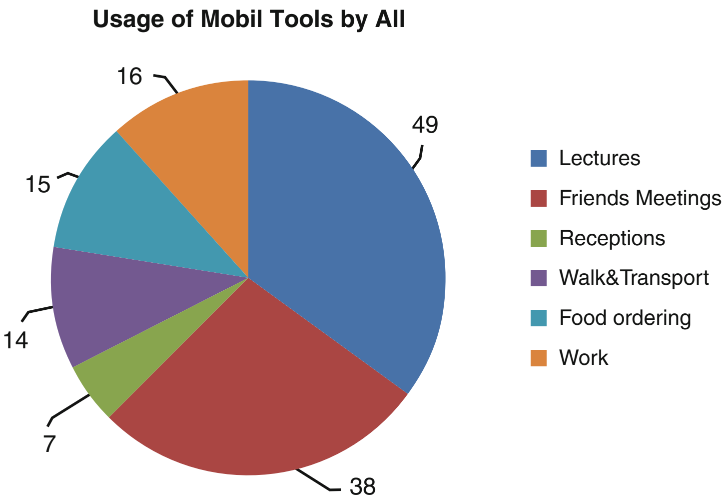



**Fig. 28** Mobile tools used by all (country and city, females and males)

3. **When do you usually use your mobile devices?**
    1. Lectures and assignments
    2. Meeting friends
    3. Reception
    4. Walking or on transportation
    5. Ordering food
    6. At work
4. **How long are you using your mobile phone to study per day?**
    1. 2 h minimum
    2. 6 h maximum
    3. 4 h on the average
5. **What do you think about positive influences of mobile learning?**
    1. Enhances the learning efficiency.
    2. Can study anywhere and at any time.
    3. Can use any time interval for studying.
    4. Increases the opportunity to request and learn during learning hours.
    5. Increases my interest for learning.
    6. Gives the possibility to be involved in discussions with students and pedagogues.
    7. Increases the quality of my presentation, preparation, and disciplines in education subjects.
    8. There is no existing role onto me.
    9. Others.

**Table 4** Daily usage of mobil phone for study purposes

| | | Female | | | Male | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | City | Country | Total | City | Country | Total | City | Country | Total |
| **1.** | **Min 2 h** | 10 | 12 | **22** | 8 | 13 | **21** | 18 | 25 | **43** |
| **2.** | **Max 6 h** | 1 | 1 | **2** | – | – | – | 1 | 1 | **2** |
| **3.** | **Medium 4 h** | 7 | 11 | **18** | 3 | 3 | **6** | 10 | 14 | **24** |
| | | 18 | 24 | **42** | 11 | 16 | **27** | 29 | 40 | **69** |

**Fig. 29** Mobile tools used for learning by females in city

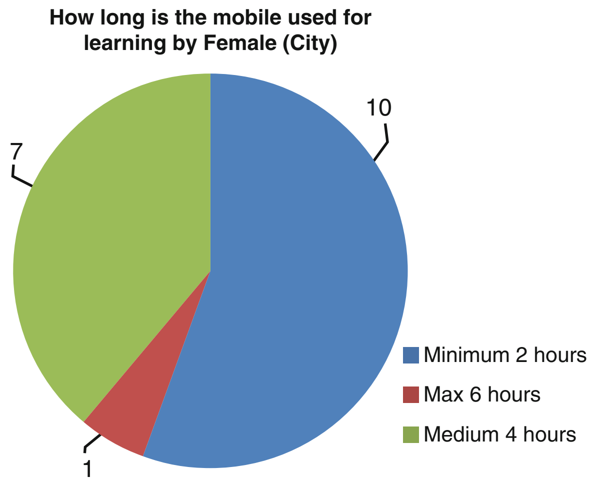
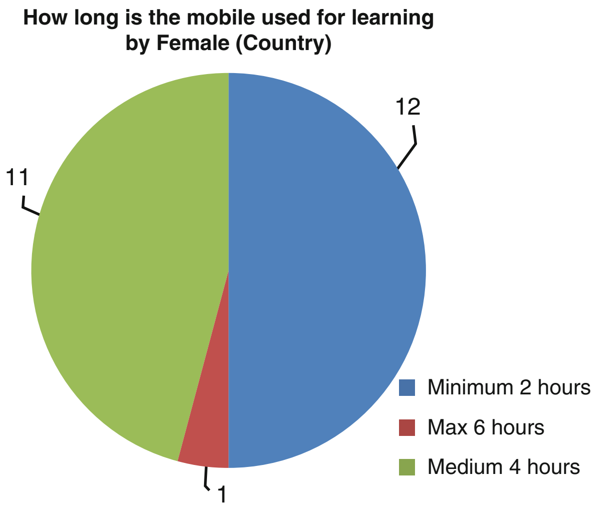



**Fig. 30** Mobile tools used for learning by females in the country




They are the data of using technology by the Albanian students in the University of Korca, part of the Economics and Education and Philology Faculties.

1. **What mobile phone are you using?** (Table 1, Figs. 2, 3, 4, 5, 6, and 7)
   By the evaluation of the responses appears the phenomenon of the usage of the most developed telephony by girls than by boys, more in the city than in the countryside, reinforcing so a thesis of the Albanian social studies which displayed that the girls constitute a stable number of students compared to boys, forming a larger number in many programs of study in the institutions of higher education in Albania (Dervishi and Fuga 2002) (Figs. 8, 9, and 10).

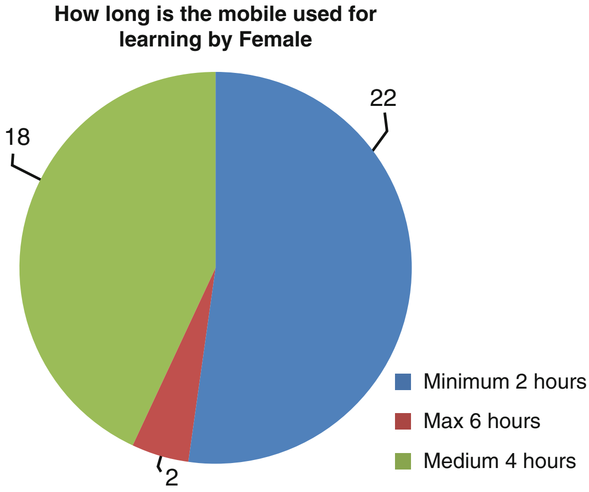



**Fig. 31** Mobile tools used for learning by females in total

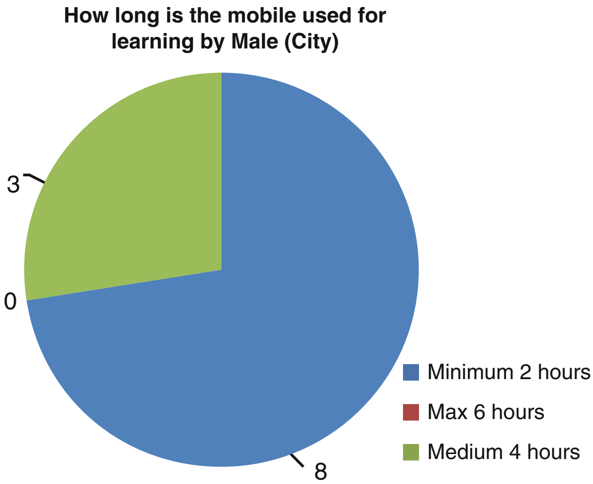



**Fig. 32** Mobile tools used for learning by males in the city

2. **Which application or Web sites usually are used for studying?** (Table 2, Figs. 11, 12, 13, 14, 15, 16, 17, 18, and 19)
   Through the assessment of responses, it may be noted that the use of the networks or applications by the girls is greater than by the boys, while boys appear more able to use applications for special purposes.
3. **When are the mobile devices usually used?** (Table 3, Figs. 20, 21, 22, 23, 24, 25, 26, 27, and 28)
   The use of mobiles is more efficient in successful communication and studies, and this is also accepted by both boys and girls, urban and rural; furthermore it appears as even having a greater impact on education, training, and research. The establishment of a balance for study use, as well as in everyday life, this study would

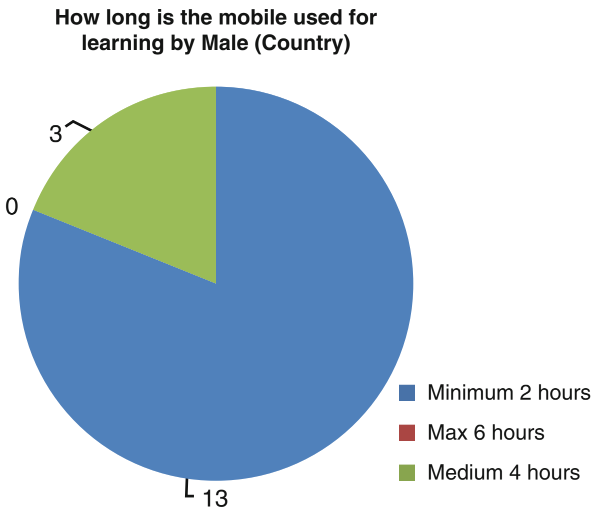



**Fig. 33** Mobile tools used for learning by males in the country

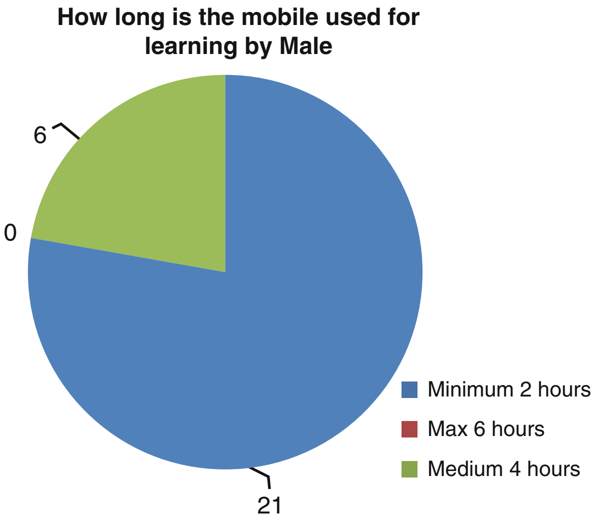



**Fig. 34** Mobile tools used for learning by males in total

ensure that development of the Albanian society has not yet had, from cultural point of view, the organization of society and daily activities on the basis of efficient use of technologies and communication forms, related to it.

4. **How long are the mobile phones being used to study per day?** (Table 4, Figs. 29, 30, 31, 32, 33, 34, 35, 36, and 37)
At the time of use, there is a difference in the interval of their use; the majority have a modest level of use; this means that even the use of technology follows the general trend of differentiation in student achievement and the fact that few of them show a consistent level of the mobile devices used for studying in a more qualitative way.

**Fig. 35** Mobile tools used for learning in the city in total

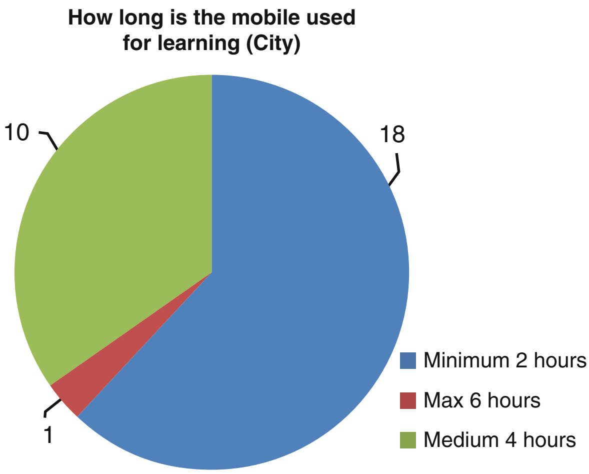
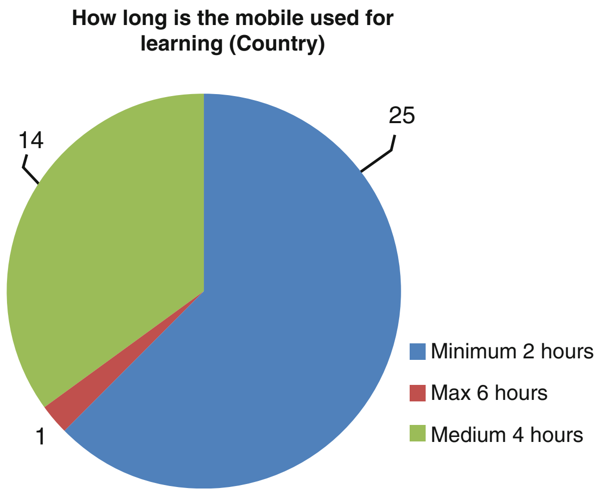



**Fig. 36** Mobile tools used for learning in the country in total




5. **What are the thoughts about positive influences of mobile learning?** (Table 5, Figs. 38, 39, 40, 41, 42, 43, 44, 45, and 46)
   Through the assessment of responses, it can be said that objectively and subjectively, real and perceived, the use of technology and mobile learning has had a positive impact on improving the performance of the students, and what deserves further attention is the harmonization of inquisitiveness and curiosity, and willingness of students with the work of the teachers and lecturers, in order to make effective the sustainable development of Albanian society, realizing a qualitative leap in knowledge and the increasingly intensive usage of the methods that see interactivity and technology as primary.

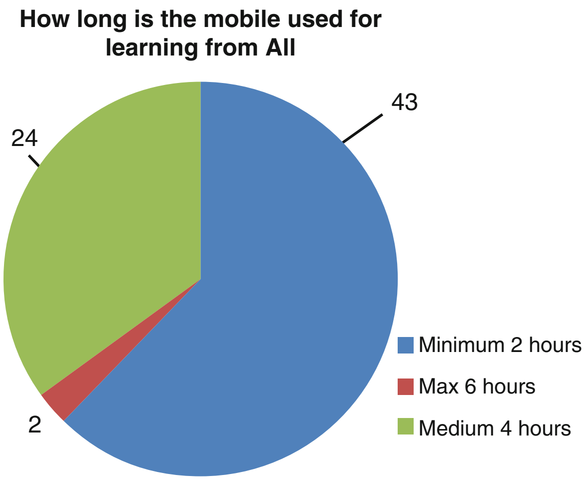



**Fig. 37** Mobile tools used for learning in total (country and city, females and males)

## 7 Future Directions

Cultural, economic, and political changes in Albania in the twenty-first century are likely to provide a solid future to new generations of students, also European integration of higher education, and new strategies of development of skills, competencies, and ideas of our students.

This process will continue with the accreditation of HEIs by foreign agencies, which are expected to give competent evaluations regarding the quality of higher education in Albania.

The Bologna Process aimed, also, to institutionalize the new European appearance of education and allowed to share some new concepts, such as:

- Qualification of higher education, which means that any title, diploma, or certificate issued by a competent authority that certifies the successful completion of a program of higher education is equally important for both employment and continuation of studies.
- Learning achievements are distinguished by learning goals, which pertain to a student's achievements and not overall in the intentions of teachers. Accompanied by transparent evaluation criteria, they determine the requirements (the minimal for rewarding students with credits).
- Competences, so, dynamic combinations of attributes (related to knowledge and their implementation in practice, with the attitudes and responsibilities) that describe learning outcomes, i.e., what are able to do the students on completion of studies.

**Table 5** Mobile influences on study

| | | Female | | | Male | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | City | Country | Total | City | Country | Total | City | Country | Total |
| **1.** | **Increased learning efficiency** | 4 | 2 | **6** | 2 | 1 | **3** | 6 | 3 | **9** |
| **2.** | **Helped to study anytime/anywhere** | 9 | 20 | **29** | 7 | 10 | **17** | 16 | 30 | **46** |
| **3.** | **Helped many times to study** | 4 | 4 | **8** | 5 | 3 | **8** | 9 | 7 | **16** |
| **4.** | **Increased the research possibility during lessons** | 7 | 1 | **8** | 5 | 8 | **13** | 12 | 9 | **21** |
| **5.** | **Increased the interest in the subjects** | 5 | 8 | **13** | 5 | 3 | **8** | 10 | 11 | **21** |
| **6.** | **Engagement in discussion with others** | 2 | 2 | **4** | 1 | – | **1** | 3 | 2 | **5** |
| **7.** | **Increased the performance in classes** | – | 3 | **3** | 5 | – | **5** | 5 | 3 | **8** |
| **8.** | **Not made a difference** | 3 | 1 | **4** | 3 | 1 | **4** | 6 | 2 | **8** |
| **9.** | **Others** | – | 1 | **1** | – | – | **–** | – | 1 | **1** |
| | | 34 | 42 | **76** | 33 | 26 | **59** | 67 | 68 | **135** |

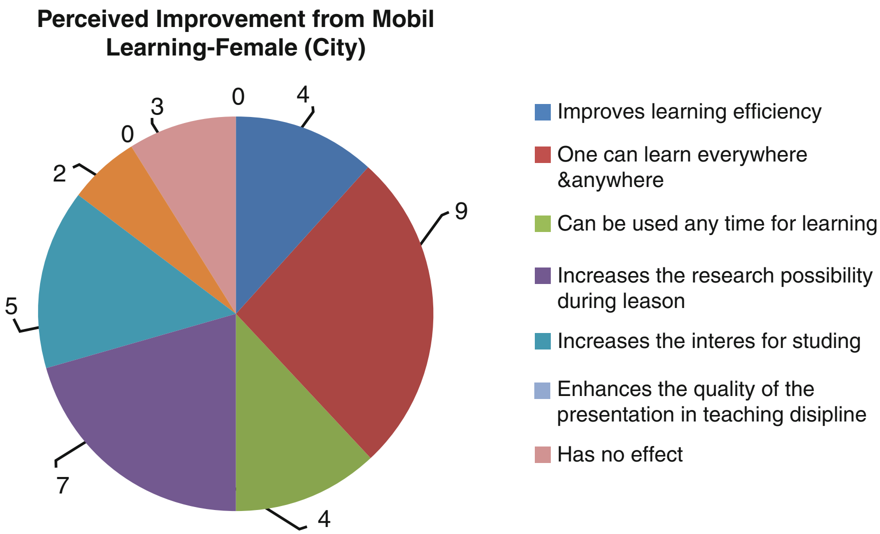



**Fig. 38** The perceived improvement by females in the city

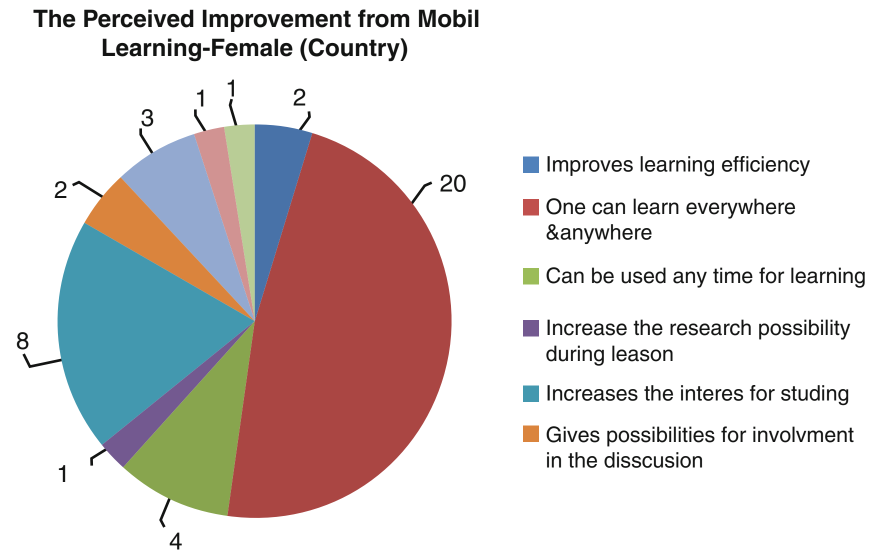



**Fig. 39** The perceived improvement by females in the country

This process from the epistemological viewpoint displays a leap from basic skills to the principal capability and competencies that refer to a combination of skills, knowledge, attitudes, and behaviors, as well as involvement of the provision for learning, considered to be the three life's basic ingredients, respectively:

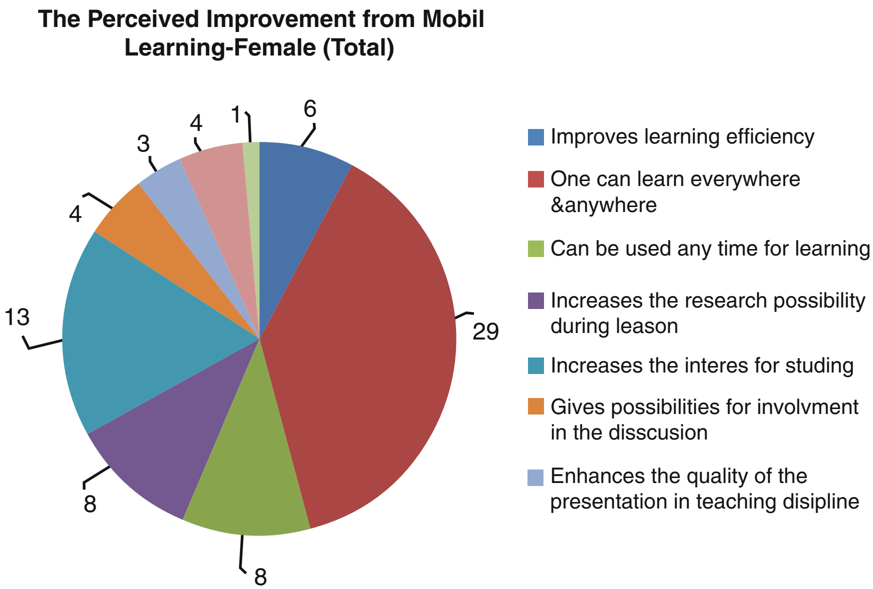



**Fig. 40** The perceived improvement by females in total

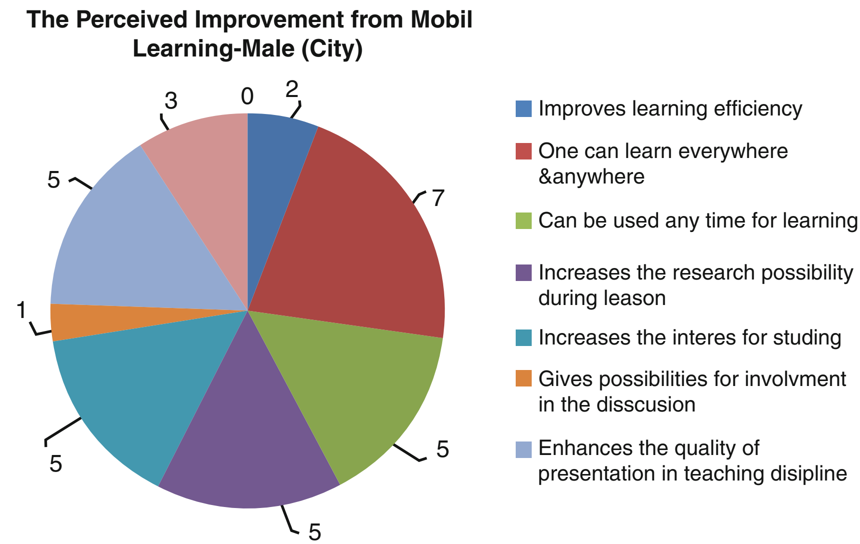



**Fig. 41** The perceived improvement by males in city

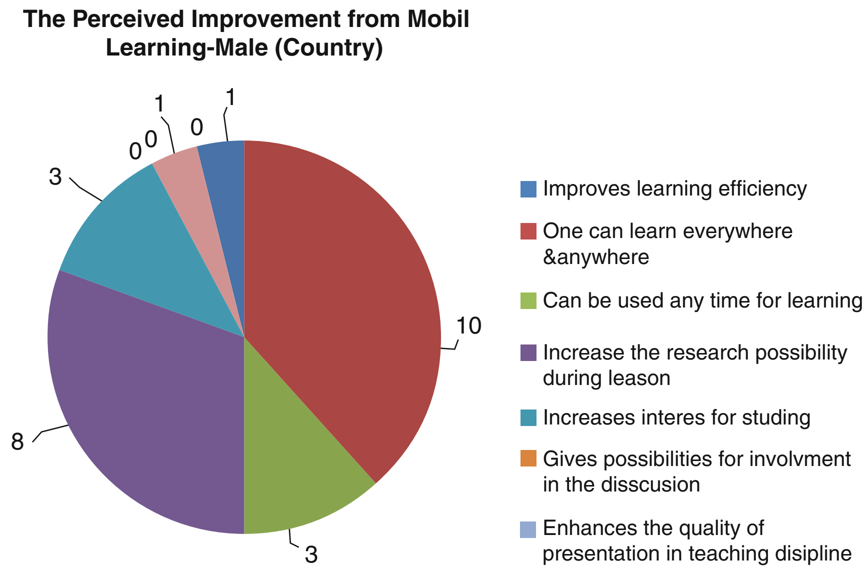



**Fig. 42** The perceived improvement by males in the country

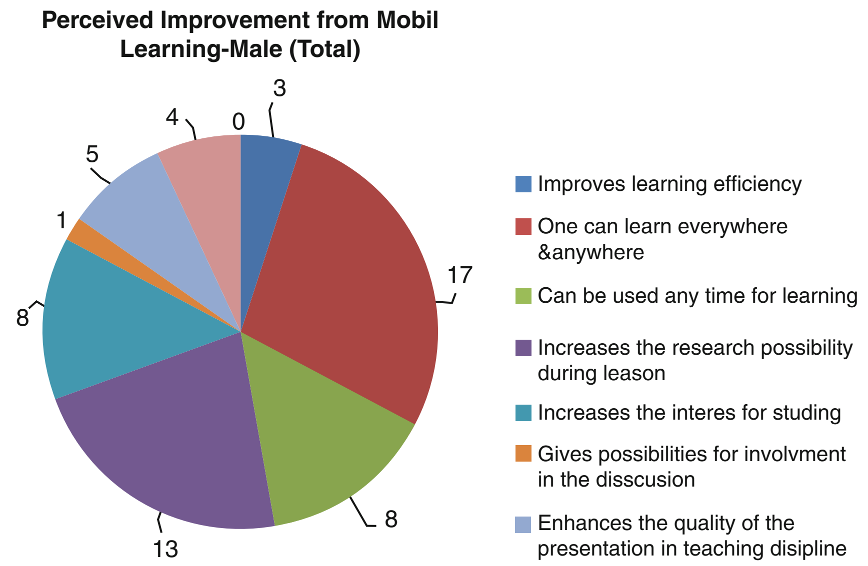



**Fig. 43** The perceived improvement by males in total

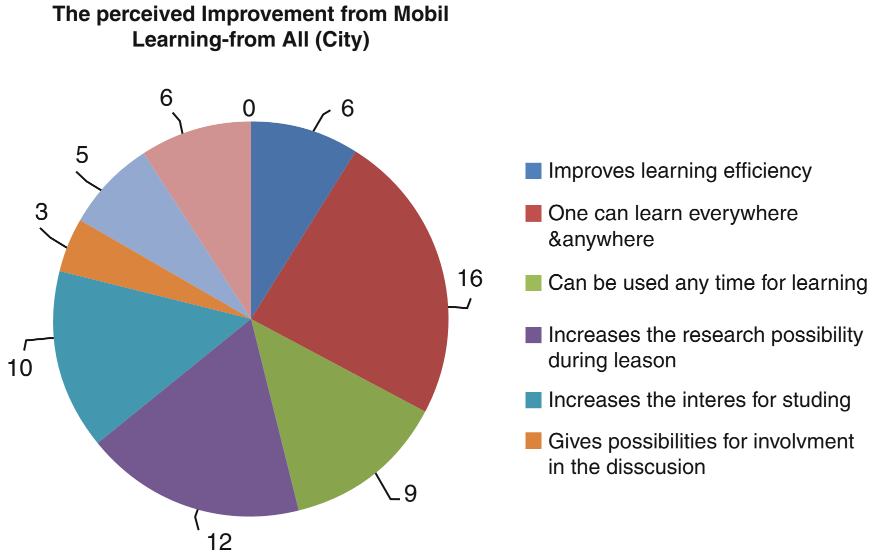



**Fig. 44** The perceived improvement from all in the city

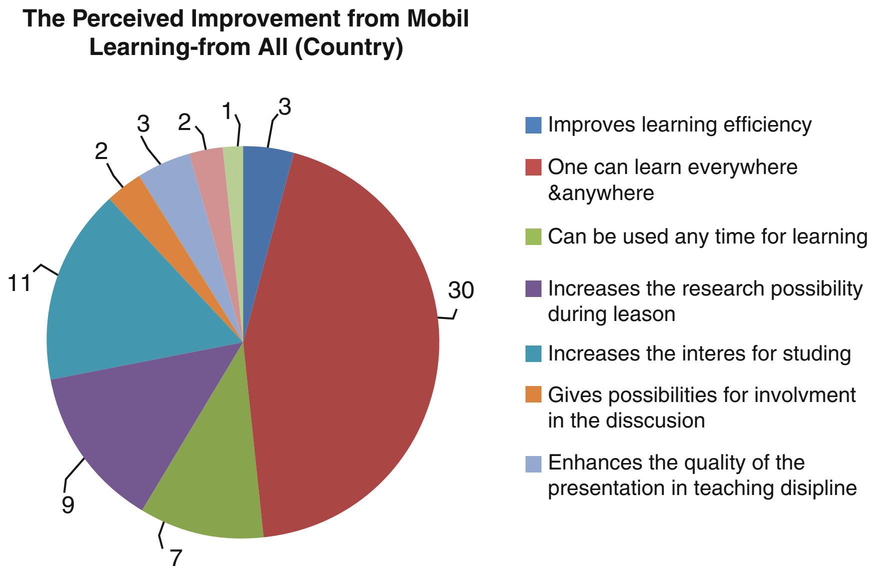



**Fig. 45** The perceived improvement from all in the country

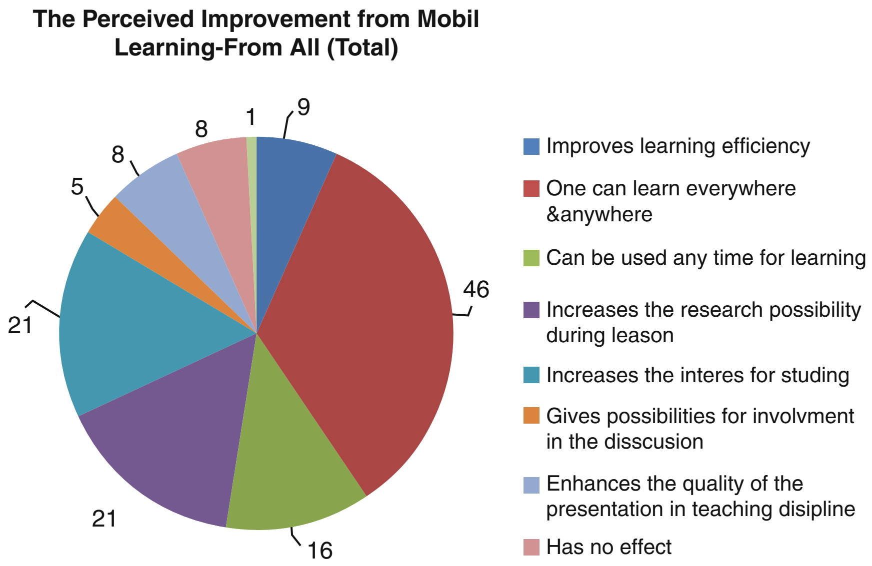



**Fig. 46** The perceived improvement from all in total (country and city, females and males)

- Lifelong personal development and gratification (cultural capital). Core competencies should enable students to pursue individual objectives in life, led by personal interests, intentions, and desires to continue learning throughout life.
- Citizenship and active involvement (social capital). Core competencies should permit anyone to participate as an active citizen in society.
- Employment (human capital), to be understood as the capacity of each person to obtain a decent job in the labor market.

Future challenges for Albanian higher education are institutional autonomy and good governance of higher education institutions, the curricula reformation in accordance with strategy of higher education and national priority, quality assurance and a fair accreditation system as a guarantee to the service rendered to the society, integration of the teaching process via scientific research, preparing the conditions for lifelong learning, increasing student mobility and participation, and providing the higher education system a better dimension through new technology and E-,T-, and M-learning (Open Education 2030)

An implementation of the synergy of E-/T-/M-learning within school programs:

- E-learning:
  - Already exists but despite some progression there are still lack of useful opened educational resources.
  - A coloration of E-learning in the future will appear in its overtness and wide use of interoperable SCO modules in interoperable e-Environment.

- M-learning:
  - Modern mobile phones have wide screens, upgraded software, great network coverage, and relatively low expenses, which make mobile phones (especially smartphones) very powerful learning instruments; m-learning is a great supplement even in some basic forms of learning.
  - Almost each student holds at least one mobile phone. A number of smartphones will boom in the future.
- T-learning:
  - T-learning will revive by enriching its potential for learning from watching video materials and for accomplishing corresponding tasks given during broadcasting and tests, which would be possible to do by TV and switchboard. This could be achieved by providing special learning TV channels or coming to an arrangement with broadcasting companies to include T-learning materials into their broadcast program.
  - Videoconferencing tools and recorded materials also ought to be considered as considerable learning enhancement instruments. Thin borderlines between mentioned different forms of technology-based learning will disappear.

This system will ensure the synergy of different types of technology-enhanced learning, such as gaming, E, T-, and M-learning, which will create prospective learner-friendly educational ecosystem with possibility to share and reuse learning objects. This will become an everyday occurrence. The e-portfolio system with its comprehensive assessment tools and collaborative environments will complementarily perfect the knowledge acquisition process and lead to competencies and skills. All embracing digitalization will cover whole educational system and learning environment.

## 8 Cross-References

► Expectations from Future Technologies and E-Learning in Higher Education in Albania

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# How Irish Postgraduate Students Use Mobile Devices to Access Learning Resources

56

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## Contents



**Abstract**

For almost 20 years, the University of Limerick has run programs in technical communication. These programs have evolved over time to encompass online delivery techniques. More recently, the suite of learning materials includes discrete learning objects and podcasts. These delivery strategies facilitate increased personalization of learning including through mobile devices. This chapter discusses how learning resources, deployed through a virtual learning environment (VLE), are used by postgraduate technical communication students (including a cohort of distance learners) in a personalized manner. Eighteen students completed a short survey about their uses of mobile devices to access learning resources. The findings indicate that over half the respondents regularly access a variety of materials, in various ways, through mobile devices. The findings also imply that, in the absence of policy, educators need to be vigilant to ensure that delivery of materials matches learner expectations.

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# 1 Introduction

Use of mobile technologies is rapidly overtaking use of other computing devices and fixed-line computing. Wohlsen and Marcus (2010) have predicted the end of the PC era, following a worldwide drop in sales of 10 % last year alone. The home market share is dropping rapidly because of increases in tablet and smartphone sales, while in emerging markets many consumers have entirely skipped the PC era in favor of mobile computing devices (IDC 2014). Recent reports (IDC 2014; Gartner 2014) forecast that tablet sales will surpass PC sales by the end of 2015. IDC note that “the transition toward mobile and cloud-based computing is unstoppable.” Because mobile devices are becoming ubiquitous, they have enormous potential to be harnessed to deliver many types of personalized educational materials to learners, though that potential may not always be harnessed effectively (Traxler 2010a).

Mobile learning is not an entirely new paradigm; rather it builds on theories of traditional and online learning but has a strong emphasis on accessibility and personalization. These are especially important features for higher-level students and for online learners (Betts and Lynch 2009).

Many chapters in this handbook examine the use of m-learning with students. For example, Zhang explores student feedback in mobile teaching and learning. The objective of this chapter is to examine how postgraduate students taking technical communication courses through a mix of on-campus and distance delivery modes exploit mobile technologies in their learning. This chapter reports on a survey of postgraduate technical communication students about their use of mobile devices to access learning materials.

The chapter begins by exploring the background to m-learning, focusing on its advantages and potential disadvantages, its use in online and distance courses, and its use with a VLE. It then describes the parameters of the study. The next section of the chapter reports the findings followed by an interpretation of what these findings mean in the context of previous studies. The final section presents directions for future research in this area.

# 2 Literature Review

This literature review provides a background to the chapter by examining the advantages and disadvantages of m-learning, discussing its use in online and distance education, and exploring m-learning in the context of a university VLE.

## 2.1 Advantages and Challenges of M-learning

ICT in education is one of UNESCO’s themes, and mobile learning is a prominent strand within that theme. UNESCO (2013) notes the benefits of mobile learning: “It presents unique attributes compared to conventional e-learning: personal, portable, collaborative, interactive, contextual and situated, it emphasizes 'just-in-time-learning' as instruction can be delivered anywhere and at anytime through it." This accessibility has carryover benefits for all students. JISC (2013) notes that "learning with mobile devices can bring many inclusion benefits, enabling learners to access content wherever and whenever they choose, and using a device they know they can operate."

Personalization of education is becoming increasingly important, as learning happens among myriad other activities in learners' busy lives (Evans 2008). Mobile learning is a form of personalized learning, enabling a means of pursuing "meaningful curriculum engagement with students' diverse life experiences, life projects and life-long learning" (Hargreaves and Shirley 2011, pp. 16–17).

M-learning, furthermore, has the potential to increase self-regulation and ultimately should result in improved learning outcomes for students (de Marcos et al. 2010).

There are, of course, also challenges associated with m-learning as a new paradigm. At the level of the student, a digital divide appears to be emerging, between those users who have access to mobile devices and have the confidence to use them and those who do not. One of UNESCO's policy guidelines for m-learning (2013) is to "develop strategies to provide equal access [to mobile devices] for all." No learner should be left behind because of lack of access or confidence. While older users may find adapting to m-learning more of a struggle than traditional learners, a study by Santos et al. (2013) shows that a "collaborative and participative approach" combined with meaningful activities helps engage older learners. A recurrent theme in the literature is that m-learning should not be the exclusive means of delivering educational materials but ideally should be blended with more formal and structured delivery mechanisms (de Marcos et al. 2010). This strategy helps to ensure that those learners who do not have access to mobile devices are not denied learning opportunities.

At the level of content, m-learning materials must be accessible to all users. Responsive design is essential for accessible content (W3C 2013). The corollary is that content is equally accessible to learners who do not use or have access to mobile devices. De Marcos et al. (2010) advocate "granularity" where small blocks of content are made available to students to support learning of discrete topics.

At the level of policy, several researchers and organizations outline the need for local (institutional), national, and international strategies to support and manage m-learning. UNESCO has developed policy guidelines for m-learning in a context where "[t]he ever-increasing availability of mobile technologies requires policy-makers to revisit and rethink the potentials of ICT in education" (UNESCO 2013, p. 7). A report from the Web Accessibility Initiative (W3C 2013) notes the convergence of web accessibility issues with the need for harmonization of design standards for mobile devices.

These challenges, and potential solutions, interact with one another. For example, the type of content an instructor develops will be influenced by the institutional policies and supports, including the VLE and its adaptability to mobile delivery.

## 2.2 Using M-learning in Online and Distance Programs

Online and distance learning programs are becoming more popular as student demographics and lifestyles change. Geith and Vignare (2008, p. 7) explain that "[o]ne of the key benefits of online learning is that it can be offered free of time and geographic constraints, thereby increasing the accessibility of higher education." According to the Irish Higher Education Authority (HEA), over 43,000 part-time students had college places in Ireland in 2013. The HEA (2013) aims to increase access for all types of students:

> Achieving full equality of access to higher education is a national priority, for people with disabilities, mature students who previously had not the opportunity to access higher education, those facing social and economic barriers, and minority groups, including the Traveller community.

The HEA Strategic Plan posits open and distance learning programs as potential interventions which could increase access for underrepresented groups within the population. Because most adults "are not in a position to put their lives and commitments on hold for 3–4 years while they pursue full-time study" (MacKeogh and Fox 2008, p. 1), e-learning, m-learning, and flexible access to educational resources are a potential means of enabling such students to participate. Even among the more traditional cohort of 18–22-year-olds, part-time work is common. Darmody and Smyth (2008, p. 353) report that 60 % of Irish full-time higher education students they surveyed work "at least to some extent, during term time". These students value, and may even expect, more flexible and personalized educational arrangements.

Betts and Lynch (2009) show that "the long-term sustainability of online degree programs is highly dependent upon student engagement and retention. Therefore, with increasing numbers of non-traditional students returning to higher education through online programs, it's critical that institutions personalize the online experience and develop strategies to bring the campus to this growing student market." According to Lee and Chan (2007, p. 202), m-learning is a "natural match" for distance learning programs because it enables learners "to undertake learning in conjunction with other tasks, or when on the move for extended periods of time, such as during business trips. Many of them are 'continuously connected' by mobile phones, laptops and hand-held devices." Making materials, including podcasts, readings, and presentations, available to users of mobile devices helps to meet the expectations of distance learning students who need to be able to access materials any time and any place and who have the technology to enable them to do so.

## 2.3 M-learning and the Virtual Learning Environment (VLE)

A VLE has become an essential tool for educators in higher education, and especially in online courses, since it can support constructivist and self-regulated learning (Betts and Lynch 2009). Through the VLE, students have access to learning resources (such as podcasts, presentations, syllabi, and readings), as well as collaboration tools (discussion forums, online chat tools, and group forums) and organizational tools (a course schedule, university handbook, and links to the university library, for example). Accessing the VLE through mobile devices takes personalization to a new level, because students are now able to read lecture materials and supporting documents, listen to podcasts, contribute to conversations via discussion forums and online chats, and find organizational supports, from any place at any time (assuming that the technological infrastructure is in place), all on a mobile device. They are not tied to the campus nor to a fixed-line computer (Traxler 2010b). Using the VLE in this way effectively does what Betts and Lynch (2009) indicate the need for: it "brings the campus to the student" rather than the converse.

There are two postgraduate programs in technical communication at the University of Limerick (UL), an MA in Technical Communication and E-Learning and a Graduate Certificate in Technical Writing by distance learning. The latter program is delivered entirely online through the university VLE. Students on both programs share courses, and they all have access to VLE resources such as readings, presentations, and podcasts, as well as shared online discussions and chats.

The mode of deployment may influence the perception and usability of a VLE in a mobile environment. The UL VLE is Sakai (called Sulis at UL), an open-source "full featured system supporting technology-enabled teaching, learning, research and collaboration for education" (Sakai 2014). This is a web-based VLE deployed using a responsive web design for mobile delivery. The site resizes to fit the – likely smaller – mobile device screen (see Fig. 1), and a mobile version of the site is also available (see Fig. 2).

Students accessing the VLE through a mobile device expect a stable deployment. According to one study (Cho et al. 2014), students using smartphones to access a VLE rated reliability as twice as important as students using desktop computers.

The authors take the view that m-learning is an extension of e-learning and do not seek to replace traditional teaching strategies but rather to take a blended approach that exploits m-learning's potential for personalization, access, and flexibility, to augment the learning experience, for both on-campus and online learners. Within this framework, the study seeks to examine whether and how postgraduate students on technical communication programs at the University of Limerick access the university VLE using mobile devices, and their satisfaction with the experience. The next section outlines the methodological approach.

## 3 Methodology

The expectations and learning environment has changed rapidly over the last few years, particularly with the influx of open educational resources; it is important to recognize that student needs and expectations have also changed. There is a lot of anecdotal-based work available in the literature describing the benefits of mobile learning, but there are fewer evidence-based cases available (Hew 2013). Even the recently circulated roadmap for building digital capacity in Irish higher education

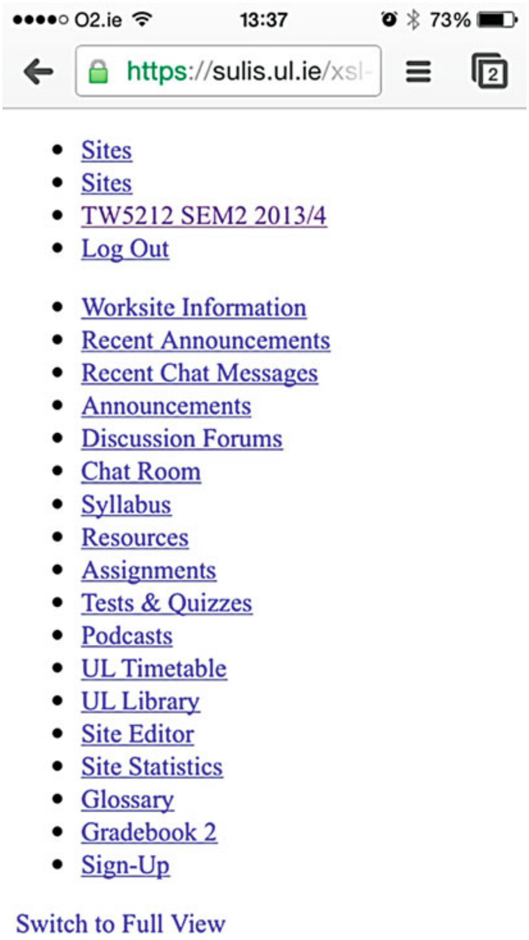

**Fig. 1** Full site via mobile presentation

(2014) does not provide any detail on the current state of mobile learning in Ireland. It merely states, “The proliferation of mobile devices such as tablets and smartphones is one area that is impacting on the technological infrastructure. This is evidenced in the huge growth in demand for Wi-Fi that is being reported across the sector” (p. 15).

## 3.1 Research Design

In order to ascertain questions to ask to capture to what extent, if any, existing teaching and learning materials were being used to accommodate some aspect of

**Fig. 2** Mobile site




mobile learning, the authors conducted a manual electronic search of the literature across the available academic databases including **Applied Science and Technology Source and the Web of Science**. These databases are highly regarded by other investigators in their search for empirical articles (Hung and Zhang 2011). The databases were used to search for articles using an open-ended search period (up till December 15, 2013). The terms used for the search strategy are listed in Table 1.

The first author read the abstracts of the studies initially identified by the databases, and relevant studies were then selected for review. The articles included case studies which discussed the impact of using Web 2.0 technologies on teaching and learning. Where the studies included questionnaires, some of the more frequently occurring questions were adapted for this survey (Chen and Denoyelles 2013). Studies where the participants of the studies were either in elementary/primary or secondary/postprimary schools were excluded.

**Table 1** Search strategy keywords

| Sequence | Keyword |
|---|---|
| 1 | Mobile learning |
| 2 | M learning |
| 3 | Mobile education |
| 4 | Web 2.0 and education |
| 5 | Virtual learning environment (VLE) |

The two aims/objectives of the study were

- To determine the effectiveness of learning resources as a personalized learning solution
- To determine which learning materials are used in "mobile" ways

In order to answer these questions, students were surveyed to get feedback on the learning resources and ascertain if any of the resources were being used to facilitate mobile learning. This strategy also sought to elicit the students' opinions on types of resources that they found of most value.

### 3.2 Participants

There were two groups involved in the study: students undertaking the Graduate Certificate in Technical Writing by distance and students on the MA in Technical Communication & E-Learning. A total of 36 students were invited to participate in a survey to explore to what extent they use mobile devices to access learning resources on the institutional VLE. This group were of a wide range of ages and experiences, and at least half of the group were in part-time employment.

### 3.3 Instruments

An online tool (SurveyMonkey) was employed to ensure that their responses remained anonymous. The students were not under any obligation to respond to the survey. However, the invitation did state that feedback would be noted and where applicable, comments and recommendations would influence the future development of teaching materials for online delivery. The questionnaire included questions pertaining to the use of the VLE by each student. Questions sought to capture data on frequency and location of accessibility and the perceived suitability of the learning resources. The questionnaire had a total of ten questions drawing on the pertinent literature.

### 3.4 Procedure

After successfully completing the first 13 week semester of their respective courses, all 36 students were invited to respond to the survey. A total of 18 responded to the survey giving a response rate of 50 %. Over the last number of decades, there are trends of decreasing response rates around the world (Fan and Yan 2010). The nonresponse bias for this survey could be attributed to many students reporting survey fatigue during the autumn semester.

This was a self-reported questionnaire on students' interaction with the available learning resources over the first 13 weeks of the academic year 2013/2014. The questionnaire was accessible via a secure website, and students that responded had their IP address captured, as well as how long they spent completing the questionnaire. The questionnaire consisted of questions relevant to the type of mobile device used by the students, frequency of student visits to the VLE, and the preferred location of the students for accessing and/or using the resources. Two additional items were relevant to the learning resources, asking students to rate the teaching materials (seven-point scale). There were three comment boxes prompting students to explain their ratings and asking for detail on what teaching materials were the most and least successful.

### 3.5 Limitations

The authors presumed that the entire student cohort had a mobile phone or access to a mobile device, but prior to collecting the survey, there was no evidence to this effect. It is also important to note that while all respondents to the survey claimed that they owned a mobile device, not all of the students responded to the survey; the response rate was 50 %. Therefore, there may be a significant minority who do not own a mobile device that are not represented in the study. The authors did not differentiate between the full-time and the distance students taking the survey nor observe the students using the resources. The data collected is from a self-reported questionnaire. This study does not claim to be exhaustive on the use of mobile technology by this cohort.

## 4 Results

The intention of this study was to invite students to participate in a survey to explore to what extent they use mobile devices to access learning resources on the institutional VLE. However, given some of the responses, it would seem that the survey was considered by some as a course evaluation. This is not unexpected for two reasons. Firstly, many of the questions could be found in a course evaluation questionnaire, and secondly, the survey was circulated to students during the final 2 weeks of the semester. Participants were aware that feedback would be noted and where applicable, comments and recommendations would influence the future development of teaching materials for online delivery.

The survey response rate was 50 % 18 out of the potential 36 completed the survey. The respondents to the survey engaged with the questions and responded with considered and meaningful replies, taking on average 9½ min to complete the

**Table 2** Mobile devices used by students

| Device | Smart phone | iPhone | Tablet | Music player | Laptop |
|---|---|---|---|---|---|
| Percent | 47.06 % | 29.41 % | 52.94 % | 0 | 64.71 % |
| Number | 8 | 5 | 9 | 0 | 11 |

**Table 3** Breakdown of use: full site or mobile site

| Full site | Mobile site | I didn't know there was a mobile option | Both |
|---|---|---|---|
| 13 | 1 | 1 | 3 |

survey. There was no evidence of the "asdf" problem nor did students enter nonsense words as responses (Müller et al. 2014). This constructive feedback may be attributed to the fact that the surveyed group comprised only graduate students. Table 2 illustrates the many devices used by this cohort to access the learning materials online. While the use of a laptop is unsurprisingly the top choice, a large number also use their smartphones/iPhones and/or tablets. One would expect that if the survey were conducted with a cohort of students in the academic year 2014/2015, the use of tablets would be even greater as there have been new releases of many tablets and they have become more affordable. It is worth noting that none of the respondents reported using a Blackberry device given that this device was one of the market leaders until 2011. The survey did not explore which specific learning resources the 12 students who reported using either a smartphone or an iPhone accessed. It would be worth conducting further study to see if students using a mobile phone device contributed to the discussion for a using the mobile phone.

It is striking that so many of the respondents reported using the full site in preference to the mobile site given that so many accessed the resources using a mobile phone (see Table 3). It is worth noting that the Help documentation provided for Sulis by the University of Limerick provides no information on accessing the mobile version of the site. This may account for students not choosing the mobile site when using a mobile device.

When asked how many times a week they visited the Sulis site, the average response was 8.3 times; the highest number of self-reported visits was 20 and the lowest was 4. Interestingly, the data stored for the Sulis site reports an average of 14 visits a week per unique visitor. However, the survey results reflect the reality that there are some very active users of the site and some that engage with the VLE to a much lesser extent.

The study aimed to establish how students were storing the material from the VLE. The majority (12) reported that they downloaded the material locally while a significant number (8) chose to download the materials multiple times. This finding may suggest that they were using multiple mobile devices to access the materials. This study did not explore the use of many mobile devices, and this topic would merit further investigation.

**Table 4** Locations at time of use reported by students

| Institutional: formal setting e.g., school classroom/university | Home | "Extra-mural": e.g., library, school playground, excursion site, museum | Informal: e.g., cafe, public transport | Other |
|---|---|---|---|---|
| 16.67 % | 100.00 % | 22.22 % | 27.78 % | 33.33 % |
| 3 | 18 | 4 | 5 | 6 |

If learning materials are to be adapted for the most effective and appropriate mobile delivery, then it is crucial to understand where the materials are being accessed and used. To this end, students were asked where they usually accessed the teaching materials. Table 4 details the locations where students reported using the materials. All of the respondents accessed the materials at home. The survey did not explore whether they used a desktop at home or not. It is a safe assumption that those accessing the materials in an "extramural," informal, or "other" setting were much more likely to have used a mobile device to do so. Therefore, at least 9 (possibly 15) of the 18 respondents used the teaching materials in a mobile manner.

Students were asked to rate the teaching materials (using a seven-point scale). The purpose of this question was to try to gauge the perception of mobile devices for academic purposes and to capture how the students were using the teaching materials to achieve some level of personalized learning. None of the statements resulted in any distinctive polarization, as illustrated in Table 5.

When asked to comment on what they had found to be the most useful of the teaching materials, many reported that the lecture slides were the most useful. The podcasts were also recognized as effective. It was useful to capture how students tended to use the lecture slides and podcasts. A significant number reported listening to the podcasts in tandem with the lecture slides in the first instance and then referring to the lecture slides on their own at a later date. This strategy could be considered as mimicking the traditional lecture whereby students attend the lecture and receive face-to-face instruction from the lecturer and take notes. They only receive this "performance" once. They then access the slides and their personal notes from the slides any number of times. Knowing that many students may only listen to the podcasts once may change how the audio is delivered in the future. It may be better to lock the audio into the presentation so that students will be presented with audio whenever they try to access the slides. Although not immediately considered a "teaching material," the discussion forum was also rated quite highly among respondents. Two of the respondents were critical of the teaching materials but did not recommend or suggest anything else that would better accommodate mobile learning. Remarkably, none of the comments suggested that video would be advantageous for mobile learning. Some of the student responses are provided below:

> "(I) saved slides as word documents and used them as a basis for better understanding the lecture through use of 'other' (resources), i.e., textbooks."

**Table 5** Student response to "mobile devices for academic purposes"

| Comment | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Total | Average ranking |
|---|---|---|---|---|---|---|---|---|---|
| Improve my quality of work | 16.67 % 3 | 33.33 % 6 | 11.11 % 2 | 27.78 % 5 | 0 % 0 | 5.56 % 1 | 5.56 % 1 | 18 | 5.00 |
| Make it easier to access my coursework | 22.2 % 4 | 16.67 % 3 | 11.11 % 2 | 11.11 % 2 | 5.56 % 1 | 11.11 % 2 | 22.2 % 4 | 18 | 4.17 |
| Make it easier to complete my coursework | 16.67 % 3 | 22.2 % 4 | 11.11 % 2 | 16.67 % 3 | 11.11 % 2 | 16.67 % 3 | 5.56 % 1 | 18 | 4.44 |
| Increase my knowledge in my field of study | 16.67 % 3 | 5.56 % 1 | 22.2 % 4 | 5.56 % 1 | 22.2 % 4 | 16.67 % 3 | 11.11 % 2 | 18 | 3.94 |
| Increase my motivation towards completing my coursework | 11.11 % 2 | 5.56 % 1 | 16.67 % 3 | 16.67 % 3 | 33.33 % 6 | 5.56 % 1 | 11.11 % 2 | 18 | 3.83 |
| Increase communication with other students | 5.56 % 1 | 11.11 % 2 | 5.56 % 1 | 16.67 % 3 | 22.2 % 4 | 22.2 % 4 | | 18 | 3.28 |
| Increase communication with my instructor | 11.11 % 2 | 5.56 % 1 | 22.2 % 4 | 5.56 % 1 | 5.56 % 1 | 22.2 % 4 | 27.78 % 5 | 18 | 3.33 |

"Easy access to materials mentioned in class was excellent for referring back. The discussion forums are an excellent source of information and help both from lecturer and other students."

"[I]I Found lecture slides most useful."

"A concise and quickly accessible summary is most useful."

"The podcasts are very useful."

"I would rank them all [lecture slides, podcasts and discussion] as quite high as used together you get a great experience as a distance student".

"The discussion forum and teaching materials are a bit weak, so I'm supplementing with library stuff."

"Lecture slides contained a lot of very valuable information and could be accessed often, very quickly. I always used them along with the podcast in the first instance but then went through them again a couple of times on their own."

"It [The Discussion forum] was useful to bounce ideas around and hear other people's responses. [I] could learn from what others wrote there."

"[The lecture slides] Contained information I could research. I would have put the top 3 [slides, podcasts and discussion forum] together as they all were useful for different things."

"Lecture slides can be easily referred to when needed, give structure to the podcasts."

"[The lecture slides were] Easily accessible visually. They provide an excellent basis."

When asked to comment on what teaching materials (if any) were not successful, many reported that the combination of resources had worked quite well but that in isolation the teaching materials were less effective. There was very little criticism of either the teaching materials or the manner in which they were presented. What did emerge from the qualitative comments was that small changes could potentially have a positive impact on mobile learning. One student stated that they would appreciate if they could be notified when new topics were posted to the discussion forum. Both the instructor and the student must activate this feature. This is a very small task that may improve the mobile learners' experience. The students also appreciated some of the recommended text being made available electronically. A small number of distance students were critical of the lab sheets provided to guide them through the software applications that are covered on the graduate program. While every effort is made to try and provide support for the delivery of this content, it remains challenging, particularly for distance students. Over the next semester, possible alternatives for the delivery of this content for distance students will be considered.

## 5 Discussion

This study set out to determine the effectiveness of learning resources as a personalized learning solution and to determine which learning materials are used in "mobile" ways.

The learning materials accessed by the students participating in this study were not specifically designed for mobile delivery. The purpose behind the materials was to try and enhance the learning experience for all students, both traditional and distance. Creating podcasts and directing learners to online supplementary material including multimedia was a natural development to enhance traditional lecture slides. The results of this study suggest that there is a gap between students using mobile devices and instructors requiring students to use mobile devices. If instructors were more aware of the devices and mobile applications that students are currently using to engage in mobile learning, then perhaps mobile learning could be exploited to a greater degree. The current situation is that instructors cannot assume that students have mobile devices or that they are comfortable using them to access educational materials.

According to Kearney et al. (2012, p. 9), personalization "has become a corner stone of e-learning. Key features associated with personalization include learner choice, agency and self-regulation as well as customization." Appropriately designed mobile learning/teaching materials can afford learners a better learning experience (Pachler et al. 2009). Mobile learning can be customized at a number of levels: the actual teaching materials created/provided by the instructor, how these teaching materials are presented (intended use), and the actual manner in which they are used. As learners are accessing the materials on their personal mobile devices, they are able to engage with the material in a more autonomous manner (Lee and Chan 2007). Learners can choose how often they wish to visit the VLE and where and how they want to store the teaching materials (Betts and Lynch 2009). This level of autonomy is evident in this study. Students accessed the materials in nontraditional educational settings, they chose where and how to store content, and they also actively chose how they would use the lecture slides (in tandem with the podcasts or not).

Instructors are encouraged to foster and promote autonomous learning. The teaching materials and course content are provided. Traditionally, the educational institutions have provided the technology and access to that technology. Now, however, a sea change is emerging in that it is the students who are assuming the responsibility for the technology (UNESCO 2013). In providing their own devices, they are changing the system (Hargreaves and Shirley 2011). As Traxler (2010a, p. 151) states, "The institutions traditionally procure, provide and control the technology for learning but now students are acquiring their own personal technologies for learning and institutions are challenged to keep pace." These devices enable students to assume autonomy over the content that is provided to them in terms of how they store, transmit, and consume information: "this potentially realises the educators' dream but for institutions is potentially a nightmare, one of loss of control and loss of the quality, consistency, uniformity and stability that delivered the dreams of equity, access and participation" (Traxler 2010a, p. 149). Traxler, among others, observes that using desktop technology takes place in a "bubble" – in committed times and locations where the user ignores the world for a considerable and possibly planned episode, whereas interaction with mobile technologies is "woven into all times and places of students' lives" (Traxler 2010b, p. 150).

Mobile devices create potential learning environments in every conceivable space. Mobile learning has the potential to redefine the very notion of a learning space (Melhuish and Falloon 2010). However, what if the space is not an appropriate learning space? Educators no longer have the power to dictate or suggest where materials are to be accessed or where work is to be completed.

This small-scale survey has shown that mobile learning is happening anyway and students will continue to use their own technology to engage in mobile learning. This finding implies that both students and instructors need a policy at an institutional and national level to better facilitate mobile learning. Without a policy, student expectations may be unrealistic and cause frustration when they are not met. Furthermore, instructors will not have any level of support in terms of what and how they offer their mobile and traditional learners.

## 6 Future Directions

This study indicates that use of mobile devices to access learning resources is widespread among respondents. Nevertheless, educators have an imperative to continue to provide learning materials that can be accessed by students with various types of technology, not only mobile devices. This study also indicates that, in the absence of policy surrounding m-learning, educators must work to ensure they use engaging and appropriate content delivery strategies.

Most respondents in the study used multiple resources in tandem with one another and found each useful for different purposes. Indeed, the granular approach to content delivery that has emerged organically in practice – providing readings, a podcast, lecture notes, and other materials to cover a topic – finds favor among the respondents and in the literature (see, e.g., de Marcos et al. 2010).

The authors believe that future investigation is merited in areas such as whether students use mobile phones to contribute to discussion forums and whether students use multiple resources to access learning materials. The findings also highlight the need to ensure that respondents understand that their responses are anonymous and not related to a course evaluation. Follow-up surveys with students on the same programs in future years will enable us to track whether dependence on mobile delivery of learning materials is increasing, as implied anecdotally and in the literature.

## 7 Cross-References

► Characteristics of Mobile Teaching and Learning
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► Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom
► M-Learning: Visible Approach for Invisible World

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# M-Learning and U-Learning Environments to Enhance EFL Communicative Competence

57

Soraya Garcia-Sanchez and Carmen Lujan-Garcia

## Contents



**Abstract**

Today mobile learning and ubiquitous learning are hand in hand when planning higher education courses. On the one hand, m-learning implies that learners have access to digital information by using any mobile device such as their tablets or smartphones. On the other hand, u-learning suggests that the walls of the traditional classroom are extended to more open spaces that facilitate not only the access to information but also to participation anywhere and at any time. Moreover, tasks can be designed having in mind either an individual or cooperative learning approach, in which the interaction between learners is the key to succeed in their learning process. U-Learning activities such as online glossaries, discussion forums, and interactive digital exercises allow today's English as a foreign language (EFL) students to effectively enhance and perform their communicative language competence in the foreign language. Thanks to technology, current higher education students can improve the key skills of a foreign language (use of English, vocabulary, reading, listening, writing, and even speaking with other participants) using mobile devices and a u-learning

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approach. This chapter aims to demonstrate the work EFL tertiary learners have produced by using both m-learning and u-learning environments. The outcomes reveal that the communicative competence and the foreign language skills are being improved by using the appropriate technology, content, and tasks that are especially adapted to today's digital students.

## 1 Introduction

Technology has been a revolution in today's population. It has improved different community sectors, and as a result, educational institutions have positively benefited from implementing e-learning tools in their courses. From b-learning (blended learning) scenarios that combined face-to-face instruction with e-learning practice, technology keeps modifying ways of learning in order to adapt education to students' needs. This approach to learning implies a proactive attitude by students and, therefore, a greater autonomy, more responsibility, and some more engaging and relevant tasks that are linked to interaction.

Two of the main functions of using a mobile phone are interaction and communication. Mobile phones are more sophisticated every day to answer the most demanding citizens. Equally, learners carry either their phones or their tablets to actively participate in their learning process anywhere and at anytime. Mobile learning (m-learning) is a current methodology in education, "supported by situated learning, personalized learning, collaborative learning, ubiquitous learning, and lifelong learning" (Castillo and Ayala 2012). As Graf and Kinshuk (2012, p. 878) state, personalized learning systems consider the individual differences of learners and tailor their learning experience to their current situation, characteristics, and needs. This adaptation increases learners' progress and outcomes and enables learners to learn with less effort and a higher motivation.

Mobile and wireless technologies have produced new ways of interacting with the world, away from the limitations of desktop computers. These devices present design opportunities for multiple kinds of collaboration and to support different aspects of the learning process (Abachi and Muhammad 2014; Milrad and Hoppe 2012). The students participating in *mobiquitous* learning environments (m-learning and u-learning) actively not only decide but they also select the resources that are best adapted to their context so that they can flexibly access the material (Abu-Al-Aish and Love 2013; Cope and Kalantzis 2010; Darias Marrero et al. 2013; Luján-García and García-Sánchez 2012, p. 10). M-Learning and u-learning environments contribute to the successful educational practices of continuity, autonomy, and interaction promoted by the European Higher Education Area (Aljohani et al. 2012; García-Sánchez 2014, p. 13). A mobile learning environment is defined as an approach that connects learning with moving or traveling, by means of a mobile device that has Internet connection. If e-learning implies accessing a computer or a laptop and typing information or clicking various links once connected, mobile learning deals with touching the device to continue on the go of learning (M-learning 2009; MoLeNET 2007;

The eLearning Guild). Moreover, the adequate application and thorough evaluation of m-learning environments imply moving the spheres of the classroom to new external spaces that require of the use of IT communication as highlighted by D. Stoller-Schai and M. J. Nursey-Bray in the corresponding chapters of this handbook (▶ Chaps. 59, "Mobile Learning Beyond Tablets and Smartphones: How Mobile and Networked Devices Enable New Mobile Learning Scenarios," and ▶ 47, "Moving with Mobiles – Using IT in the Classroom as Against Online: Comparative Reflection from South Australia"). With an appropriate Internet connection, the possibilities for facilitating, supporting, enhancing, and extending the user's knowledge are massive (MoLeNet). Ubiquitous learning goes beyond any time and place restrictions in order to provide learners with the real learning context they need at a specific time (Burbules 2012; Chen et al. 2013, p. 1; Kalantzis and Cope 2012). Mobile devices present design opportunities for multiple kinds of collaboration that satisfactorily support different aspects of the learning process (Milrad and Hoppe 2012). Nowadays, u-learning occurs in everyday scenarios that are constructive, individual, cooperative, and collaborative (Bomsdorf 2005, p. 2; García-Sánchez 2012, p. 95).

If m-learning and u-learning approaches are intertwined, the skills of a foreign language can be positively enhanced. It is a fact that the main purpose of learning a foreign language is to communicate with others via written or oral expression. Currently, communication quite often takes place on one's mobile phone, not only by means of having a conversation with others but also by accessing instant messaging, social networks, and video chats with common software such as WhatsApp, Facebook, and Skype, which require Internet connection. Moreover, free apps for iPhone and Android have recently become quite useful when learning a foreign language. Some learners more often approach you by commenting on a new app that is suitable for the specific content they are learning. Some even prefer posting these useful apps that respond to their immediate needs on the course forum so that it is shared with others, as it was the case of the Cambridge UP phrasal verbs app. A smartphone is a complementary tool for learners, and although they mostly use it for personal communication, the mobile phone is becoming the most useful device to access instant information while walking or while traveling on the bus, for instance.

This study is based on the communicative approach to teaching and learning English as a Foreign Language (EFL) at a renowned university in Spain using *mobiquitous* learning environments. The authors will focus on the written and oral expression of students of EFL while working in m-learning and u-learning environments. The following key questions will be addressed:

1. Can m-learning and u-learning environments improve individual and cooperative abilities in EFL?
2. Are the various EFL skills being constantly enhanced by our learners by especially accessing m-learning and u-learning environments?
3. What u-learning activities are successful to express written and oral forms of communication?

### 1.1 Higher Education Participation in M-Learning and U-Learning Approaches

A Spanish university has participated in innovative projects which have contributed to the creation of digital material in order to support our students' learning process. Some teaching staff, devoted to the area of English as a foreign language (EFL), has elaborated videos of a different purpose in order to consolidate essential skills in this foreign language. Those videos were often supported by a number of interactive exercises of different type (e.g., gap fill or multiple choice), which learners could do and revise instantly. The type of material created for EFL was classified according to level B1 or level B2 on the *Prometeo* and the *OCW* platforms.

*Prometeo* was the initial innovative project that especially promoted the creation of short videos of specific content teachers could upload on the platform. This project, presented in January 2008, was addressed to our educational community since participants were required to have a username and a password to have access to the digital material. *Prometeo* was also beneficial for the teachers of this project because they could use the flipped class methodology (Bergmann and Sams 2012), which implied that some instructive videos were designed as an integrative part of the course for students to watch outside the classroom (as homework), so that more face-to-face sessions could be devoted to practice communicative skills in English. Guerra-Artal et al. (2012) have demonstrated that digital tools such as the whiteboard *Picasst* can be effective for teachers who would record their animated flipped classes using their PCs or mobile devices and Internet connection. This project was closed in August 2012.

In February 2011, this higher education institution launched its *OpenCourseWare* (*OCW*) platform, which followed the initiative launched by MIT (Massachusetts Institute of Technology) of publishing free online lectures and learning material. MIT started making public their first 50 pilot courses in 2002. Now the educational content, which was previously limited to the learning community with a username and password, is open and free for anyone to use anywhere and at anytime (Fig. 1).

After having participated in these innovative projects, which contributed to creating some useful digital content for EFL and other subjects of the institution, a group of innovative education researchers (*Grupo de Innovación Educativa*) produced the multilingual web *Ubilingua*, which has also a channel on YouTube with the videos recorded by its members. *Ubilingua* is currently opening their space in other languages such as Arabian, Chinese, French, German, and English and also in consecutive translation (Spanish–English and Spanish–German). Anyone can access these foreign language courses for free by simply registering on the website. These courses at *Ubilingua* do not have a unique learning pathway, but learners can choose the level, the skill, or the topic they would like to improve at a specific time (Figs. 2 and 3).

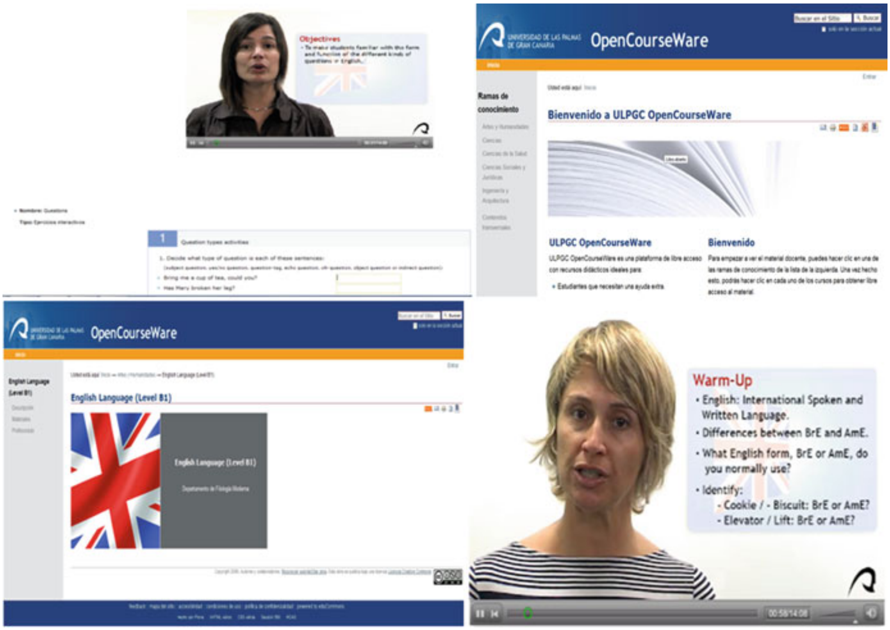


**Fig. 1** University OCW platform

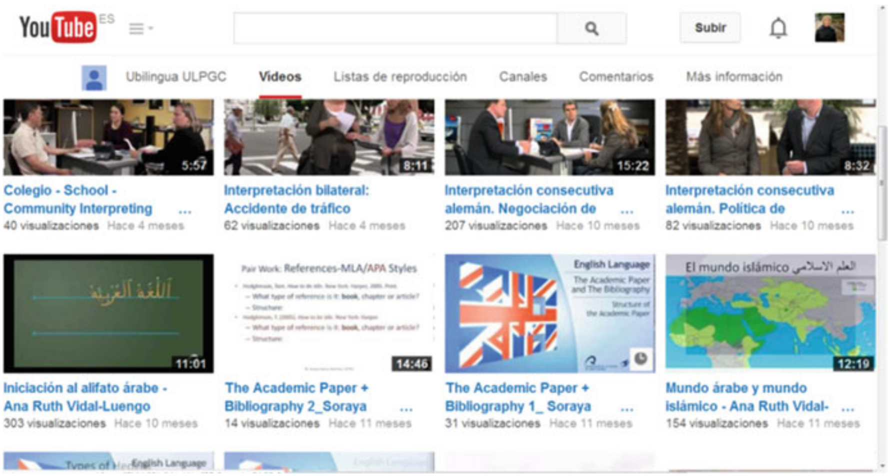


**Fig. 2** YouTube channel of *Ubilingua*

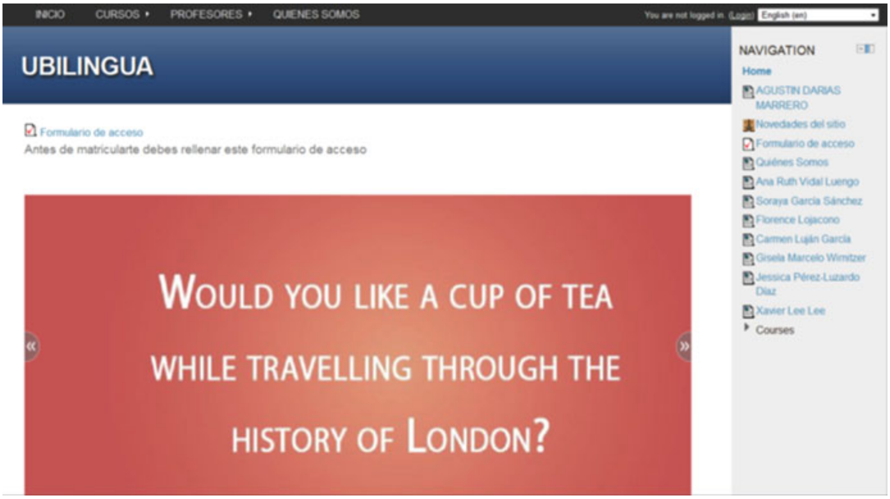


**Fig. 3** *Ubilingua* interface based on *Moodle*

## 2 Communication and EFL Knowledge Building

Learners are not always engaged in the communication process of a foreign language, especially if they are studying a university degree. A vast number of Spanish EFL learners do not feel confident enough to speak in public, even less if they have to do it in English. Several scholars have highlighted that motivation plays an important role at the time of learning any skill or content (Dörnyei 1997, 2001; Huiping and Hornby 2014; Kim and Pekrun 2014; Pintrich 2003; Sears and Pai 2013; Vizoso 2013; Wu et al. 2011). Some of the common characteristics that prevent our students from performing their communicative competence in English have to do with interpersonal fear (Sappington 1984, p. 24). They fear to be called upon for active participation in front of the class. Some are also embarrassed when talking in English because they may not feel confident when using their verbal language. When different language levels happen in the same group, which is quite common, it is frequent to observe that learners may be apprehensive by others criticizing their contributions in EFL. Is this fear of public speaking in EFL a cultural characteristic commonly shared by the Spanish population? Have Spanish children or adolescents been practicing their public speaking and question making from an early age? Without a doubt, most Spanish citizens have not been trained for active participation and therefore for public speaking. Active participation used to be penalized by the majority of past instructors. The lessons were more teacher centered, and learners were used to receiving information and instructions quietly. Now, it seems that teenagers tend to be more active participants. The learning environment in Spanish educational institutions seems to be changing to a positive lifelong learning context that trains EFL learners to speak up with appropriate presentations and questions from an early stage. Research on this area is essential in order to adapt the most efficient learning process to present-day students' needs in Spanish higher education. These needs aim to combine the proper use of ICT with the improvement of EFL to its highest communicative competency, especially if the young population is immersed in an adequate foreign language environment from an early age (Luján-García 2011, p. 18).

One of the questions we aim to answer in this article corresponds with performing the communicative competence when working in m-learning and u-learning environments. In fact, we believe that thanks to technology the communicative competence, which implies using words and correct grammatical structures in the foreign language, together with the appropriate use of the language and correct use of communication strategies (Canale and Swain 1980), is performed by EFL students at a distinguished university in Spain not only in the classrooms but anywhere else and at any other time, out of the academic schedule. This implies that current students are constantly performing their communicative competence when watching videos on their mobile phones or when responding to forum topics from their tablets. This study aims to focus only on one part of the communicative competence: learners' spoken and written expression.

### 2.1 Expressing Themselves by Means of Written and Oral Tasks

The written and oral expression of EFL learners can only be improved if students are based on an interactive learning environment (ILE) that allows them to exchange messages in English. According to J. Psotka (2012):

> An interactive learning environment (ILE) is a system built in software and sometimes with specialized hardware designed to support teaching and learning in education. The interaction in the system can be between the learner and the system, the teacher and the system, or between teachers and learners with each other using the system.

ILE can be easily combined with technology nowadays having as a result *mobiquitous* learning scenarios that facilitate communication and interaction among students. In this line, written and spoken forms can be integrated in their learning routines and adapted to their specific needs successfully.

## 3 Methodology

### 3.1 The EFL U-Learning Environment with Mobile Devices

This research integrates a context-aware ubiquitous learning environment with the enhancement of the EFL communicative competence, using mobile devices in higher education. Two degrees have been selected for this study. The first is the Degree in Modern Languages (DML), in which students are highly motivated to improve their communicative oral and written expression in English. The second is the Degree in Telecommunications Engineering (DTE), in which students are not given the possibility of choosing the English subject in the third year of their course because it is compulsory. Although English is obligatory in both cases, it is understood that students of DML have preferred to study languages so that they are motivated to improve their language skills, while in DTE, students have no other option rather than studying a six-credit subject during the second semester of the third year of their degree.

A deductive qualitative methodology has been applied for this research, based on describing the phases, the task-based learning approach, and the consequent results achieved when using m-learning and u-learning scenarios. This investigation has also focused on a descriptive–comparative approach that aims to observe the EFL learning progress of our students by implementing u-learning environments in both degrees, DML and DTE, during three consecutive years (2011–2012/2012–2013/2013–2014). The stages are shown below:

- First phase: Register the m-learning EFL material that was needed for learners to follow the English courses in DML and in DTE. Once this m-learning material was selected, it was posted on the courses platforms. The m-learning material created by the EFL staff was posted on the *OCW* platform, on the *Ubilingua* website, and on the YouTube channel. Here we are referring to different approaches that combine the flipped classroom with u-learning environments.
- Second phase: Design and collect the type of digital activities created by students of DML and DTE that resulted in enhancing their communicative competence by means of m-learning and u-learning environments: online glossaries, discussion forums, and interactive digital exercises. Here the instructions, the tools, the skill especially performed, and whether the activity is performed individually or in groups would be of consideration.
- Third phase: Analyze the activities together with the results and assessment for these communicative tasks. Assess if these m-learning environments satisfied students.

## 3.2 Procedure

As mentioned before, this study was conducted during three consecutive academic years in a 15-week semester for each university program. During these 3 years, the study groups were asked to participate in a variety of learning approaches depending on the task or the content studied. On some occasions, students watched video lectures individually and outside the classroom (flipped classroom) in order to allow the physical space for tasks devoted to practice their written and oral expression. On other occasions, students were interacting with others while posting their comments on discussion forums or while elaborating glossaries on the course platforms (u-learning). Ultimately, they also delivered group oral presentations and individual written assignments that required the u-learning context-aware

**Table 1** Activities to improve written and oral expression in EFL

| EFL communicative activities focused on written and oral expression | | |
|---|---|---|
| | *Degree in Modern Languages* | *Degree in Telecommunications Engineering* |
| **2011–2012** | Discussion forums, group oral presentations using visuals, written assignments | Discussion forums, individual oral presentations using visuals, written assignments, online glossaries |
| **2012–2013** | Discussion forums, group oral presentations using visuals, written assignments | Online glossaries, discussion forums, in class debates, group oral presentations using visuals, written assignments, online glossaries |
| **2013–2014** | Discussion forums, group oral presentations using visuals, written assignments, in class debate | Online glossaries, discussion forums, in class debates, group oral presentations using visuals, written assignments, online glossaries |

environment and the m-learning approach of using their mobile devices anywhere and anytime to do some research and to elaborate their tasks. The following Table 1 shows the activities designed for these students to demonstrate their oral and written skills in the EFL courses.

## 3.3 Level B1 and English

In Spanish higher education, it is essential to obtain a diploma that certifies a minimum of B1 level in English, according to the Common European Framework of Reference for Languages (CEFRL) in order to be graduated in any degree. Students are given the possibility to obtain this B1 level in English by means of one or several subjects in EFL they have to attend throughout their degrees. In the specific cases of the two university degrees we are analyzing in this paper, DML and DTE, students have different subjects that provide the adequate conditions for them to obtain this B1 level.

In DML, students may obtain a B1 level by attending their first two subjects in EFL (*English I* and *English II*), both of them taught in their first year at university. However, those students will be future experts in foreign languages, so they are required a higher level (C1) that they will achieve by attending four more compulsory subjects in EFL (*English III*, *English IV*, *English V*, and *English VI*) taught throughout their second and third years of degree. By contrast, students of Telecommunications Engineering are required a B1 level in English, and they have two compulsory subjects, *English* and *Communicative Competences in Englis*h, which are taught in the last 2 years of DTE.

Despite the obvious differences between both degrees in terms of demand of English, all the students are required a B1 level in EFL, and that is the level we have focused on in this paper. The adequate design of tasks that correspond with the soft skills to perform level B1 in EFL will improve the written and oral competencies that follow:

**Written Expression**

The main goal as regards this skill within level B1 is to be able to write well-structured texts about daily life topics and related to the academic and professional fields. The competencies to be developed will be, first, the capacity to tell and describe feelings and experiences through simple written texts and to write real and imaginary short stories and, second, the ability to summarize information related to students' specialties and express their opinions in brief written texts.

**Oral Expression**

The main objective that students have to achieve is to describe in a simple and organized way a set of topics related to daily life. The specific competencies to be developed by students are, first, to be able to describe experiences and tell stories and events; second, to express opinions, plans, and actions; and, third, to present a topic, following an academic format, in front of an audience.

The next section provides some examples of specific activities that students completed in order to achieve the abovementioned competencies set for level B1 regarding the oral and written expression. We will especially classify the tasks that were created using m-learning and u-learning methodologies.

## 4 Results and Discussion

The outcomes reveal that the written and oral expressions together with the rest of EFL skills have been improved in both degrees by using the appropriate technology, content, and tasks that were especially adapted to these digital students. The authors have attempted to adjust their courses to the learners' context. In this line, this section will be classified according to the following pairs of activities that happened in a *mobiquitous* learning environment: written or oral task and individual or cooperative work.

### 4.1 Expressing Themselves by Means of Written and Oral Tasks

**Written Tasks**

The written expression had a similar plan in both the DML and DTE courses. Students practiced the process of writing: how to generate ideas; how to narrow the topics; how to outline their essays, the paragraph structure, the essay structure, the appropriate use of linking words, and the passive voice for formal context; and how to include their opinions in the most objective and formal possible way as part of their writing sessions. These learners did various peer to peer exercises in class and online. They not only received constructive feedback from their teachers but also from their peers, who following the evaluation criteria posted on the platform, provided suggestions to improve their written expression. It was an input–output exercise that they especially enjoyed. Moreover, these learners also received feedback and suggestions to improve from their teachers, not only once the first assignment was marked but during the writing tasks they posted on the forums or glossaries, for instance. Previous to the final written assignment, which was done in class in exam condition, these EFL learners had to express themselves, share their written work, offer feedback to other peers, and receive the suggestions provided in a constructive way with the intention of improving their writing skills. Students' written expression was mostly assessed individually once the first essay was handed in and once the final essay was written in class in exam condition following the rubric they had already been using in this u-learning environment. The teachers also provided students with some feedback on the most common mistakes made by them during a class session with the whole group. Students generally discovered and recognized their own mistakes.

Some DML students also wrote mini-sagas or stories in 50 words. They had to choose a topic they liked and write a mini-story by using only 50 words. It means that they had to carefully summarize the contents of their stories with the most appropriate words. Once they wrote their mini-sagas, they posted them on the virtual platform to share their anecdotes with their classmates. Students felt proud of seeing their creations posted and they could vote for the best mini-saga.

One more activity students in DML had to accomplish was the appropriate structure of an email with its opening, body, and closing paragraphs and the specific features of this kind of writing activity (informal language, abbreviations/contractions, and so on). Students were asked to write an email to an old friend they had found on Facebook. This task was sent to another classmate and to the teacher. Each student received an email from a classmate. They had to correct each other considering the conventions worked in class.

The discussion forum was the most regular activity posted on these DML and DTE platforms. They did not only respond to the topics suggested by their teachers, but they even invited classmates to follow up the discussion with new welcoming conversations. The motivation level when participating in forums was generally high, and even the shiest student had the opportunity of speaking up and having a say on the topics proposed. Furthermore, the discussion forum remains one of the most useful activities to promote informal discussions in EFL for the improvement of lexis, grammar, and written expression. Learners are more often used to interacting by means of posting m-learning messages that can be read from their mobile devices.

Another u-learning activity planned to improve their written structures was the digital glossary. The online glossary is based on *Moodle* and it allows learners to create a group glossary with the most useful new terms studied in the course. Once students were presented some definition structures, they followed these instructions to add terms in the glossary created by the group. Each glossary differs each academic year since it is adapted to the specific needs of the learners participating in the course. This implies that the final glossary depends on the educational community participating in the course. This task was not only useful but successful at the time of creating correct definitions and sentences with the terms in a context applied to students. Although this tool could be printed out, most learners accessed this resource from their laptops (less frequent was the PC), their tablets, and their mobile phones.

### Oral Tasks

The EFL courses of this study planned for DML and DTE implied that students were immersed in an EFL scenario 24/7, when attending and interacting in face-to-face sessions or when accessing m-learning content. So, they could practice their written and oral expression together with their listening and reading comprehension, the lexis, and the use of English studied in these courses. The concluding oral tasks that formed part of their assessment criteria were the group oral presentation and the debates, both delivered in class.

The oral presentations and the debates required that students created their groups in order to organize their work and assign roles to each group participant. These two oral tasks were founded on a cooperative learning approach that "was designed in order to highlight social and affective skills that would improve students' confidence in the foreign language and the performance of various language skills" (García-Sánchez 2014, p. 7). The findings demonstrate that these tasks were positively accepted by students who mostly enjoyed the procedure of actively creating their speeches, either for a debate or for an oral presentation purpose. The cooperative approach was positively accepted by these learners who understood the level of decision-making and group compromise needed to fulfill these tasks.

The intention, the format, the rules, and some expressions were explained at the end of one session so that students could do some research for homework. Initially, students were told that the class would be divided into three groups: the group in favor, the group against, and the audience. One member of the class, if possible a volunteer, would be the moderator who runs the debate controlling the time and the turns when speaking. Once the form of the debate was explained, students were told the topic of the discussion for them to do some research that could support their positive or negative arguments. Making some questions for the positive and the negative team was also suggested since they could also be assigned the role of the audience. Nobody would know which role they would have in the debate until the date planned for it. So, it is expected that everyone is well informed to contribute in either of the two teams or as part of the audience, which would also interact at the end of the discussion with some questions, comments, and/or suggestions. The rules and the steps for students to prepare the debate were also provided, together with some polite language they could use when introducing the topic or when expressing disagreement, for instance. In the DML group, this activity was done only in the second year of this study, while in the DTE, the debate had its place during the 2 years of this research, but it was only in 2013–2014 when the two classes (Group A and Group B) together with their teachers were joined in one common session to start the debate. The figures below show some of the slides presented in class during the last explanation of a debate (Fig. 4).

Regarding the oral presentations, they were organized in groups of four or five students, and they had absolute freedom to choose a topic related to their field of expertise or a topic seen in class. Each student needed to present a section of their group speech and demonstrate coordination among the group members. Groups had to design their presentations following a set of guidelines presented by the teacher.

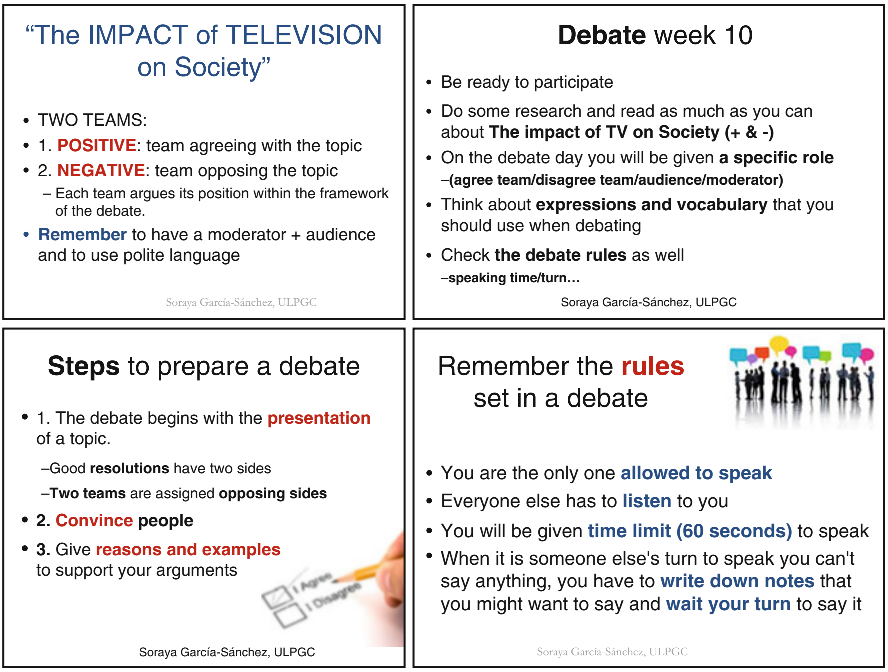


**Fig. 4** Slides explaining the structure and rules of the debate

On the day of their presentations in class, the rest of the students were required to be proactive, asking questions, saying comments or suggestions, and so on. It means that each presentation took around 20 min followed by 10 min of discussion. Obviously, students freely prepared this activity with various resources available to support their presentation such as music, videos, PowerPoint or Prezi, and disguises.

Once the instructions for the delivery of the oral presentation were given (Fig. 5), learners could access the evaluation criteria on *Moodle*. They could understand which factors and percentage would be given to their work. The following figure shows an example of the rubric for one of the subjects in the DML. Students could understand the expectations of their work and the final grading. This rubric did not include the levels of quality (from poor to excellent or from 1 to 5, for instance), but the top standards for each evaluation category were given for students to peer assess (only in DML) each other and for teachers to evaluate their students' work. In one of the subjects of the DML, peer to peer assessment was implemented during students' presentation. While two groups delivered their speeches, the rest of the class followed their presentation and were welcome to make contributions or questions. Once their oral presentations were finished, one member of a group assessed another member of the other group (20 %), while the teacher was assessing everyone (80 %). In addition, each student was asked to write individually a few

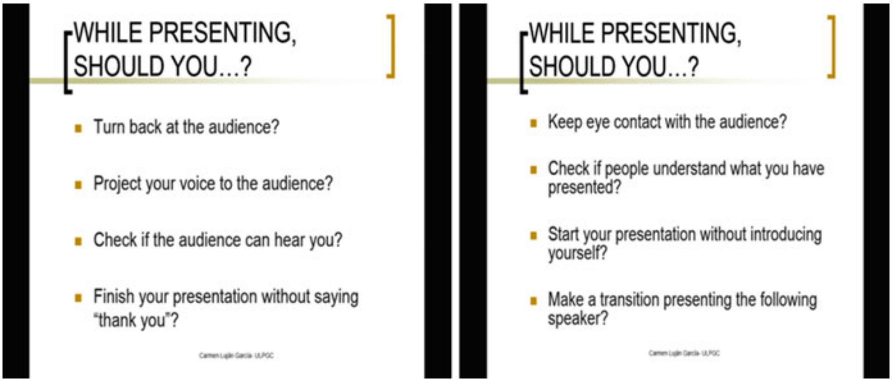


**Fig. 5** Slides showing some tips students should follow to prepare their oral presentations

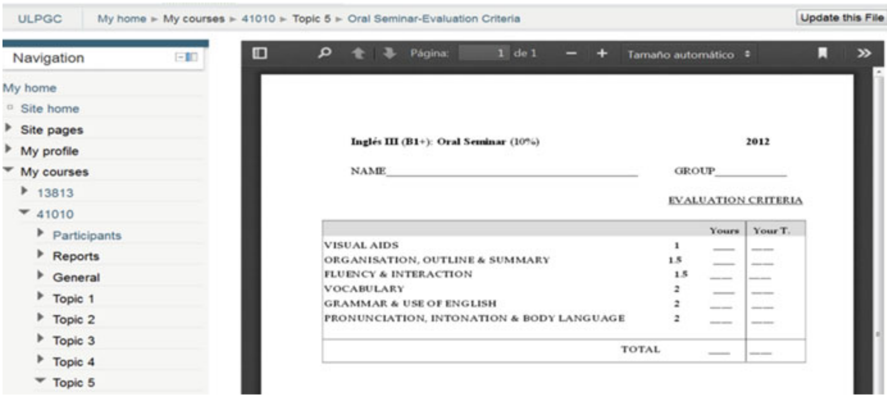


**Fig. 6** Example of a rubric for oral presentations posted on *Moodle*

lines to state the mark they considered fair for their performance. Then, they handed in this piece of paper to the teacher. The final mark was summative and included both the students' and the teachers' feedback on the students' goals. As E. Silva (2009) has suggested, current learning methodologies put "[a]n emphasis on what students can do with knowledge, rather than what units of knowledge they have" (Fig. 6).

The results demonstrate that the oral presentation and the debate were the most satisfactory activities for students. In the organization of these activities, students had to establish clear roles that depended on each other to have a concluding product: the oral presentation. At the same time, preparing their oral presentation implied that they used the vocabulary, appropriate structures, and other important aspects such as body language, visual contact, voice projection, and suitable design of their PPT presentations, for their talks to be formed successfully. They also had to divide the participatory interactions among the group members.

Delivering a group oral presentation was a necessary requirement to pass these subjects. The vast majority of groups in both DML and DTE were actively motivated in participating in their oral presentations (85 %). Although some students initially were frightened of this particular oral task, they finally succeeded and felt satisfied with their group and individual contributions. Even the less motivated students were immersed in providing similar responses to their class peers with the elaboration of their work, and therefore, they put a special effort in speaking up and letting their voices be heard by the classmates.

Both the organization and elaboration of either the debate or the oral presentation allowed this tertiary educational community to participate in u-learning and m-learning environments. Students were given the instructions, the tools, and the evaluation criteria to accomplish these two oral tasks, which implied adapting their speeches to the specific context of the course and the students' needs. Likewise, learners had to access flipped classrooms ("how to deliver an oral presentation" and "discourse markers," for instance) and other u-learning spaces ("linking words," "polite language," and other web references) for their research and knowledge creation in EFL. These individual and cooperative preparatory exercises were mostly done outside the classroom with no schedule limitations, which implied performing individual and group tasks.

## 4.2 Autonomy, Responsibility, and Cooperation

K. Yujaroen has previously highlighted in this handbook how necessary learners' autonomy is when learning a foreign language in m-learning environments. The design of the exercises and tasks students had to accomplish in this study was planned having in mind an individual learning approach together with a cooperative learning approach. This proposal establishes a logical dialogue between two terms: autonomy and cooperation. Under the sphere of a learning environment, responsibility is the key concept behind a successful learning approach that should combine individual and cooperative work. Normally, a citizen that is aware of their daily tasks has a positive impact on the rest of coworkers or family and friends. The same would happen in a learning environment. If a learner understands his or her goals in a responsible way, they cannot only be successful lifelong independent learners, but they can also contribute with other peers in team tasks that require that same level of compromise. When this responsibility takes place in both spheres, the final result is successful learning.

The individual tasks planned for these EFL courses were especially designed to improve learners' vocabulary, use of English, written expression, reading comprehension, and listening skills. The cooperative tasks, on the contrary, implied more peer to peer interactive actions that contributed to oral communication practice either by means of daily conversations in class and online discussion forums or by means of debates and oral presentations. While participating in these cooperative tasks, learners were also involved in enhancing other skills of EFL since they had to do other secondary actions such as reading, watching videos, writing, and supporting ideas in addition to using the vocabulary, for instance, to finally share and create the oral presentation and the debate. In this line, this study demonstrates that both the individual and cooperative activities were established in a communicative learning approach that promoted active participation by means of adding u-learning and m-learning environments that go beyond the time and space limitations of the classroom.

## 5 Future Directions

Nowadays, it is doubtless that learning English as a foreign language (EFL) implies constant interaction between students and teachers and regular access to information by means of mobile devices. Learners of EFL in higher education are more often used to actively participate in the performance of exercises that focus on the skills of the foreign language: use of English, vocabulary, reading, listening, writing, and even speaking with other participants. A m-learning approach improves the regular access to information from any mobile phone or tablet, and it even goes beyond by extending the possibility of communicating other than face-to-face as stated by L. Liu in a previous chapter of this handbook (▶ Chap. 38, "Health Guidance of Children's Psychological Development"). U-Learning suggests that knowledge and information is context aware and available anywhere and anytime.

The written and oral exercises performed in class and online were carefully planned having in mind u-learning and m-learning environments, in order to allow these tertiary education students to be prepared for life and for professional purposes. Due to adapting these EFL students to current methodologies that included more participation, resourcefulness, and interaction, these learners were positively improving their written and oral expression in English since they were frequently involved in wireless systems of communication that not necessarily happened inside the classroom (Liu and Hwang 2010). Although some of the students' final written and oral tasks were presented in class, it is assumed that their knowledge building occurred partly outside the classroom (individually and cooperatively) and by means of accessing u-learning spaces that contributed to EFL acquisition and production.

From an empirical viewpoint, it is not new to affirm that this type of EFL lessons demands to be regularly innovating learning plans and assessment criteria that can be especially adapted to students' needs. Depending on the contents, the number of learners, the number of weeks, and the u-learning tools, teachers can propose a u-learning environment that can be combined with a m-learning approach in order to promote anywhere and anytime self-determination for learning. In doing so, teachers can be closer to students' reality. Consequently, current citizens' needs are not being ignored.

This study suggests that some EFL current instructors and learners are moving forward when accessing flipped classes or when creating interactive online glossaries and cooperative wikis. It is true, though, that only by means of proper training and continuous revision of goals can educational institutions contribute in the achievement of successful learning (Rudd II and Rudd 2014, p. 6). Deepening in this kind of approach to learning EFL by using m-learning and u-learning environments is a challenge that we, as teachers, are committed to. Future prospects could be related to doing some rigorous research that can assess learners' performance when they are participating in these u-learning environments that more frequently add the use of apps (Kim et al. 2013) and other open access tools students individually discover and share with their educational community.

## 6 Cross-References


▸ Mobile Learning Beyond Tablets and Smartphones: How Mobile and Networked Devices Enable New Mobile Learning Scenarios
▸ Moving with Mobiles – Using IT in the Classroom as Against Online: Comparative Reflection from South Australia


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# M-Learning: Visible Approach for Invisible World 58

Kshama Pandey

## Contents



**Abstract**

With 16 % of the world's population, India is today the second largest populated country in the world. Future trends in global population growth could be significantly affected by improvements in both the quality and quantity of education, particularly female education. According to the UNESCO Report on Education in the twenty-first century, higher education is the mandate to bridge the knowledge gap between countries and communities, enriching dialogues between people and culture, and international linking and networking of ideas, research, and technologies. On 2011 enrollment was only 207 lakhs for higher level. We can not supposed to education for all because a huge population is still not able to reach basic education. Huge populations have mobile access in India. In India, total number of rural subscribers is 311.33 million in October 2014. Indian rural people are advanced in technology and there is a need to facilitate mobile as a learning tool. It has required a great motivation to achieve this target. In the future, we will witness mobile phones, computers, and various other computing/media devices (iPods, Digital Cameras, PDAs, etc.) we use converge into a single personal mobile computing device. At such a time, the differentiation between eLearning and m-learning will cease to exist; all learning

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will be electronic and mobile. Therefore, there is tremendous potential for the growth of mobile learning even in the invisible world.

# 1 Introduction

Education is the prime mover of the society. It determines the role and approach for the modernization of society and the nation at large. Since "development" is the buzzword for the advancement of our nation, the quality of our education is of paramount importance along with access and equity to tap rich dividends from our demographic capital. We live in an ever-changing world. Higher education has to be assessed from a broader perspective in the context of various types of changes in the micro and macro environment. New technologies keep coming up and if you do not want to be left behind, you must keep up with the world that is moving fast. Integrating technology in education everyday helps students stay engaged. Today's students love technology so they are sure to be interested in learning if they can use the tools they love. With technology, the classroom is a happier place. Students are excited about being able to use technology and therefore are more apt to learn. When mobile technology is readily available in the classroom, students are able to access the most up-to-date information quicker and easier than ever before.

## 1.1 Educational Landscape in India

With 16 % of the world's population, India is today the second largest populated country in the world. The world population is on the rise. In addition, America is working harder to maintain an educational system that ensures a proper education to every student, regardless of race or financial ability. Providing this education seems to be more difficult as time goes on, and there may be a direct correlation between the population growth and the educational difficulties. Future trends in global population growth could be significantly affected by improvements in both the quality and quantity of education, particularly female education.

Education is essential for the growth and prosperity of both a nation and its society. Apart from primary and secondary education, higher education is the main instrument for development and transformation. Higher education has the omnipotent role of preparing future leaders for different spheres of life such as social, economic, political, cultural, scientific, and technological. According to the UNESCO Report on Education in the twenty-first century, higher education is the mandate to bridge the knowledge gap between countries and communities, enriching dialogues between people and culture, and international linking and networking of ideas, research, and technologies. Thus, higher education provides the competencies that are required in different spheres of human activity, ranging from administration to agriculture, business, industry, health, and communication, and extending to the arts and culture (Powar 2002, p. 74). In India, the growth of Indian higher educational system has undergone a remarkable transition from an

**Table 1** Population census

| Year→ | 2001 | 2011 |
|---|---|---|
| Total population (in crore) | 102.80 | 121.01 |
| Male | 53.20 | 62.37 |
| Female | 49.65 | 58.64 |

Source: MHRD, India (2011)

**Table 2** Level wise enrolment (in lakhs)

| Year/level | Primary (I–V) | Upper primary (VI–VIII) | Secondary/Sr. secondary (IX–XII) | Higher education |
|---|---|---|---|---|
| 1950–1951 | 192 | 31 | 15 | 4 |
| 1960–1961 | 350 | 67 | 34 | 10 |
| 1970–1971 | 570 | 133 | 76 | 33 |
| 1980–1981 | 738 | 207 | 110 | 48 |
| 1990–1991 | 974 | 340 | 191 | 49 |
| 2000–2001 | 1,138 | 428 | 276 | 86 |
| 2005–2006 | 1,321 | 522 | 384 | 143 |
| 2006–2007 | 1,337 | 544 | 398 | 156 |
| 2007–2008 | 1,355 | 572 | 445 | 172 |
| 2008–2009 (P) | 1,345 | 554 | 455 | 186 |
| 2009–2010 (P) | 1,356 | 594 | 482 | 207 |

Source: MHRD, India (2011)
*P* Provisional

elite system, having deep colonial roots, to an egalitarian system striving to meet the aspirations of a vibrant democracy.

In India the growth of higher education is remarkable but there are still some gaps that deserve attention. We start from the total population of India as 121.01 crores (Table 1). It is evident from Table 2 that enrolment was only 1,356 lakhs for primary level, 594 lakhs for upper primary level, 482 lakhs for secondary level, and 207 lakhs for higher level. Census Data show that we can not supposed to education for all because a huge population is still not able to reach basic education.

## 1.2 Dropouts: Invisible World Deprived from Learning

Dropout has been defined as the proportion of children that cease to remain enrolled in the schooling system. In 1993, 27 million children entered school in Class 1 in India but only 10 million (37 %) of them reached Class 10 in 2003. Dropout rates peak in the transition between Class 1 and 2 and again in Classes 8, 9, and 10. Dropout rates have remained negative between Classes 4 and 5. The state of Pondicherry improved its performance concerning school dropouts from the fourth place in 1991 to the first in 2001, displacing Kerala as the best performing state.

The states of Bihar, Jharkhand, Uttar Pradesh, and Arunachal Pradesh perform poorly in this ranking.

India has seen a steady increase in primary school enrolment over the last decade – as of 2013, over 96 % of rural Indian children of primary school age had enrolled in the schooling system, up from hovering around 80–85 % in the early 2000s.

However, many of these students leave – a UNESCO 2012 report shows that 13.54 million South Asian students leave school before completing their primary education. This problem presents in increasingly large proportions too – to take one state as an example, in 2013 over 14 % of female students between the ages of 7 and 16 went missing from school in Maharashtra, as opposed to 11.7 % in 2012. Thus, it seems that although the prevalent ethos and the legislation (including the Right to Education Act of 2008) in India nearly guarantees that every Indian student will start schooling, it does not yet have the abilities to ensure that the environment to actually attain an education exists.

Dropping out of school is a worldwide phenomenon with drastic mental health consequences for children, families, and society. Every year, a large number of students drop out of school worldwide. A significant number of them go on to become unemployed, living in poverty, receiving public assistance, in prison, unhealthy, divorced, and single parents of children who are likely to repeat the cycle themselves. A huge number of our population is still invisible from main canvas. These marginalized students disappear from the real world and get involved with invisible world. We need to explore this world. Now the question arises that how these invisible people can access a quality education. The answer may be technology. We can adopt an advance cost effective technology for the education of this invisible world. Mobile learning would be the best solution for these marginalized students.

## 1.3 M-Learning in Rural India: An Overview

While scope of Mobile-learning is growing fast, it is imperative to address the problems of low level of literacy, limited understanding of English language in rural and semi-urban areas, and text-driven interface in order to reap the benefits of this technology.

As per 2011 Census, India is recognized as one of the youngest nations with a majority of its youngsters entering the workforce by 2015. This has instigated the demand for a different kind of an education system that should be capable to fulfill the necessities of quality and quantity aspect of the education system. Hence it should such that increases the penetration of the education sector in remotest places and removes the barricades in quality education. It is evident from Table 3 that the total number of rural subscribers is 311.33 million in October 2014 and the number of subscribers has increased 1.23 % from previous month. It shows that Indian rural people are advanced in technology and there is need to facilitate mobile as a learning tool. It has required a great motivation to achieve this target.

**Table 3** Rural GSM subscriber

| Rural GSM subscriber figures, October 2014 | |
|---|---|
| 1. | Total number of rural subs as of October 2014 – 311.33 million |
| 2. | Rural subs net additions in October 2014 – 3.79 million with 1.23 % increase from previous month |
| 3. | Maximum rural subs net additions in the month of October by Airtel – 1.66 million |
| 4. | Maximum rural subs addition in the month of October in Bihar – 0.79 million |
| 5. | Maximum rural subs – Airtel – 99.11 million |
| 6. | Maximum rural subs for the circle – UP (E) – 33.01 million |

Source: TRAI report (2014)

The bull's eye of completion for the different programs of Digital India is fiscal year 2016. The implementation of this program is a very rigorous process and seems very difficult to complete within duration. In these circumstances, mobile as a tool for learning is an easier and cheaper mode to educate millions of youth than a personal computer or laptop. According to Telecom Regulatory Authority of India (TRAI) Report and Census 2011, mobile dissemination in India is 76 % in comparison to broadband, which is only two per cent. This further solidifies the view that mobile is more prime solution for intelligent young professional who wish to pursue education. However, meagerness of ICT infrastructure presents an enormous barricade. According to one of the estimates of TRAI during the coming year there will be an additional 200 million new mobile subscribers. This supports the research of wearesocial.net, that there are more than 898 million mobile subscribers in India, 292 million of these living in rural areas.

## 1.4 Efficacy of M-Learning

Mobile learning is not just a fashion. It is instead a transformative opportunity both for learning, and for the learning organization. Mobile learning supports formal learning, nonformal learning, and informal learning. Social learning is also enhanced by m-learning.

The actual implementation of m-learning is growing faster in some capabilities than others. According to eLearning Guild research data collected from members worldwide, the use of m-learning for social networking and communication is more prevalent than it is for the development of custom applications, with 38.1 % of organizations either implementing, designing, or building the business case for social networking and only 25.7 % for custom application development. Of those who have conducted an m-learning implementation, 50 % are seeing positive returns.

Surpassing and increasing access to expanded educational opportunities for all students has long been an aspiration for policymakers, educators, and parents. In recent years, the government has emphasized the importance of mobile technology as a way for achieving this goal. Mobile technology can help connect teachers to students, parents, and free educational resources. Mobile technology also helps schools share classes, curricula, and other resources. The nation has made great strides toward connecting its educational infrastructure to high-speed internet, but the actual circumstances show that rural schools and communities have inadequate network coverage when compared with their nonrural counterparts. Inadequate connections for rural schools will become a growing problem for India if steps are not taken now – one fourth of all Indian students attend a rural school and in latest years rural enrolment growth has outpaced expansion in all other school locales.

The availability of mobile network in the isolated area of the country enables to leverage the extensive use of technology through introducing modifications to the ecosystem of education sector through m-learning. Technology has only extended class room of urban schools, where it is again limited to computer labs and audio-visual rooms. With cultivating infrastructure, the Indian Education system is already making advances towards adopting the M-education (KPMG's the Cloud: Changing the Business Ecosystem, 2011)

## 1.5 Requisite of Mobile Learning

Mobile is a powerful new tool for supporting organizational performance, including a wide-variety of learning opportunities including innovation, collaboration, research, and design. Mobile generates new products, services, and helps solve problems. Whether providing needed tools, augmenting learning, or connecting individuals, mobile devices are empowering individuals and organizations.

M-learning solutions provide access to innovative teaching pedagogy to the educators which help to solve the training issue of undertrained educators.

Engaging learners and enhancing the understanding of the learner demands customizing teaching styles according to the needs and preferences of each learner. This is impractical in traditional classroom environment. More interactive formats and content tailored to individual learning styles developed under the m-learning platform has the potential to increase engagement levels of students to understand better. In comparison to traditional time-consuming evaluation system, m-learning provides regular assessment system during the learning process which helps the teachers to understand and determine the specific learner requirement for conceptual clarity.

## 1.6 Principles of Designing Mobile Learning

Mobile learning needs specific learning principles of design that is given in Fig. 1. Very initially, it is required to know the features of device and nature of target learners. Learning should be multifunctional and experience oriented. It is essential to explore the learner's need and requirement so that it may be possible to connect the learner with this meticulous learning. It is very essential for the device to be simple in functioning.

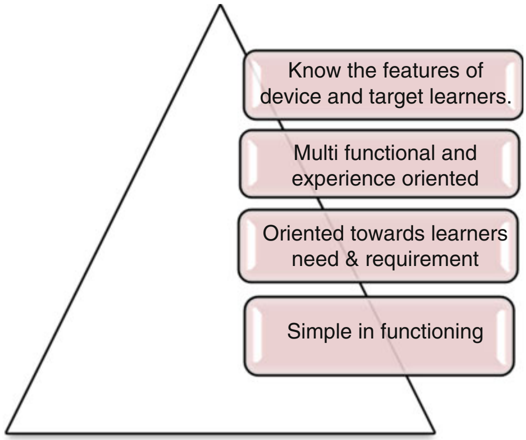


**Fig. 1** Basic principle of m-learning

M-learning will be fruitful and beneficial if the learning will be provided on the bases of these principles. If a teacher will do it, then your target learners will appreciate an engaging, useful, and pleasant mobile experience.

## 1.7 Mobile Learning Design

Content preparation is a beginning step for mobile learning design. Content should be focused on learners' necessity. It may be fusion of traditional and innovative approach. In m-learning, learning material and content needs to be cast effective. Mobile learning should be required to follow some steps in organizing mobile learning design as given below:

Steps of mobile learning design

- Content preparation
- A blended approach
- Magnitude of course file
- Mobile usability
- Device orientation

(a) **Content preparation**

As learners may choose to use short portions of m-learning at a time, they need to know how each learning nugget fits into a whole course or curriculum. The teacher should help them identify this by making the formation of the overall course clear when they access each learning nugget. A content preparation of the whole course at the beginning of each learning nugget would be a useful strategy for accomplishing this. Similarly, it is important to make the objectives for each learning nugget clear at the start, so that learners have an overall indication of what will be covered.

(b) **A blended approach**

Designing the course of m-learning should be learner centered. One of the major "mistakes" in designing m-learning is that too much content is inappropriately used for smartphones and tablets, resulting in a poor user experience. Instead of attempting to create whole eLearning courses for a small screen size, a different type of approach should be considered. Designer should be aware to produce relevant course material for small screen.

We can adopt a blended approach for m-learning solution. For example, "just-in-time" elements of m-learning such as revision modules that can be taken instantly before presentations or meetings, job aids and top tips can all be used along with traditional eLearning or instructor-led training in a blended approach. Learners can access these "learning nuggets" on their mobile device whenever and wherever they necessitate them. Resources such as these would sit well in a blended approach, perhaps alongside traditional eLearning, or instructor-led training. If the learners would like further information on a particular subject matter, then required to available them. Teacher could do this by directing them to other modules in the course, other aspects of the blended approach, or alternative resources, such as websites or supporting documents.

(c) **Magnitude of course file**

With the introduction of content being delivered with, bring your own device (BYOD), learners using their own mobile device for m-learning will be passionate to maintain their personal costs to a minimum. It should always be remembered that learners may not always have access to a Wi-Fi connection, and may be very unwilling to use their own data payment for learning content. Therefore, designer should require considering the overall file size of the course content. Another concern in m-learning design is that content should be available both online and offline.

(d) **Mobile usability**

Most users of mobile devices expect a good user experience. They expect applications to integrate well with their operating system, and do not expect to need to learn new navigation systems or unconventional gestures. Consider mobile usability heuristics to ensure that instructor is providing a positive useful experience for their learners. Aim to build content where users will not notice the usability experience. If they notice it, it is probably for the wrong reasons.

(e) **Device orientation**

In some instances, most mobile devices utilize both landscape and portrait orientation. Instructor should ensure that their learners are able to use both; otherwise, he should present content that is fixed to one orientation. Therefore, there really are many facets to consider when designing mobile learning. These will consistently change and advance over time and will depend on your customer's specific need or requirement.

## 1.8 Features of Mobile Phone as a Learning Tool

Mobile phones have the following features:

(a) **Voice**
Such phones with voice are the most basic phones, are still prevalent though being rapidly replaced. Only technology can be used to learn languages, literature, public speaking, writing, storytelling, and history amongst a whole range of topics. We have known that voice based learning works for millennia now.

(b) **SMS**
Widely used in India, literally billions of short text messages are sent over the phone networks. These messages can be written quickly and offer enormous learning opportunities. SMS can be used to provide just-in-time information of almost any type, like reminders (e.g., someone undergoing a formal mentoring process). SMS can be used for informational quizzes. There are also innovative games based around SMS that have strong learning potential.

(c) **Graphic displays**
Almost every mobile phone has a graphic display, even if it just shows signal and battery strength. Most phones today have far more graphic power and are able to display words, pictures, and animation. Such screens also allow for meaningful amounts of text to be displayed, supporting rapid serial presentation of context-appropriate information. You can use this type of displays for almost any sort of learning. Eventually these displays will render content that is today rendered on personal computers.

(d) **Downloadable programs**
With mobile phones that have memories, and can accept and install downloaded programs an entire new learning space is opened up on the phone. Almost any sort of learning content and interaction technology can be delivered to the phone using this method.

(e) **Mobile Internet Browsers**
Internet browsers are now built into an increasing number of phones, especially those that take advantage of 3G or enhanced data networks such as GPRS. Mobile should have browser that make it able to access learning resources like web browsing including Google, LMS applications, typical eLearning courseware, and other tools/applications.

## 1.9 Digital Inclusion with M-Learning

These days, mobile devices are stylish. Children are carrying more technology to school in their pockets than we have been able to buy them over the last 30 years, says Shelly. However, for many of these cell phone users, mobile technology is the only way they can get online. Access to richer graphics and data, as well as superior tools, is still limited on many affordable mobiles. At the same time, many schools continue to demonize cell phone use during school, which may be an outdated policy. Not only are there an increasing number of educational applications for mobiles but, as Blake-Plock advocates, prohibiting phones now means "disconnecting the adolescent from what's actually happening in most of our lives."

Digital exclusion remains a significant challenge in the India. A vast number of adults are offline. Within this group the elderly, the underprivileged, and those with lower incomes and less education are all disproportionately represented. This figure has been gradually falling, but there are substantial challenges ahead, because most of those with the desire to access online resources. Consequently, a significant mainstream of those still deprived to access online resources have no interest in moving to online resources.

In particular, it argues for offering mobile devices for online resources that:

- Come to the user and motivate for using mobile apps for educational purpose
- Mobile features should be as simple as possible, to ease the skills challenge and to enable experimentation and also to inspire them for further usage.
- Device should be vigorous, in the sense of easy to maintain and very easy for a beginning user.
- Learner has to integrate, incorporating both equipment and connectivity.

Moreover, the internet is increasingly a mobile phenomenon being accessed from mobile devices and the quantity of web content personalized for mobile browsing is on the increase. Over half of Indian adolescents use a smartphone or other mobile to get online resources. In the near future, internet exclusion will be exclusion from a medium primarily used via such devices. Governments must not underestimate the role mobile technology and networks have to play in bringing more and more people online.

Mobile phone has attributes, which construct it highly valuable as a tool to deal with digital inclusion. Mobile phones with internet connectivity are simple to use and technically robust; need much lesser financial commitment than a PC with fixed broadband; are sound suited to passing individuals and those with in-home mobility challenges; and come with a range of integrated potential such as cameras which many PCs lack.

As the task of helping people move online is becoming more challenging. Mobile phone is the best tool to help learners moving online and it will be the best option for an increasing number of individuals transitioning online. The nature of digital inclusion is changing increasingly. Those offline simply perceive a need to move online. Mobile has great potential as one such tool, and is currently underutilized. We believe the following steps could be valuable towards mobile meeting its potential in this context.

- Availability of the devices
- Accessibility of the technology at hand
- Literacy cater

## 2 Potential of Mobile Learning in Rural Areas

Without proper research evidences it is hard to express at the worth of the m-learning market in India, any projection is unfounded; and is also due to the improbability of being able to predict the rate of technological (read network) adoption and penetration. However, empirically, we are seeing an increasing interest in m-learning.

Similar to India, it is hard to quantify adoption in more developed markets. It is well known that Asia and Europe are far ahead in terms of m-learning adoption compared to the North American market. The US market for Mobile Learning products and services is growing at a 5-year compound annual growth rate (CAGR) of 21.7 % and revenues reached $538 million in 2007 (Chahal 2012). It would be fair to say that revenues in Europe and Asia will be equal to if not greater than the North American market.

Almost every sector will benefit from the use of m-learning; however, we feel three primary areas that will feel the biggest impact: education, agriculture, and healthcare. Additionally, rural communities will benefit tremendously not just from m-learning, but the mobile technology as a whole. Mobile devices are far cheaper than personal computers and do not depend on a continuous power supply to function.

There is a definite appeal in gaming for learning using mobile phones. Currently, several companies are experimenting with game-based learning technology for mobiles. However, the feasibility of such an approach depends on the cost of development and deployment of such applications, which are quite high at this time. With increasingly capable hardware and connectivity available and dropping costs, it is only a matter of time before learning games on mobile become commonplace.

In the future, we will witness mobile phones, computers, and various other computing/media devices (iPods, Digital Cameras, PDAs, etc.) we use converge into a single personal mobile computing device. At such a time, the differentiation between eLearning and m-learning will cease to exist; all learning will be electronic and mobile.

Finally, it seems relevant to examine the potential of mobile learning in rural areas. Fifty mobile users are selected for this short study from rural areas. They were aged between 16 and 20 years old. To achieve this objective, the investigator adopted SWOT (Strength, Weakness, Opportunities, and Threats) analysis framework. Table 4 exhibits the future promises and confronts of m-learning among the people of the invisible world.

### 2.1 Suggestions

(a) **How to use mobile phone as a learning device?**
Data show that the realities in most rural Indian adolescents have mobile phones in their pockets. Findings of SWOT analysis for mobile learning show that it

**Table 4** SWOT analysis of m-learning

| **Strengths** | **Weaknesses** |
|---|---|
| • Convenience and flexibility<br>• "Situated rather than simulated" and so it makes learning possible at the point of need<br>• Mobile learning empowers learners to take the initiative and direct their own learning activities<br>• Good use of "dead time"<br>• Suitable for many different learning styles<br>• Improves social learning<br>• Encourages reflection<br>• Easy evidence collection<br>• Supported decision making<br>• Easily digestible learning: avoids cognitive overload<br>• Easily trackable via Wi-Fi<br>• Cost-effective build<br>• Context sensitive learning<br>• The power of personalization | • Multitasking may not be best all time<br>• Technology presents problems: Many students may be unable to load coursework and participate in mobile messaging discussions because their devices are not compatible with the class's software and websites<br>• Battery run-down can cause loss of data and applications<br>• Back-up systems are required to restore configurations<br>• Battery life decreases dramatically if add-on cards are used or life wireless communications are enabled<br>• Stylus input is only suitable for short notes, simple diagrams, and selecting options on screen<br>• Security of personal information is a major issue, particularly for medical and nursing education<br>• They are easily damaged, lost, or stolen |
| **Opportunities** | **Threats** |
| • Mobile learning enables forgotten or mistakenly remembered information to be speedily accessed and redressed<br>• Short nuggets of learning are offered on mobile devices, accessed prior to meetings or beginning tasks, improve learners' confidence in their skills<br>• Quick-fire knowledge or mobile assessments/quizzes, in between other kinds of training activities, keeps learning fresh and at the forefront of learners' minds, making success more likely<br>• Better planning for face-to-face sessions<br>• Direct interaction with learning<br>• With the integrated connection of mobile devices to the web, it opens up the possibility of tracking everything the user does, how they use the training, what questions they got right, and even their behaviors | • Mobile security is a serious problem<br>• Hackers can compromise mobile devices by embedding malware into mobile apps<br>• Hackers can steal private information from the device<br>• Wi-Fi hijacking or Wi-Fi snooping is another threat<br>• Hackers can also exploit vulnerabilities when Bluetooth connectivity is turned on<br>• Cyber criminal<br>• Lack of standards for learning on mobile and even general use of technology on mobiles<br>• Multiple platforms and varied technical frameworks. Adds to complexity in terms of design and development, especially when the need is to build native apps, which can utilize the true potential of the mobile platform |

has great potential for future prospects instead of various weakness as well as threats. It is not looking good to perceive mobile phones as evil why not get these tools use them for leaning. Mobile phone can be used as revolutionary tool for education to invisible world.

Here are some easy to employ strategies to use cell phones as learning device:

- **Recording lectures**
  The learning material can be structured as a form of video recording. Teachers are required to record their lessons using video or audio, students are listening to that outside of class as the homework, and in class, they are completing the practice and the teacher serves as a guide, re-teaching as needed. Because of mobile phones, have features to restore data so that learner can use it and watch video of previous lessons of an appropriate clip on YouTube.
- **Instant response system**
  With mobile device, a teacher can track instant answers from all students. Teacher can receive feedback for their improvement. In this regard, it may be an inspiring tool for teacher as well as learner.
- **Delivering materials**
  In present days, curriculum materials are available in digital form and creative teachers are benefitted with delivering materials directly to students on their personal cell phones. This learning platform makes it possible for teachers and students to collaborate in discussion areas and chat with each other making blended learning a real possibility.

(b) **Common problems using cell phones in learning**

- **Students lacking cell phones/smart phones**
  Every student cannot afford mobile phone. It is also a big issue for mobile learning. The easiest way to work around this is to have students working in groups, collaborating and solving problems together. Therefore, we only need one cell phone to report out the group work. To get the solution of any problem we need to be creative.
- **Wireless access**
  Wireless access might be another dilemma. Smart phone users will usually try to locate a wireless network instead of going through the provider signal. The network might be burdened and required material would be lost.
- **Maintenance & uses of cell phone**
  When the class is started with mobile phone, it is the responsibly of instructor to make their class more interactive. Teacher should ensure that their students should be more convenient with m-learning rather than conventional learning. Teacher should make various efforts to reduce fear for using technology from regular routine. Instructors are needed to help students understand the consequences of things like cyber bullying, sexting, and posting things to social networking sites.

(c) **Awesome smart phone apps for teacher**
Presently, various smart phones are available in market with smart apps. These features make the life much smoother for professionals of all types. Therefore it should be inculcated among teachers. Here a list of smartphone apps that teachers can put to work in the classroom and beyond, creating a powerhouse of back-to-school mobile tools (Table 5).

**Table 5** List of smartphone apps for teachers

| Awesome smartphone apps for teacher | |
|---|---|
| Evernote | **Evernote** is a web-based app that allows end users to capture, store, and synchronize text, image, and video files across multiple computing devices |
| Attendance | iPhone-enabled teachers adore this application allowing them to keep track of their students' classroom habits and even learn their names via flashcard |
| Grade Book for Professors | Google Spreadsheets as a useful strategy for organizing and tracking student grades, either through the paid or free version |
| Percent Calculatop | Get grades done harder, better, faster, and stronger using this quick and easy calculator just for figuring out percentages |
| E-Clicker Polling System | Available on the iPhone, the eClicker Suite lets teachers poll their students about anything and everything during class |
| Voice Recorder | Perfect for Android users wanting to make permanent records of lectures for students who cannot make it to class for whatever reason |
| i-talk Recorder | It is a way to keep an audio record of classroom discussions using the iPhone |
| Blackboard Mobile Learn | Blackboard practically provides a classroom for an app, available on almost all smartphone and tablet platforms |
| Course Smart | Provide unlimited access to thousands of digital reads on their phones and tablet devices |
| Teacher Aide Pro Lite | Provide every specific organizational requirement educators need to succeed |
| TeacherKit | Provides a way to stay on top of grades, attendance, and any other factors they need to know |
| **Dropbox** | This simple, popular tool focuses mostly on transferring documents back and forth between different computers and smartphones alike |
| RE.minder | Educators with time management issues might want to consider downloading RE.minder, with a to-do list feature and handy alerts when tasks are almost due |
| iAnnotate | iAnnotate helps iPad-owning teachers edit, organizes, read, and annotate (of course) PDF files, making it an ideal tool for grading student projects |
| Free Wi-Fi Finder | It helps to know what nearby locales host free wireless service |
| Instapaper | Save pages from useful websites and blogs that you encounter for offline viewing and reading with this much-ballyhooed timesaver |
| Documents To Go | View and create PDFs and Microsoft Excel, Powerpoint, and Word documents from almost anywhere |
| Bento | Keep a database on contacts, projects, upcoming events, due dates, and more with one of the most acclaimed organization applications available |
| Edmodo | Connect with other teachers as well as students using Edmodo, which acts as a social media resource limited exclusively to the schooling sector |

(*continued*)

**Table 5** (continued)

| Awesome smartphone apps for teacher | |
|---|---|
| LinkedIn | Access the ridiculously popular professional social media site and network with others in the education industry for ideas, inspirations, and information about how to improve your career |
| iBlueSky (mindmapping) | Get great ideas out there and in the open with this productivity app that means to push every user's inherent potential forward |
| Bump | "Bumping" two enabled phones together automatically exchanges contact information – great for staying in touch with parents as well as other teachers and administrators from education events |
| Twitter | The ubiquitous microblog's app covers every smartphone platform available, and offers a stellar way to share resources with other professionals as well as students and their parents |
| Flashcards | Create, share, and download flashcards on every subject imaginable – awesome for classroom use or staying current on changes within education and areas of inquiry |
| Facebook | It is a social networking apps as well as learning platform |
| The Leadership Challenge Mobile Tool | Wiley Publishers provide a $4.99 resource packed with information, inspiration, and a series of articles and activities meant to bolster general leadership acumen |
| Pulse News | Stay on top of the current news of the day by sticking with this Android app, which involves easy access to any online reads the user chooses. Pulse News makes for one of the best ways to remain relevant in the general education sector as well as any academic subjects taught |
| Goodreads | As a social network and personal library inventory system stands as solid proof |
| Wolfram Alpha | Turn a smartphone into the world's most powerful reference tool, with extensive information about literally every academic subject imaginable packed into one stunning application |
| Dictionary.com –Dictionary & Thesaurus, Free | Like the title states, this app from Dictionary.com combines dictionary and thesaurus tools for quick vocabulary look-ups |
| Wikipedia | Read through and share articles from the world's largest encyclopedia on every smartphone platform out there |
| Wikipanion | Wikipanion streamlines the Wikipedia experience even more, allowing for bookmarking, archiving visit dates, multilingual searches, and other amazing additions gratis |
| How To Videos from Howcasr.com | Learn how to do just about anything using crowdsourced videos, and even upload your own instructions to open up your classroom to the world |
| Free Graphing Calculator | It's a free graphing calculator |
| ASL Ultimate | Teachers with hearing-impaired students will greatly appreciate having this resource around for advice on what to say and how to say it in ASL |
| World Factbook | Every year, the CIA releases its World Factbook to smartphone audiences and grants them access to detailed information about every nation on the planet |

(*continued*)

**Table 5** (continued)

| Awesome smartphone apps for teacher | |
|---|---|
| Google Search | Google Search provides many more options than the web-based engine, and smartphone fans love taking advantage of how it sends returns based on photos and other multimedia input |
| Kindle | Available on every smartphone platform, Amazon's popular ebook reader make free and for-profit digital literature easy to access during free moments |
| TED | TED provides an edifying way to pass the time, with hundreds of videos featuring experts lecturing on every topic imaginable |
| Instagram | In between pictures of cats and food, try posting some from the classroom and share ideas about decor, or host a digital art show for students |
| Showyou | Showyou curates the best of the best YouTube videos, and encourages others to share what they love most. The educational applications here ought to be readily apparent! |
| Musee du Louvre | Digitally walk the famous halls of the world-class art museum at the end of a stressful day and get lost in its glorious collections |
| Foursquare | Play fun, deal-seeking check-in games with friends or even draw some up for student scavenger hunts |
| Cracked Reader Lite | Cracked is so ridiculously hilarious, people sometimes forget it actually features some insightful and educational content on the reg |
| Google Earth | Fun with or without playing with it on an educational level, Google Earth inspires awe and wonder at our planet's true complexities |

Source: Classroom aids: http://classroom-aid.com/author/classroomaid/

## 2.2 Future Directions

Education is for people and its development is ultimately aimed at maximizing the capacity for achieving full welfare of the population. The educational planner as well as administrator is constantly engaged in activities for and with the people. The question arises: What are the demographic challenges facing educational planning today? Population growth results in significant variations in the age and sex compositions of the population besides the numerical increase. By 2030, India will be amongst the youngest nations in the world. With nearly 140 million people in the college-going age group, one in every four graduates in the world will be a product of the Indian education system. We have gross enrolment ratio of about 17.9 % now, while an ambitious target of 25.2 % has been envisaged by the end of 12th Plan.

According to the latest report released by one of the universities in India, mobile internet users within the boundaries of India are estimated to go up to 160 million users by the end of 2015. An education sector especially remote area has not been left behind and do these internet mobile devices provide greatly exploring the opportunity. Currently, education sector in India including higher education has shortage of skilled human resources and quality facilities. This has resulted due to the lack of sociability among students. With introduction of technology, a greater opportunity has been provided to overcome such hurdles among students. This is because students can now use their mobile phones to navigate through the internet and join public chats on sites such as Facebook and Twitter.

With the outburst in the number of educational apps, online courses, and smart phones in the hands of Indians young and old it may be possible to access education for the people belonging to the invisible world. According to Bruck, Motiwalla, and Foerster, mobile devices have now become the fastest growing technology in human history. He has cited numbers from the International Telecommunication Union. His "statistics shows more than 6 billion mobile phone connections existed at the end of 2011 worldwide and will grow to 12 billion by 2020 (ITU 2012 is cited in Moesser (2012)). Very soon mobiles will outnumber humans living on earth, presumably by 2013." Rapid changes are taking place in both the technology and materials of mobile phones. Surprisingly, applications are being designed specifically for learning. Therefore, there is tremendous potential for the growth of mobile learning even invisible world.

## 3 Cross-References

▶ Accessibility Challenges in Mobile Learning
▶ Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom
▶ Mobile Learning in Southeast Asia: Opportunities and Challenges

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# Mobile Learning Beyond Tablets and Smartphones: How Mobile and Networked Devices Enable New Mobile Learning Scenarios

# 59

Daniel Stoller-Schai

## Contents




**Abstract**

There is a growing set of mobile and networked devices, which can be used to design, develop, and implement mobile learning scenarios in schools, enterprises, and public institutions such a museums and libraries. Networked objects with iBeacon, radio-frequency identification (RFID), Bluetooth, and other technologies are located in buildings and communicate with users who approach them. This article will give an introduction to this new possibility to create mobile and networked learning scenarios and present a range of examples from schools, enterprises, and public institutions. The article is a first glimpse into new applications and possibilities of mobile learning based on an extended understanding, which goes beyond tablets and smartphones. Some ideas are still sketches and basic descriptions. The goal is to encourage one's own experience and to explore new ways of teaching and learning with mobile technologies.



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# 1 Introduction

Mobile learning will expand to other devices, which become part of the daily life. Tablets and smartphones will remain key devices for mobile learning, since they have a display to present information, connectivity to networks, computing power to execute calculations, games and other tasks, and a broad variety of sensors to gather contextual information. However, part of these functions will drift to other devices such as watches, bracelets, clothes, and glasses or become components of buildings, cars, public institutions, stores, etc. Mobile learning will be a commodity the more the Internet of Things becomes a reality. This is good news for educators in public schools and trainers in small or large enterprises. They can design learning scenarios, which are situated in the learning and working context of their pupils and employees. Learning takes part outside of formal settings and becomes an experience with light bulb moments.

# 2 Five Decades of Learning Technologies

For the last 40 years, different types of personal computer technology have been developed and evolved which could be used not only for working or leisure time, but always also for learning purposes. Over five decades, computers became always smaller, more connected, and more mobile (Campbell-Kelly and Campbell-Kelly 1996; Ceruzzi 2012). They moved from the computing center to the palm, which is not just the basis for mobile computing but also for mobile learning.

In order to understand the past development and predict and anticipate the future development, the five decades are briefly described and summed up with a short conclusion regarding the relevance for mobile learning (for more details, see (Crompton 2013)).

## 2.1 First Decade: 1975

When the first personal computer was invented in the mid-1970s, the usage was focused on the built-in features and functions of the machine; it was a stand-alone – almost immobile – engine. It has been used mainly for programming, hardware bricolage, gaming, and certain low-level office tasks (Fig. 1).

### Significance for Mobile Learning

Actually, computers were isolated machines, at least for people outside the universities. Computers could be used to teach programming techniques, to learn with stand-alone programs and early versions of computer-based training (CBT) on floppy disks and later on compact disk read-only memory (CD-ROM). Media-based learning could not be considered as “mobile.”

**Fig. 1** First decade: Personal computers, e.g., Commodore 64 (Source: Flickr, Author: Blake Patterson, URL bit.ly/dss_mobilelearning_fig1, Retrieve data Nov. 11, 2014, Copyright: Creative Commons BY)

## 2.2 Second Decade: 1985

With a standardized connection to the Internet in the mid-1980s, computers became a "window" into a huge world of information and communication, but this possibility was still limited to a small group of people, who knew how to use acoustic couplers, mailbox systems, use groups or Internet Relay Chat (IRC), etc. (Fig. 2).

Before the continuous connection to the Internet, the users were mainly satisfied with the local functions of their desktop computers. Now, the focus moved slightly away from the machine to the net, and computers became "access points" to the connected world.

### Significance for Mobile Learning

With the first laptop computers, it was possible to change location. In reality, this happened not really a lot since the first laptop computers weighed still a couple of kilos or pounds and were not very "mobile friendly."

## 2.3 Third Decade: 1995

With the built-in connection to the Internet and the invention of the Hypertext Transfer Protocol (HTTP) and the World Wide Web (www) after 1995, the next big leap occurred. Now, the access to website, online games, and communication with others was in the focus. All of a sudden, thousands of web servers with interesting content were reachable (Fig. 3).

### Significance for Mobile Learning

In the 1990s, mobile computers and first tablets were available (such as the Apple Newton, which was never a real success). It was possible to gain first experiences

**Fig. 2** Second decade: Personal computers, e.g., IBM PC (Source: Flickr, Author MarcinWichary, URL bit.ly/dss_mobilelearning_fig2, Retrieve data Nov. 11, 2014, Copyright: Creative Commons BY)

**Fig. 3** Third decade: Connected computers, e.g., iMac (Source: Flickr, Author Carl Berkeley, URL bit.ly/dss_mobilelearning_fig3, Retrieve data Nov. 11, 2014, Copyright: Creative Commons BY-ND)

since computers left the desktop and could be carried around. Additionally, the first mobile telephones and the Wireless Application Protocol (WAP) interface allowed limited access to the Internet from a personal mobile device. Mobile learning became an important topic as a research topic in universities and as a new opportunity for corporate training programs in enterprises and public institutions.

## 2.4 Fourth Decade: 2005

The fourth decade was mainly characterized by two evolutions (Fig. 4):

First, with the Web 2.0, the behavior, how the Internet is being used, changed again. Now, self-presentation, exchanging personal information, building relations, watching movies, shopping online, etc., became the main reason to start a

**Fig. 4** Fourth decade: Mobile computers, e.g., iPhone (Source: Flickr, Author William Hook, URL bit.ly/dss_mobilelearning_fig4, Retrieve data Nov. 11, 2014, Copyright: Creative Commons BY-SA)

computer. A disconnected computer from the Internet was almost worthless. It could not serve its main purpose anymore to be the entry point into the "digital world." Actually, not the computer was important anymore, but the access to a connected information space.

Second, the invention of smartphones with touch screens in the mid-2005s made almost the same processing power as a desktop computer available in a mobile device. The window to the connected information space became smaller and could be carried around. Access to everything from everywhere at anytime became a reality – as long as there was a paid connection with a network provider and a charged storage battery available.

#### Significance for Mobile Learning

The fourth decade is the birth of mobile learning in the pure meaning of the word. With smartphones and touch screens and a broad range of apps, learning became mobile and available for almost everybody. In addition, the understanding of learning expanded from "formal learning" (e.g., in a classroom or a seminar room) to "informal learning," which happens on the road, at the workplace, or even in the personal spare time – with no syllabus, lecturer, or teachers. In that sense, mobile devices expanded our understanding how learning occurs, as a small percentage of formal learning and a large percentage of informal learning, triggered by the needs, the interest, and the curiosity of the learners: With smartphones, it is possible for the first time to answer almost any questions just right away. Especially for rural regions, this is a very important source for education and teaching (UNESCO 2014).

### 2.5 Fifth Decade: 2015

After computers left our desktops, they will also leave our palms in the fifth decade (Fig. 5). The Internet becomes part of everyday objects and is being integrated into daily commodities. Our mobile devices can communicate with the "Internet of

**Fig. 5** Fifth decade: Wearable computers, e.g., Google Glasses (Source: Flickr, Author Ted Eytan, URL bit.ly/dss_mobilelearning_fig5, Retrieve data Nov. 11, 2014, Copyright: Creative Commons BY-SA)

Things" (Madisetti and Bahga 2014), and new displays such as watches, glasses, and lenses are currently being invented. A lot of "things" are collecting or transmitting data without any or just reduced displays such as "wearables" (computers, which are integrated into bracelets, necklace, and rings or which are parts of clothes and shoes). This personalized data gives us information about a lot of parameters about our daily routine: Where have I been? How many calories did I burn? When did my heart rate go up? How was my sleep?

### Significance for Mobile Learning

With the "Internet of Things," not only computing, but also learning becomes ubiquitous. Mobile learning allows situating learning into the daily life of a person. With new displays in glasses, lenses, and watches and with a broad range of devices that collect and deliver information, new learning scenarios are possible. Some of them will be described in the following chapters.

As an overview, the five decades of computer development and learning are depicted in Fig. 6.

## 3 Learning Beyond Tablets and Smartphones

Although mobile learning is still in its infancy and in many schools and enterprises not yet developed, it is already possible to piloting the next generation of mobile learning scenarios, which deal with smart objects (e.g., indoor positioning systems, wearable, or activity trackers).

However, this does not mean that mobile learning takes place without smartphones and tablets, since a display and processing and communication power are still needed. But mobile learning, which is integrated into the daily life and smartphones or tablets that interact with additional external devices, generates the possibility to create situated learning situations (Lave and Wenger 1991) or "situated mobile learning" (Pfeiffera et al. 2009).

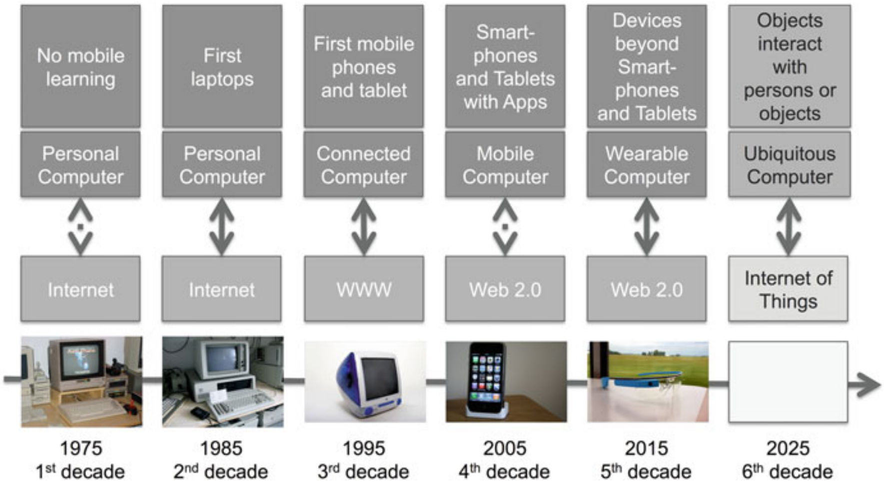


**Fig. 6** Five decades of computer technology: from immobile to mobile to ubiquitous (Source: Author Daniel Stoller-Schai)

To create new situated mobile learning scenarios, a two-folded approach is needed.

**The device**

First, it is crucial to know the range of available and future devices that can interact with a smartphone or a tablet. Based on this knowledge, teachers, trainers, and learning professionals have to gain their own personal experiences, before they can design situated mobile learning scenarios.

**The setting**

Second, a pedagogical attitude is needed to generate a curiosity in learning processes and asking new questions about the personal world of the learner. If a learner has no questions to ask, all the connected learning scenarios are useless, because there is nobody to be interested in the answers. Learning professionals and education designers have the duty to design a setting, which creates new questions and offers the setup to answer them. Connected mobile device offers a broad toolbox of opportunities to cover both aspects.

## 3.1 The Device

The situated setting of mobile learning technology beyond smartphones and tablets has to be divided into four components (Fig. 7):

– The first component is the **display**. Normally, the built-in displays of smartphones or tablets are used to read, to hear, or to watch any kind of information. Actually, there are many more displays available, which are built-in in other devices.

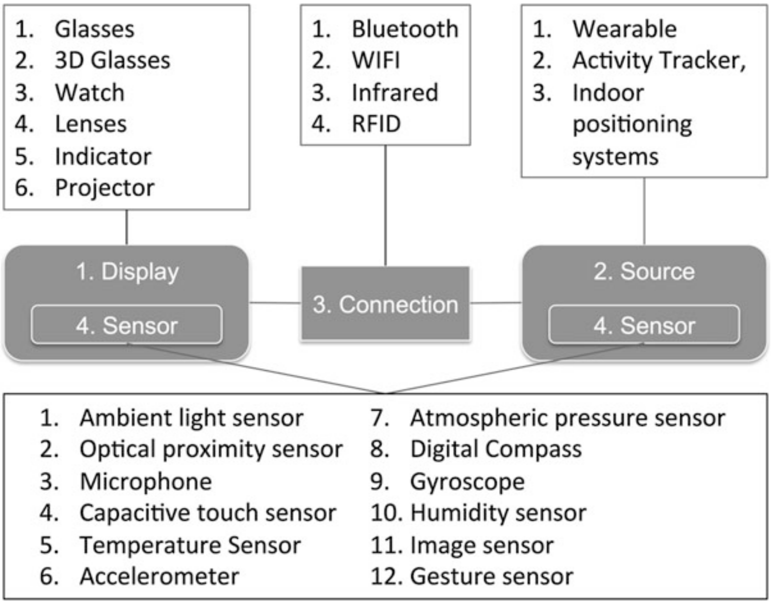


**Fig. 7** The device: four components to build the technological ecosystem (Source: Author Daniel Stoller-Schai)

– The second component is the external **source**. In addition to web servers, which remain one of the main sources of information, it could be an activity tracker, indoor positioning system, etc.
– The third component is the **communication** connection between the source and the display. If the source is inside the device, the connection is hardwired. If the source is outside the device, the connection must be wireless.
– The fourth and last component is the **sensor**. Sensors are very important for mobile devices and an important factor for their commercial success. Sensors can be part of the device (e.g., a smartphone) or part of an external source (e.g., the wind sensor of a Wireless Fidelity (Wi-Fi)-enabled weather station).

## Display

First, in addition to the standard touch screen displays of smartphones and tablets, there is a broad range of new displays available (Table 1).

## Source

Second, the information to feed the devices comes from a variety of sources, which are on or around a person (Table 2).

**Table 1** Range of new displays

| Display | Definition | Purpose | Examples |
|---|---|---|---|
| 1. Glasses | Special glasses with an optical head-mounted display (OHMD). It can display information in a smartphone-like format | Display information to execute tasks directly to the retina. The main benefit that glasses allow is a hand-free handling, which allows using hands for other tasks | Google Glasses<br>DigiLens<br>Vuzix Wrap<br>iOptik Innovega |
| 2. 3D Glasses | Open or closed glasses with a display to produce 3D images | Virtual reality headset for 3D gaming or exploring 3D architecture models. Together with data gloves, it is possible to manipulate objects in the 3D world | Oculus Rift<br>ARCHOS VR Glasses<br>Samsung Gear VR<br>Durovis Dive<br>Zeiss Cinemizer<br>Epson Moverio |
| 3. Lenses | Contact lens with built-in light-emitting diode (LED) arrays | Display information to execute tasks directly on the retina. With LED array lenses, the computing power which is available for the user becomes invisible to another person | *There are several research projects in progress* (Parviz 2009)*, but no commercial product is yet on the market* |
| 4. Watches | A small display integrated into a watch to communicate with other mobile devices | Reduction of the display and its integration into a watch free up again both hands for other tasks | Apple iWatch<br>Motorola's Moto 360<br>Samsung Gear Live<br>LG G Watch<br>Pebble Steel |
| 5. Indicators | A device, which has no visual display but sends signal by vibrations or LEDs | Collect personal activity data, e.g., heart rate, blood pressure, etc., and inform wearer about past, current, or anticipated status | Withings Pulse<br>Fitbit Flex<br>Garmin vivofit<br>Basis Carbon Steel<br>Misfit Shine |
| 6. Projector | A device, which projects the display on a surface, e.g., the arm bed | Displays personal activity data, e.g., heart rate, blood pressure, etc., directly on any surface | Cicret Bracelet |

*Note*
The examples in the fourth column for this and the following subchapters are based on the market situation at the end of 2014 and can change quite rapidly. The purpose to mention concrete products is to give the reader of the chapter the opportunity to continue their own research

## Connection

Third, there are different technologies and communication protocols to connect an external source with a mobile device. The most important ones are presented in Table 3.

**Table 2** Different sources to acquire information

| Source | Definition | Examples |
|---|---|---|
| 1. Wearable | "Wearable technology (. . .) are clothing and accessories incorporating computer and advanced electronic technologies." (Wikipedia 2014d) | Motion Recognition Clothing/Medibotics Hexoskin |
| 2. Activity tracker | "A device or application for monitoring and tracking fitness-related metrics such as distance walked or run, calorie consumption, and in some cases heartbeat" (Wikipedia 2014a) | See activity trackers above |
| 3. Indoor positioning system | "An indoor positioning system (IPS) is a solution to locate objects or people inside a building using radio waves, magnetic fields, acoustic signals, or other sensory information collected by mobile devices." (Wikipedia 2014b) | iBeacon, Apple IndoorAtlas sensewhere Other applications (Mautz 2012) |

**Table 3** Connection technologies and protocols

| Technology | Purpose |
|---|---|
| 1. Bluetooth | Used to connect mobile devices with audio components and television and to set up indoor positioning systems |
| 2. Wi-Fi | Basic technology to gain access to the Internet |
| 3. Infrared | Basic technology for remote controls |
| 4. RFID | "Radio-frequency identification (RFID) is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information." (Wikipedia 2014c) |

### Sensor

Finally, with each generation of new smartphones or tablets, the range of available sensors is being expanded. For special purposes, more accuracy or flexibility, a lot of specialized sensors are made as stand-alone products (Table 4).

# 4 The Setting

## 4.1 Pedagogical Starting Point

Before discussing different learning scenarios, it is important to mention that the new learning possibilities are related to the fact whether teachers or trainers as well as pupils or corporate learners are interested about their environment and are able to formulate learning-related questions.

If there are no creative, reflective, and critical questions, all new mobile learning channels are useless (The Critical Thinking Community 2014). Therefore, it is important as teachers or trainers to arouse first the interest of pupils and corporate learners toward their specific world. If there is an interest, learning becomes an

**Table 4** Overview of sensors

| Sensor | Purpose |
|---|---|
| 1. Ambient light | Measures the intensity of light in the environment |
| 2. Optical proximity | Measures the distance between an object and the device |
| 3. Microphone | Records sound from an external source |
| 4. Capacitive touch | Notices pressure on a touch-sensitive surface |
| 5. Temperature | Measures the temperature of any material |
| 6. Accelerometer | Measures the movement of an object |
| 7. Atmospheric pressure | Measures the atmospheric pressure for weather forecasts |
| 8. Digital compass | Indicates the direction of the four cardinal points |
| 9. Gyroscope | Measure the position of the device in a 3D space |
| 10. Humidity | Measure the humidity of any material |
| 11. Image | Captures images or movies from a camera |
| 12. Gesture | Visually detects gestures to trigger an action |

ongoing activity, and mobile devices and other objects are powerful tools to design effective learning scenarios, which answer those questions.

A mobile device can become a tool to proof our personal scientific hypotheses about our world. With multisensored and connected mobile devices, it is possible to design an experienced-based education as intended by the German physicist and pedagogue Martin Wagenschein:

> His goal was to reconnect science teaching with both the developing child and nature. He saw the detrimental effects of theory-based instruction and rote learning that informs so much of science education today. He developed an experience-based approach to science education. For him science classes should be first and foremost an exploration of concrete phenomena – students thereby learn science as a process of inquiry rather than as a body of set facts and theories (The Nature Institute 2014; Wagenschein 2013; Udell 2013).

The setting consists of six steps (Fig. 8):

1. Question: Starting point for a situated mobile learning scenario.
2. Setup: Design of the pedagogical experiment to answer the questions.
3. Experiment: Execution of different actions to go through the defined steps of the pedagogical experiment.
4. Reflection: Personal reflection of the results and observations.
5. Discussion: Social learning activity by discussing and arguing the results with peers or teachers and trainers.
6. Report: Formulate the answer to the question in the first steps. Archive learning results and transfer solution into the daily practice.

In the following chapter, this setting or part of the setting is being applied to basic and advanced teaching scenarios for pupils and employees (Table 5).

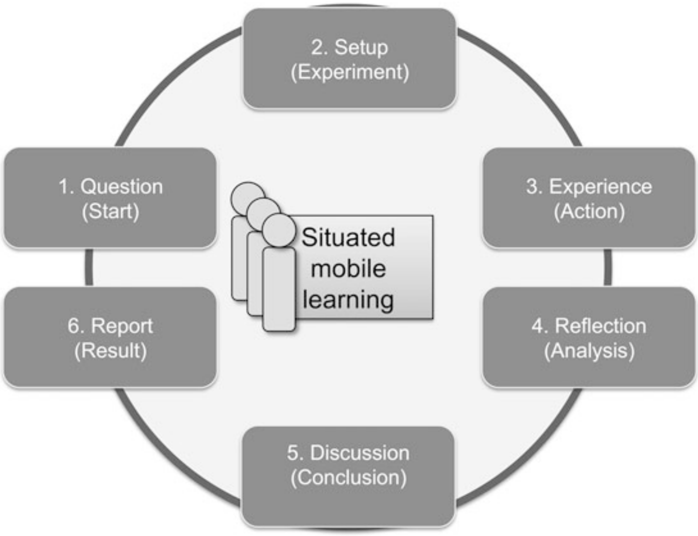


**Fig. 8** The setting: six steps for situated mobile learning (Source: Author Daniel Stoller-Schai)

**Table 5** Overview of teaching and learning scenarios

| Pupils | Employees |
|---|---|
| Basic teaching scenarios for pupils in schools | Basic learning scenarios for employees in enterprises |
| Advanced teaching scenarios for pupils in schools | Advanced learning scenarios for employees in enterprises |

## 4.2 Basic Teaching Scenarios for Pupils in Schools

After discussing and introducing the different components of a situated mobile learning scenario, a couple of concrete examples will be presented to demonstrate how these possibilities can expand learning scenarios in a classroom (Table 6).

## 4.3 Basic Learning Scenarios for Employees in Enterprises

Another couple of examples describe different basic (informal) learning scenarios for employees in enterprises (Table 7).

## 4.4 Advanced Teaching Scenarios for Pupils in Schools

In addition to the basic scenarios, there are more advanced teaching scenarios for pupils in schools (Table 8).

**Table 6** Basic teaching scenarios for pupils in schools

| Learning question | Setup | Experience |
|---|---|---|
| How cold is water when it turns to ice? | Temperature measurement with smartphone and thermometer (e.g., Kinsa, Thermodo, etc.) | Cool down water in a bucket and continuously measure the temperature until ice building starts |
| How loud is my music speaker? When does the music volume become unhealthy? | Loudness measurement with internal or external microphone and decibel app (e.g., apps like dB Volume Meter, TooLoud?, DeCibel, etc.) | Let one group play their favorite music on their preferred volume level. Let another group measure the decibel and compare it with references for ear protecting |
| How far is it from my home to school? What is actually the shortest way? | Distance measurement with GPS/maps and activity tracker app (e.g., apps like Moves, Argus, Endomondo Sports Tracker, FitBit, etc.) | Start with estimating certain distances and suggestions for shortest way. Proof these hypotheses by walking the defined route |
| How fast does a flower open its blossom? | Camera: take pictures every 30 seconds (or less, or more) with a stop motion app (e.g., StopMotion Recorder, Stop Animator, Frameographer – Stop Motion & Time-Lapse, iMotion HD, etc.) | Put a camera on a tripod and activate the app to take pictures with a predefined frequency |
| How do I jump over a hurdle? | Camera: take pictures with a slow motion app (e.g., Coach's Eye, PotPlayer full HD media player, Slow Motion PRO, Slow Motion Video, etc.) and analyze it | Put a camera on a tripod and activate the app to take a movie. Analyze and compare style, accuracy, etc., of different people |

*Note*

The example will start with the question; describe briefly the setup and end up with a sketch of the experience. Other steps like reflection, discussion, and reporting cannot be described, since they are part of a concrete learning process. The examples are just starting points to trigger own teaching scenarios

Again, product examples reflect the market situation at the end of 2014 and can change quite rapidly. The purpose to mention concrete products is to give the reader of the chapter the opportunity to continue their own research

*Note*

A couple of the described scenarios require special equipment or a special environment. Both may not be available for a specific school class. In this case, it is often enough just to use the built-in technologies and sensor of a standard mobile device

## Network, Example 1: A Quest Through an Old "Château"

With an indoor positioning system such as iBeacon and with a platform provider who delivers the appropriate development package (application programming interface, API; software development kit, SDK; content development network, CDN; web panel and admin. app, e.g., from Kontakt.io), it is possible to build your own quest through a museum, a shopping mall, or a school building.

**Table 7** Basic learning scenarios for employees in enterprises

| Question | Setup | Experience |
|---|---|---|
| How can I stay in contact with my colleagues/ customers? | Solution approach: see who is currently in your neighborhood with an app, e.g., Swarm by Foursquare | Especially in projects where all the members of a team are dispersed geographically, a visual map of all the locations can help to solve ad hoc problems and foster informal learning |
| Who knows what and who can help me to solve a problem? | Solution approach: Intelligent networks which connect people, competences, and location, e.g., Starmind. "Starmind matches your questions with real solutions from direct human input. Give your team access to know-how that is stored inside a corporate brain. Always up-to-date, always in real time." (Starmind International AG 2015) | The learning organization as described by Peter Senge (Senge 1990) is based on human interactions and networks. To access this "corporate brain" is now possible with technology and apps, which are integrated in personal smartphones and tablets |

**Table 8** Advanced teaching scenarios for pupils in schools

| Network | Equipment | Body | Perception |
|---|---|---|---|
| Example 1<br>A quest through an old "Château" | Example 2<br>A personal weather station | Example 3<br>Body measurement | Example 4<br>Augmented reality |

The following example shows part of a quest through an old "Château"– the "Schloss Birlinghoven" in Sankt Augustin, Germany – which is the headquarter of the "Fraunhofer Institute for Applied Information Technology FIT" (FIT 2014). The quest was part of a conference to demonstrate current and future mobile technologies, which took place in October 2014 (Fig. 9).

As users walk through the rooms of the "Château," they see on a map their position and get information about the rooms and the objects on their tablet. It is even possible to place an iBeacon on a specific person. If a user is in the neighborhood of the equipped person, the appropriate information is displayed again on the tablet. Since the application can be expanded, it is possible to add own comments and photos and share them with a community. In a collaborative action, a dense net of information about the "Château" can be weaved together.

## Equipment, Example 2: A Personal Weather Station

A second advanced example covers the analysis of weather data and challenges the weather forecast on television.

With a weather station, a weather app, and the transfer of weather data to a social community (Fig. 10), it is possible to create a weather observatory to answer questions as the following:

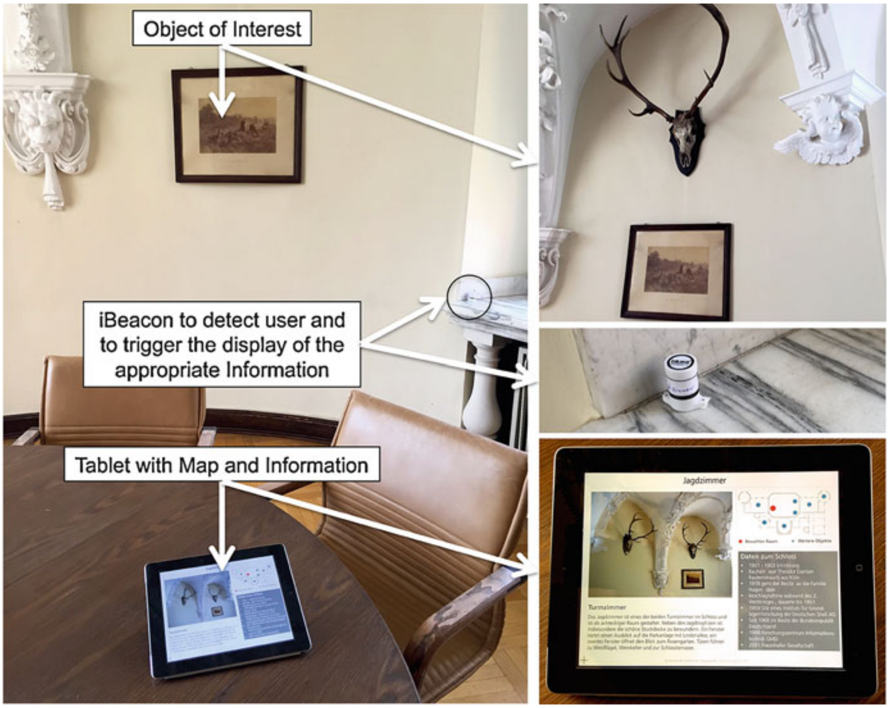


**Fig. 9** Example of a quest on an iBeacon platform (Source: Author Daniel Stoller-Schai)

– What is the saturation of $O_2$ and $CO_2$ in our classroom (when the windows are closed or opened)?
– How fast is the wind currently blowing?
– How much did it rain since yesterday?

The collected weather data can be shared on a community platform. As in the example before, these data are again a contribution to a dense net of information about the weather situation in the region or in other parts of the world.

### Body, Example 3: Body Measurement

A similar example can be built up with activity trackers, apps, and webpages to answer these questions:

– How does my heart rate go up when I step up a stair?
– How many calories do I burn if I walk on a hill?
– How do I collect personal data (big data awareness) with activity trackers?

### Perception, Example 4: Augmented Reality (AR)

In case that a class can afford the purchase of 3D glasses for 3D visualization and tackles the challenge of programming a 3D environment, it is possible to explore

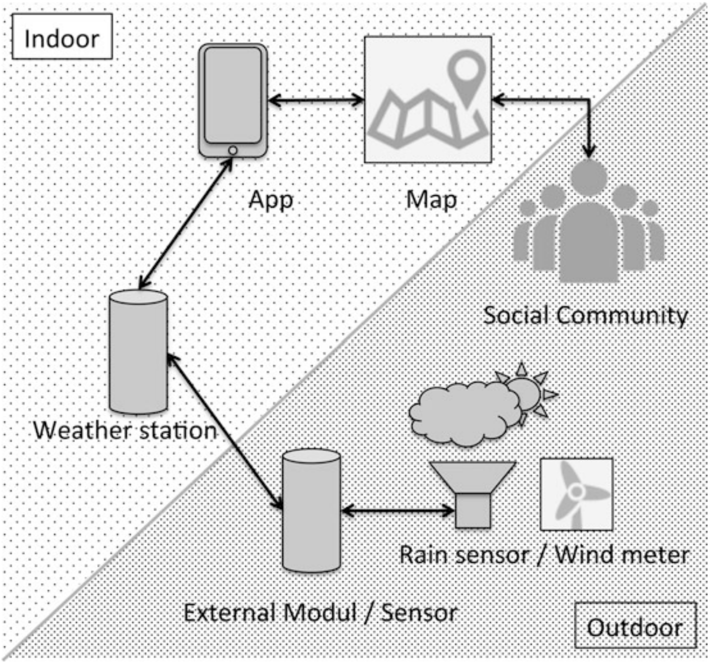


**Fig. 10** Example of a weather observatory based on a weather station platform (Source: Author Daniel Stoller-Schai)

historical facts about a building or a city with a head-mounted display or an AR Browser.

### 4.5 Advanced Learning Scenarios for Employees in Enterprises

There are some advanced learning scenarios for employees in enterprises (Table 9).

**Network, Example 5: Onboarding Learning Path with iBeacon**
Newly hired employees get a tablet and explore on their own the main building and the campus of their new enterprise. Similar to the example above ("Network, Example 1: A Quest Through an Old 'Château'"), there are a series of iBeacons dispersed in rooms, on persons, and in the environment of the main building which trigger information and tasks on the tablets of the employee. With this approach, the employee follows a journey (learning path) and gathers personal information about people, processes, and products.

**Equipment, Example 6: Onboarding Learning Path with Action Camera**
Another way for new employees to explore their enterprise, the people, processes, and products is to film the personal way of the first 1 or 2 weeks. For this purposes,

**Table 9** Advanced learning scenarios for employees in enterprises

| Network | Equipment |
|---|---|
| Example 5<br>Onboarding learning path with iBeacon | Example 6<br>Onboarding learning path with Action Camera |

an Action Camera (e.g., GoPro Camera) is attached to the clothes or the back bag of the employee, and he/she decides when to start/stop the camera. This source material is the basis for a personal onboarding diary. Multimedia producer has to give assistance on how to cut, to assemble, and to finish such a movie.

### 4.6 Tips and Tricks How to Start

In order to start situated mobile learning scenarios, it could help to follow the suggested steps:

1. **Personal curiosity:** If a teacher or a trainer does not ask questions, the pupils or employees won't. Teacher and trainers should train themselves how to ask questions about the world.
2. **Particular experience:** It starts with personal experience such as the following:
   - To download a couple of interesting apps
   - To buy some activity trackers or other devices and test them in the daily life
   - To start equip a home, a school, or a building with an indoor positioning system and play around with the new possibilities
3. **Collaboration with others:** Teachers or trainers should collaborate with institutes and students from their neighbor university to set up more advanced mobile learning scenarios, which require programming effort, webpages, or even the integration of a content development network (CDN) partner.
4. **Available devices:** It is not necessary to wait until special devices or the subscription of an expensive service is affordable. The built-in sensors and functions of a smartphone or a tablet are already a good starting point.
5. **Best practice sharing:** As soon as some personal experiences are gathered, these personal insights and related questions should be shared with a community. A lot of trainers, teachers, and researchers have the same questions and problems. A person, who starts to share, will often get back a multiple.

## 5 Future Directions

The sixth decade will bring a lot of smart objects, which can communicate with a person who triggers the communication or autonomously with other objects.

Mobile learning is and will become the main manner on how we learn with media. Every media-based learning scenario has to start with a "Mobile First" approach. Typical eLearning scenarios such as learning with a web-based training, which is stored on a learning management system (LMS) and proofs your knowledge by conducting an eTest, will slowly fade out. Media-based learning must be situated in our daily life.

Since the "Internet of Things" is a growing topic, which affects every part of our life, it is obvious that situated mobile learning scenarios will be an integrated part of teaching and learning in school or training in enterprises. Computers will leave not only our desktop, but also our palms and will be part of other equipment such as glasses, clothes, and watches. The next future steps are to integrate devices into our bodies. The LED array lenses are just first steps. Authors like Bruce Sterling (Sterling 1986) and William Gibson (Gibson 1986) have foreseen this development since a long time. As William Gibson once pointed out, "The future is already here – it is just unevenly distributed" (Wikiquote 2014).

## 6 Cross-References

▶ Advanced Image Retrieval Technology in Future Mobile Teaching and Learning
▶ Apps in the Field: Prototyping HyperSite for describing Work Practices in Workplaces
▶ Augmented Reality and 3D Technologies: Mapping Case Studies in Education
▶ Learning to Teach with Mobile Technologies: Pedagogical Implications in and Outside the Classroom
▶ Increasing Learning Outcomes in Developing Countries by Engaging Students Out of the Classroom Using SMS and Voice Mobile Technology
▶ Use of Short Message Service for Learning and Student Support in the Pacific Region

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# Mobile Technologies and Learning: Expectations, Myths, and Reality 60

Lina Petrakieva

## Contents



**Abstract**

M-learning is often approached as an innovative method to teach, but quite often without the proper planning of the actual learning process and proper understanding of the implications on the pedagogy of the learning process in such a setting. Because of the multiple stakeholders in the process – the institution, the learners, the educators, the policy makers, etc. – it is very difficult to encourage educators to engage with something so different that will require a re-think of their teaching practices. In addition, with so many different technical elements and challenges, it is often simply just too daunting a prospect.

It is also unfortunate that m-learning is often only limited to simply mobile access. A good m-pedagogy will not just transfer the learning process to a mobile device, but incorporate the very nature of mobile, flexible, user-guided, bite-sized learning.

A real m-learning needs to have a real purpose and the stakeholders need to see the value in it for it to have a chance to be a success. With all the correct

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m-pedagogy in place, if the educators and the learners see the value of engaging, m-learning can bring real benefits – flexibility of access and flexibility of engagement – and thus allow a real tailoring of the learning process. It has only been very recently that a real attempt has been made to move to adaptive learning, incorporating pedagogy and AI (artificial intelligence) methods, and this approach seems to be pointing to a future of real adaptive m-learning.

## 1 Introduction

With the development of the humble mobiles from a cordless phone that can be carried around to a supercomputer that can do almost anything imaginable that a piece of technology is capable of, the excitement of the potential use for education has grown exponentially. As the new generations of learners are coming seemingly more and more digitally literate, the drive to get more technology-enhanced learning is being mostly driven by the learners (because they are used to it) and by the management (seeing it as a cost saving exercise and promotion opportunity).

However, the full understanding of the pedagogy in relation to the use of technology, the understanding of the real level of digital literacy of the learners, the fast pace of technological development as well as the sometimes resistant to change educators or CAVEs – colleagues against virtually everything – have to be taken into account when any technology-enhanced learning and especially mobile learning solution is being implemented.

The term "educators" will be used in this chapter for lecturers, teachers, and many others involved in teaching in one way or another, bearing in mind that not all involved in mobile learning will be lecturers; there will be tutors, learning technologists, teaching fellows, and others.

## 2 Myths and Expectations

There is an expectation from learners that when they come to university or college, they will be given Wi-Fi access, access to technology, as well as being provided with training of how to use it in an education setting. The Digital Student project (JISC 2015), due to finish at the end of 2015, shows that although the expectations vary greatly, some are quite wide spread. According to Beetham (2014) some of the common are:

- *Robust and ubiquitous Wi-Fi across campus locations*
- *Easily to connect their own devices to the university network, and access personal/social web services*
- *Continued access to institutional devices, especially desktop computers with relevant software for their use*

And while the students have some clear expectations in terms of the technology and connectivity, when it comes to the role of technology in their education and especially in terms of their chosen course and future career, the students are unclear (Beetham 2014). This is where the role of an educator comes in and it is important to understand that this role comes with big responsibility. The Information and Communication Technology (ICT) confidence of the teaching staff has strong impact on the students and their own use of technology.

From institutional point of view, “digital natives” (Prensky 2001) are an increasing proportion of the new learners, so they are not supposed to need so much support and training, apart from access to technology. Although a number of subsequent studies (Margaryan et al. 2011; Bennett and Maton 2010) have shown that the “digital natives” are a myth and there is much more variety and nuances in the skills, abilities, and attitudes of the learners, the institutions seem to cling on to that notion that learners use technology all the time and are able to learn how to use it on their own.

With the ubiquitous access to mobile devices now, most institutions are also keen to implement a BYOD (bring your own device) strategy, as this is usually seen as a very cost effective way to reduce the money spent on technology. However, the Digital Student project’s (JISC 2015) most recent findings published, clearly state that students “don’t want technology to be a substitute for the real people, in the same place, learning together” (Beetham 2014). That means that the institutions are still expected to maintain access to computer labs, printers, etc. and with the increased diversity of devices brought in as a result of BYOD, the technical and support staff actually have an increased workload, so overall the idea of using BYOD for cost saving reasons for the institution ends up costing more to the staff (Keyes 2013).

Most of the universities and colleges have included the notion of creating digitally literate graduates in their policies, mostly with emphasis on employability, but the strategy to achieve that is usually simply relying on the teaching staff to be able to do that as part of their subject teaching and not recognizing the need for specialist on digital literacy to teach both the educators and the learners. Most of the time the institutions will be keen to promote and show that they are implementing technology-enhanced learning or blended learning and have the attitude that all learning is suitable to be carried out using technology, even if that means simply putting up your lecture slides in the institutional Virtual Learning Environment (VLE). Using VLE for every module is one easy way of showing that the institution is using “blended learning.” Providing electronic feedback is another common use of technology that often justifies the use of the term “blended learning.” However, there is a big difference between providing access electronically to teaching material and true blended learning and m-learning (Littlejohn 2007). Universities, colleges, and schools have all tried to modify and adapt the teaching to incorporate mobile technology and almost all support departments are scrambling to create apps, so they can get to the learners quicker and closer. A quick search in the App Store and Google Play with almost any higher education institution’s name will show at least one app created. A lot of institutions are also using generic apps to get access to their resources like Library (LibAnywhere, Borrow Box Library, etc.) and VLE (Blackboard Learn, Moodle Mobile, etc.). However, a lot of them are still struggling to understand and utilize the potential of true mobile learning, not just mobile access or mobile services. What is usually lacking is a proper m-learning and m-teaching strategy, with support for both educators and learners to fully benefit from m-learning.

# 3 Reality

## 3.1 Technical Side

The use of mobile devices in a learning and teaching setting also has technical limitations that need to be taken into account. Some of the issues of using mobile devices to access information are discussed by Petrakieva (2012, p. 159) and although the mobile device features are constantly improving, the majority of issues are still present simply due to the nature of the devices. Some of the main ones are:

- **Access to technology** – educators can design good m-learning only if they are familiar with the particular technology and this means having access to it. It also means that in order to make sure that everything will work on the learners' devices, the institutions will have to either issue the devices to every learner and thus ensuring parity, or make sure that anything created is rigorously tested on all popular systems (iOS, Android, Blackberry, Microsoft, etc. devices as illustrated by icrossing (2014), see Fig. 1) while also offering borrowing options for those without a smart mobile device.
- **Wi-Fi and mobile internet access** – if the m-learning is to be part of a class, access to the internet due to buildings that were built before Wi-Fi was available or simply lack of bandwidth to support large classes are common problems. Same problems exist with the mobile network coverage and not all learners will have mobile phone contracts that will allow them internet access or they may simply not wish to use a personal device and contract in class nor should they be expected to.
- **Software access** – most of the m-learning solutions will involve specialist software, either ready to buy or custom made. In both cases there is the issue that most free versions have severe limitation and thus limited application or a license needs to be purchased which usually involves preparing a business case by the educator so the institution can justify spending the resources. The required know-how in choosing the right software, the skillset involved in using the software, potentially having to write a business case and the time required are great deterring factors for educators not to pioneer m-learning in their institutions.

When m-learning is concerned, it also shouldn't be forgotten that the situation in the developing countries is very different in terms of access to technology, access to the internet, etc. Although the difference between the availability of mobile

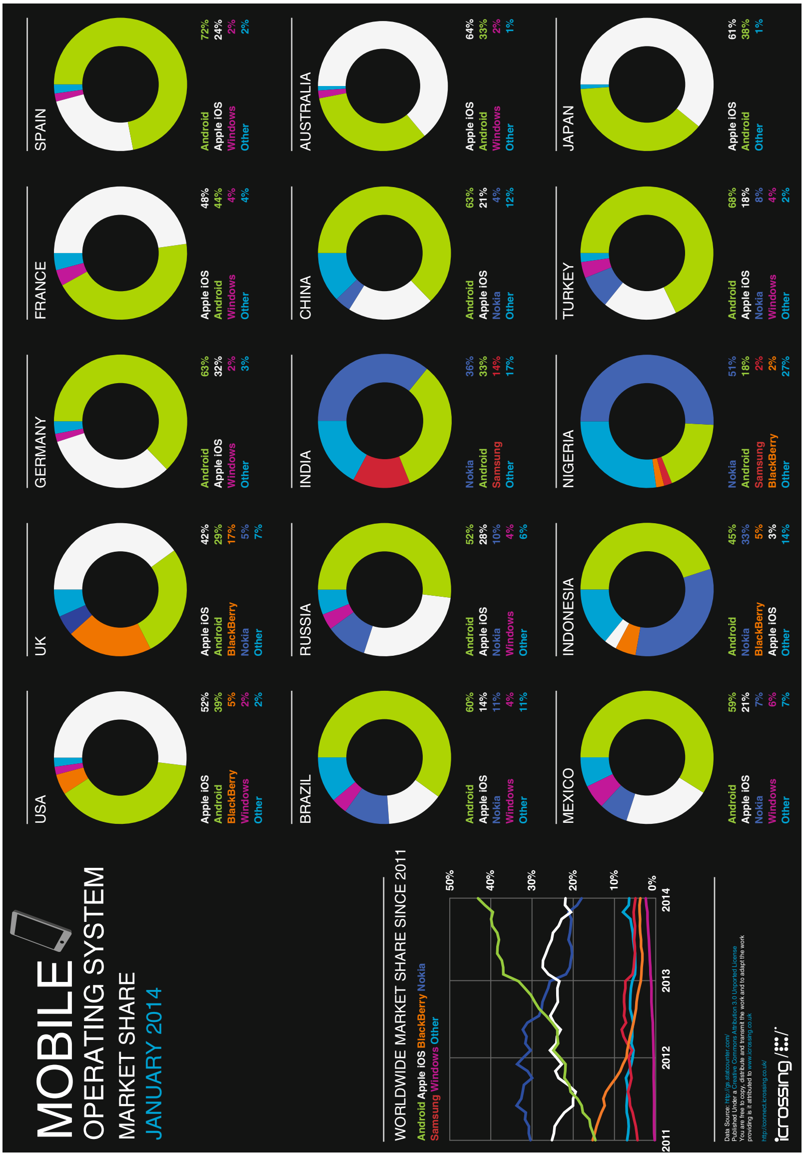



**Fig. 1** Mobile operating systems market shares, January 2014 (http://www.icrossing.co.uk/)

technologies in the different parts of the world is narrowing, it is going to have an impact on the way m-learning is being used for some time yet. In a recent report by UNESCO (West and Ei 2014), it is very clearly shown how simple basic access to mobile reading makes a big difference to the people in the developing countries; however, simply having access is not enough. “People who think that literacy can be achieved by mere proximity to reading material should be reminded that it took the most talented linguists on the planet over a thousand years to decipher Egyptian hieroglyphs. The challenge wasn’t access to hieroglyphs; it was figuring out what they communicated. Humans may have a language instinct, but there is nothing natural about reading; it is a skill that needs to be taught and practiced, again and again and again.” (West and Ei 2014). Similarly, there is nothing natural in using technology for learning either. Simply providing access to it to educators and learners will have a very minimal and limited effect. That is why a development strategy, support structure, communication, and willingness to change and develop are some of the major other components of a successful implementation of m-learning that are often forgotten or ignored.

For now the focus will be on the developed markets where the mobile technology penetration is much higher and the m-learning can be considered as a viable option to go into the mainstream education. And although developed countries are assumed to be uniformly well-off, there are big differences within them. There is a big drive in a lot of countries for widening access and participation. “Across the world, higher education has turned from a privilege available to an elite few into a mass expectation.” (David et al. 2012). All learners are assumed to have access to technology (pc/laptop at home, smart phone with internet access, tablet); however, as mentioned earlier, access does not equate skills to use the technology for educational purposes. The digital divide is still very much alive, and although there seems to be a shift from knowledge gap to usage gap (van Deursen and van Dijk 2013), there should not be an assumption that all learners will have access to mobile technologies to an extent of using them for m-learning.

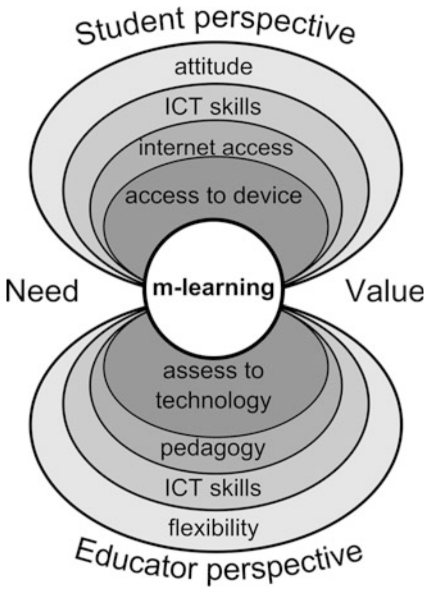
## 3.2 The M-Learning Paradigm

Before any m-learning is implemented, a clear investigation of the particular needs of the learners, educators, and the underlying pedagogical reasons is necessary. Implementing m-learning for the sake of doing it is a common reason why it fails to deliver on the expectations. Taking into account the Universal Instructional Design (UID) principles for mobile learning suggested by Elias (2011) with emphasis on solid pedagogical approach can be the key to a successful m-learning application.

The major stakeholders in the process – the learners and the educators – have to see the need and the value in investing in potentially difficult new approach. Without this full investment in the process, after the initial novelty effect has worn off, the learners will simply revert to the familiar study patterns.

Following Maslow’s idea (1943) of hierarchy of needs, going from basic (deficiency) needs to growth (self-actualization) needs, the m-learning could be viewed

**Fig. 2** M-learning requirements hierarchy




in a similar way, taking into account the slight differences of the two main stakeholders: learners and educators (see Fig. 2). Although a real m-learning can only be achieved when all layers are present, so it should be outside, encompassing all, it has been put in the center, as a pearl in a shell that can only develop fully when the shell is complete and strong and surrounding environment is fertile.

## The Learner Perspective

The most basic requirement to achieve real m-learning is to make sure that the learner has access to a smart mobile device. This may be taken for granted in most developed countries; however, that cannot be simply assumed when the learning is taking place in a developing country, for example. And it is not so much the mobile devices themselves, but their ubiquitous access to the internet, that makes the difference to what people use their devices for. And although in most universities there is free Wi-Fi access, the m-learning idea is to make the learning accessible anytime anywhere and that means learners having ready internet access. Very few institution yet are providing the mobile devices to their learners and that means that most mobile devices are for personal use as well as for study.

The influence of the ICT self-efficacy to the adoption of m-learning (Callum and Jeffrey 2013) should also be considered. When the learner is faced with using new technology, the real and perceived lack of ICT skills may be a barrier to the engagement. The appropriate support in place is crucial for overcoming such problems.

Nurturing a positive attitude to the process is key to the success of the process, as even with all the technology set up and with all the skills necessary, if learners do not want to engage, the implementation and use of m-learning will not be a success.

### The Educators Perspective

Access to technology is even more crucial for educators as they need to be able to set up the m-learning to work with any mobile device that the learners can use, or make sure that one is issued to them. Most of the time this requires either a lot of resources (in the cases when devices are issued to the learners) or specialist technical knowledge, usually from technical staff in the institutions (in the cases when the m-learning has to be compatible with all devices). Because of this, most of the time the educators end up simply setting everything up just through web access and because all mobile devices now ubiquitously have this capability, this approach ensures that all learners can access it. But this ends up no different than the e-learning that educators are used to and it becomes too easy for them to fall into the pattern of producing just e-learning materials and not really adapting the approach for a real m-learning. Providing the educators with the technology and the necessary training to use this technology is important for allowing them to adopt fully m-learning and to concentrate on best using the technology to support the pedagogy.

There is also need to re-evaluate the pedagogical approach when using m-learning (Clark 2014) and not just add on technology or "mobile access" and claim that that is m-learning. The fundamental difference of using mobile devices, with their limited screens, limited creativity tools, and limited internet access, does also provide an opportunity to develop a more natural, bite-size delivery that is not just linear, but interlinked and thus allowing good educators to deliver a better learning process and achieve better learning outcomes by providing flexibility and allowing the learner to incorporate the learning into their life.

Once the m-learning pedagogy is thought through and properly planned and with the technology in place, the educators' ICT skills will play a crucial role in translating the pedagogy in a real m-learning experience for the learners. If the educators have low self-efficacy in ICT, that will have an impact on the perceived difficulty of engaging with m-learning by the learners (Mac Callum and Jeffrey 2014). The expectation that educators will have adequate ICT skills to implement m-learning can be one of the major reasons for the educators not to get involved in m-learning as they feel they do not have the skills and they will not be offered support to develop those skills (Aubusson et al. 2009).

Another one of the main features of the m-learning approach is flexibility. Allowing the learner to dictate how, when, and what they access is paramount and in order to create a m-learning process that can accommodate that, and even more, to use this as its main advantage, means that the educator has to have approach and attitude flexibility. Change should become an intrinsic part of the process and thus the expectation that things will happen according to plan is tenuous. So flexible attitude is needed – plans will change, technology may fail, and learners will not behave as expected, and that should be taken as an opportunity to develop better, more flexible, and more robust approach to m-learning and not as a sign of an impossible task. That flexibility and preparedness for change should be a vital part of the attitude of the educator to make the m-learning a success story.

### The Environment

The m-learning process can only really succeed when there is a need to implement it and both sides of the process – the educators and the learners – see the value in doing so. If the m-learning is used just as a box-ticking exercise to show that the institution is engaging with new technology and approaches, the process will inherently start off with the incorrect premise and neither the educator not the learners will have the impetus to engage with it. Both main stakeholder will have to see the need and the value in using m-learning and thus will be invested in making it a success.

## 4 Future Directions

The communication side of the mobile devices was probably the first one to go mainstream – texting in class, texting announcements, expectation that learners will receive their email on their phone, etc. However, deeper learning with mobile devices requires more developmental pedagogical approach from the educators' perspective and more engagement and correct attitude from the learners.

Having a more flexible approach to m-learning and acknowledging that it is also an individual tool for note taking, collating information, and quick access to info may be the use of mobile technology that should be encouraged and supported more, as this will develop some of the skills that will be used in the real world of work. So instead of trying to adapt the teaching to be delivered to mobile devices at all cost, it should be acknowledged that sometimes having mixed approach to teaching – traditional, location, and time set learning, with the addition of using technology and specifically mobile devices may be more practical approach for the time being.

Until the m-learning becomes more adaptive learning, the process of setting it up may be a bit too complicated for most, hence the limited adoption. Recent attempts to develop adaptive learning by the Edinburgh based company CogBooks that uses AI (artificial intelligence) techniques to learn from the learner's behavior and to guide them to the most pedagogically sound next step is may be the most appropriate stage in the development of m-learning. Then the educators can concentrate on developing the m-pedagogy and using a unified system to deliver the m-learning itself.

## 5 Cross-References

► Characteristics of Mobile Teaching and Learning
► Expectations from Future Technologies in Higher Education: Introduction
► Framework for Design of Mobile Learning Strategies
► Implementation of Mobile Teaching and Learning in University Education in Nigeria: Issues and Challenges

▶ Learning to Teach with Mobile Technologies: Pedagogical Implications In and Outside the Classroom
▶ Mobile Learning and Engagement: Designing Effective Mobile Lessons
▶ Mobile Learning: Critical Pedagogy to Education for All

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# Implementation of Mobile Teaching and Learning in University Education in Nigeria: Issues and Challenges

61

D. J. Kayode, A. T. Alabi, A. O. Sofoluwe, and R. O. Oduwaiye

## Contents




**Abstract**

The issue of access to university education due to low capacity of the universities to accommodate the qualified students into the university system has become a great concern for parents and the governments. The introduction of mobile learning will be a welcome development to reduce poor student access to the university. However, there are issues and challenges that are likely to create a barrier toward a successful implementation of mobile learning in universities in



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Nigeria. This paper therefore explains the concept of mobile teaching and learning, features and benefits of mobile learning in the university system as well as the issues and challenges toward a successful implementation of mobile teaching and learning in universities in Nigeria. Some recommendations were suggested on how such issues and challenges can be addressed which include the training of both the students and the academic staffs on the benefits of some of the networking like LinkedIn, Facebook, etc., to enhance teaching and learning in higher education.

## 1 Introduction

As the world has become a global village because of the technological advancement in the world and Nigeria in particular (Alabi, 2008; Kayode & Ojo, 2011), mobile teaching and learning (m-learning) in recent years has become a valuable and real contribution to learning environment rather than what it used to be in previous years as a theory, academic exploration, and technological idea (Alzaza and Yaakub 2011). Mobile technology according to Premadasa and Meegama (2013) has become an imperative technology that landed recently upon the arena of emerging educational technologies in the global academic sphere (p. 106). Some scholarly observers of educational trends expect mobile learning to be the next significant innovation in higher education (Alexander 2004; Wagner 2005). Therefore, the role of the lecturers and the students are considered as a fundamental element in the learning situation.

Even though mobile learning has advanced from testing stage to a new educational trend widely being used by countries like Britain, Denmark, Japan, and the USA (Osang et al. 2013), mobile learning is still very new and has not being fully implemented in most of the higher institutions in Nigeria. In a review of the literature on mobile learning as stressed by Croop (2008), the exact origin of mobile learning could not be pinpointed. However, according to Keegan (2000), the first extensive use of mobile learning as a label for learning through the use of mobile devices surfaced in several pan-European mobile learning projects that started in the late 1990s and the early 2000s.

According to Osang et al. (2013), the University of Ibadan in partnership with Education Advancement Centre has also implemented it for the senior secondary students preparing for Joint Admission and Matriculation Board (JAMB UTME) in order to guarantee outstanding result in their exams. However, the University of Ilorin which is one of the federal universities in Nigeria in an effort to implement mobile teaching and learning has provided tablet PCs to over 7,000 students matriculated for 2013/2014 academic session. It therefore becomes pertinent to discuss how mobile teaching and learning can be successfully implemented as many schools, both private and public, are working toward mobile teaching and learning in their various schools.

The current young generation is growing up in a world dominated by communication with others and access to information through the use of cell phones and other mobile devices (Croop 2008). Conversing on the fly, text messaging, accessing media and information uninterrupted anywhere, and viewing text and other media on a small screen may be affecting the manner in which young students prefer, and possibly will need, to study and learn. Therefore, this paper discussed the issues and challenges in the implementation of mobile learning in higher education in Nigeria and how such challenges can be addressed.

## 2 What Is Mobile Learning?

Despite the fact that there is no single definition for mobile learning and Winters (2007) stressing that mobile learning has not yet been defined (Croop 2008), many researchers have put forth proposed definitions of the concept. Some of the authors who have suggested definitions have emphasized the mobile technologies that make nomadic learning possible (Aderinoye et al. 2007), while other researchers have chosen to focus on the experience of the learner in regard to the location and the type of learning activity encountered in mobile learning (Balasundaram and Ramadoss 2007).

Mobile learning according to Alexander (2004) is often abbreviated as m-learning or mLearning. It is a concept that has "different meanings for different communities that refer to a subset of E-learning educational technology and distance education that focuses on learning across contexts as well as learning with mobile devices" (Mehdipour and Zerehkafi 2013, p. 93). It is a concept with different names which include m-learning (Alexander 2004), u-learning (Alexander 2004), personalized learning (Crompton 2013), learning while mobile, ubiquitous learning (Clark and Flaherty 2002), anytime/anywhere learning (Crescente and Lee 2011; Alzaza and Yaakub 2011), and handheld learning (Yusri and Godwin 2013; Mehdipour and Zerehkafi 2013).

Ozdamli and Cavus (2011) defined mobile learning as a mode of learning that allows learners to obtain learning materials anytime and anywhere using all sort of wireless handheld devices which include mobile phones, personal digital assistant (PDA), wireless laptop, personal computer (PC), and tablets. Also, Cobcroft, Towers, Smith, and Bruns (2006) defined mobile learning as the type of learning that provides opportunity for learners using mobile devices to access learning resources anytime and anywhere.

As argued by Mehdipour and Zerehkafi (2013), mobile learning is not just a mere conjunction of "mobile" and "learning" but has always absolutely meant "mobile E-learning" (p. 93). However, its history and development have to be understood as both a continuation of "conventional" E-learning and a reaction to this "conventional" E-learning inadequacies and limitations. In other words, it is the "mobile" that makes it to stand apart from other types of learning. Mobile learning has been described as a subdivision or subset of electronic learning (Peters 2007). Therefore, mobile learning focuses on the mobility of the learners, interacting with portable technologies and learning that reflects a focus on how society and its institutions can accommodate and support an increasingly mobile population.

According to MOBIlearn (2003), mobile learning is seen as any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies. This was further stressed by Aderinoye et al. (2007) when he defined mobile learning as any learning carried out with the employment of a wireless or mobile device. Fraga (2012) further defined mobile learning based on: facilitating technologies (Traxler 2007; Richardson 2006); location and type of activity (O'Mailey et al. 2003; Balasundaram and Ramadoss 2007; Clark and Flaherty 2002) and in the context of research (Fraga 2012).

## 3 Mobile Learning Devices

In the study conducted by Georgieva et al. (2005), mobile learning system was classified into seven components based on mobile devices and their capabilities which are: communication technology used, access of services whether online or offline, communication between students and lecturers, information which comprise learning materials and administrative information, the location of learners, and e-learning standards whether supported or not (Rekkedal and Dye 2007).

According to Alzaza and Yaakub (2011), mobile learning features include WAP-based protocol; anywhere and anytime accessibility; wireless network; mobile network connectivity (GSM, GPRS, UMTS, or CDMA); mobile phone, smartphone, or PDA; and device size – very small screen size of a mobile phone has maximum of 480 × 640 pixels, while the common PDA has 240 × 320 pixels (p. 96). Riva and Villani (2005) enumerated specific devices for mobile learning which include cell phones, PDAs, web-enabled cell phones, wirelessly network-connected PDAs, wirelessly network-connected laptop computers, wirelessly network-connected tablet personal computers (tablet PCs), and the ultra-mobile personal computer (UMPC). This list was expanded by Alexander (2004) in his definition of mobile learning to include MP3 players or iPods, Bluetooth-enabled devices, handheld gaming devices, digital cameras, wireless access points, USB drivers, and radio frequency identification (RFID) tags.

However, van't Hooft coined the term *highly mobile* which further limited devices to ones operated with one hand (Croop 2008) which if considered will eliminate laptops and most tablet PCs from the list of devices considered as mobile learning devices or appliances. But, for the time being, the inclusion of laptops and tablet PCs as mobile learning devices is predominant in the relevant literature.

As found in relevant literature according to Croop (2008), the usage of mobile device is illustrated in Table 1.

## 4 Benefit of Mobile Learning in Higher Education

Access, context, collaboration, and appeal are considered to be the primary advantages of a mobile learning environment (MLE) compared to any other traditional classroom-based learning methods identified so far (Premadasa and Meegama 2013). However, to set up a reliable MLE, a number of important factors, such as

**Table 1** Examples of mobile devices and its usage

| Mobile devices | Examples of mobile learning | Source(s) |
|---|---|---|
| **Cell phone** | Using cell phones to teach English in Japan requiring students to, throughout a typical day, exchange text messages in English outside of class | Thornton and Houser (2005); Levy and Kennedy (2005) |
| **PDA** | Employing PDAs to access PowerPoint and other course resources, participate in discussion boards, e-mail other students and the instructor, and share work | Ramsden (2005) |
| **SMS** | Relying upon SMS to pose questions to students and receive responses via cell phones in facilitating daily assessment of achieving learning objectives | Balasundaram and Ramadoss (2007) |
| **PDA** | Utilizing PDAs to run class organization software | Sharpies et al. (2005) |
| **Cell phone** | Using cell phones to teach literature though multimedia messaging, Web searching, mobile posting to blogs, and content-related gaming | Shih and Mills (2007) |
| **Laptop, cell phones, PDAs,** | Distributing to students audio files that can be played on the learners' portable media players to address false preconceptions and anxiety related to an information technology class | Lee and Chan (2005) |
| **Cell phones** | Facilitating the polling of students, assessing comprehension, and fostering increased interactivity during a large business communications class with the help of students' mobile phones | Fisher and Baird (2006) |

Source: Croop (2008)

contents of the learning material, learner's mental ability, learning environment, space for the mobile learning, delivery method, technological aspects, and time for mobile learning, need to be considered (Laouris and Eteokleous 2005). Lecturers are busy in numerous academic activities which include preparing learning materials, assignments, quizzes, group discussions, and news forums to organize a better learning environment (Premadasa and Meegama 2013). Therefore, supporting the lecturers in their teaching activities is an indirect form of supporting a student's learning ability (Gaudioso et al. (2009). As stressed by Bartlett-Bragg (2013), mobile learning is all about the learners experience and also about reframing traditional design and pedagogical frameworks to consider critical elements like time and place, relevance, collaboration, user control, and personalization (p. 25).

According to Yusri and Goodwin (2013), mobile phones have more potential as a tool for mobile learning than any other handheld devices because it is available to everyone, has a low-cost services, has wide coverage of the mobile network, and is a familiar devices (Douch et al. 2010). According to technology time's newspaper, out of the 167 million Nigerians, 63.9 % of the population has access to mobile phones. Mobile phones have been seen as a sensible choice for educational investment (Williams 2006), and it is perceived as beneficial for both the learners and instructors in developing nations because of its cost-efficient method (Motlik 2008).

As stated by Croop (2008), the impact upon higher education of a global society that is becoming more mobile can be seen in a 2005 survey of 1,600 randomly selected University of Wisconsin-Madison students. The study reveals a quick abandoning of desktop computers in favor of laptops. This was also revealed in the study conducted by eMarketer in 2006 according to Oblinger (2006) that over 80 % of college students have cell phones, 56 % of college students own a laptop, and 75 % of college cell phone owners use text messaging most often on their phones.

According to Premadasa and Meegama (2013), mobile learning technology has improved the learning efficiency between the lecturers and the student as SMS has become one of the best communication technologies that can be used to bond the two roles, the lecturers and the student, for distributing information in the MLE. Therefore, the communication media as stressed by Rau et al. (2008) is an essential factor in the mobile learning environment (MLE) to increase intrinsic motivation without causing additional pressure in a demanding learning performance.

As highlighted by Attewell (2005), mobile devices can help improve literacy and numeracy skills, encourage independent and collaborative learning experiences, identify areas where learners need assistance and support, mitigate resistance using ICTs, engage reluctant learners, enable learners to remain more focused for longer periods, and promote self-esteem and self-confidence (pp. 13–15). This was supported by Crompton (2013) in her discussion about the benefit of mobile learning to the students where she discusses five learning approaches using mobile devices; this is shown in Table 2.

According to Croop (2008), the impact upon higher education of a global society that is becoming more mobile can be seen in a 2005 survey of 1,600 randomly selected University of Wisconsin-Madison students. The study reveals a quick abandoning of desktop computers in favor of laptops. This was also revealed in the study conducted by eMarketer in 2006 according to Oblinger (2006) that over 80 % of college students have cell phones, 56 % of college students own a laptop, and 75 % of college cell phone owners use text messaging most often on their phones. Furthermore, based on a survey of 107 students in Texas where all were owners of cell phones, Corbeil and Valdes-Corbeil (2007) proposed the first device that should be researched as a vehicle to implement mobile learning is the cell phone. Mehdipour and Kerehkafi (2013) heighted some applications of mobile phones which is shown in Table 3.

Fraga (2012) further highlighted the benefits of mobile leaning as: it is convenient and flexible (Peters 2007; Motiwalla 2007); mobile learning can be ubiquitous, localized, and personalized (Clarke and Flaherty 2002; Alexander 2004; Keegan 2002; Peters 2007; Shih and Mills 2007); it is more portability at a lower cost (Kukulska-Hulme 2005; Motiwalla 2007; Balasundaram and Ramadoss 2007; Attewell 2005; Nyiri 2006); it increased learner motivation and engagement (Balasundaram and Ramadoss 2007; Kukulska-Hulme 2005);

**Table 2** Learning approaches through mobile devices

| Learning types | Description | Example |
|---|---|---|
| **Contingent** | Students respond to the changes in environment and experiences | A student can be walking down the street and may see a word on a billboard that interests him, so he looks it up then and there on his mobile device. Learning was not planned, but it happened |
| **Situated** | Students learn in an environment appropriate to their learning | Students listen to a podcast about erosion as they examine rocks in a quarry |
| **Authentic** | Tasks are directly related to the learning goals | Students use the vibration meter app as they learn about earthquakes |
| **Context-aware** | Students interact with the environment using the tools on their mobile devices | On a visit to a museum, a student scans a QR code to find out more about a warrior helmet she is looking at |
| **Personalized** | Learning is customized to the preferences and needs of each student | As the students in the class are watching a short video clip on their mobile devices, one student who is hard of hearing, realized his sound was too low. He stopped his video, turned up the volume, and then continued to watch the video |

Source: Crompton (2013)

it increased collaboration (Brown 2005; Ramsden 2005; Oblinger and Oblinger 2005); mobile learning can complement other learning platforms (Traxler 2007; Aderinoye et al. 2007); mobile learning is student focused (Kukulska-Hulme and Traxler 2005; Kukulska-Hulme 2005; Fisher and Baird 2006); and mobile learning can contribute to the achievement of learning objectives (Shih and Mills 2007).

## 5 Issues and Challenges Toward the Implementation of Mobile Learning in Higher Education in Nigeria

As stated by Traxler (2010), Corbeil and Valdes-Corbel (2007), implementing mobile learning in higher education is still challenging due to cultural, social, and organizational factors. Therefore, the first step toward a successful implementation of mobile teaching and learning in higher education is the understanding of factors the influence learners' adoption of mobile learning.

According to Mohamad et al. (2012), the challenges of introducing mobile learning in Malaysian schools are grouped into six key issues which are: misuse, management and maintenance, current educational policy, digital divide, stakeholders' attitude, and personal space invasion (p. 133). Therefore, some issues and challenges discuss in this paper as pertinent to higher education in Nigeria include electricity supply, management and maintenance of mobile devices, acceptability by both the lecturers and the student, affordability of mobile device, and little knowledge about some of the mobile teaching applications.

**Table 3** Current capacities and application of mobile phones

| Subject | M-learning |
|---|---|
| **Place** | Learning anywhere, anytime |
| **Pedagogical change** | More voice, graphics, and animation-based instructions<br>Learning occurring in the field or while mobile |
| **Instructor student communication** | Instant delivery of e-mail or SMS<br>Instant communication<br>Synchronous<br>Spontaneous |
| **Student to student communication** | Flexible<br>Audio and video teleconference possible<br>27/4 instantaneous messaging<br>No geographic boundaries<br>No travel time with wireless internet connectivity<br>Flexible timing on 27/4 basis<br>Rich communication due to one-to-one communication, reduced inhibitions |
| **Feedback to student** | One-to-one basis possible<br>Both asynchronous and synchronous<br>Customized instruction<br>Performance and improvement based grading<br>Real-life cases and on the site experiments<br>Less paper, less printing, lower cost |
| **Assignment and test** | Any location<br>27/4 instantaneous<br>Any amount of time possible<br>Individualized tests<br>Instant feedback possible<br>Flexible length/number of questions |
| **Presentations, Exams, and Assignment** | Practical oriented exams direct on site, hands on based<br>Observe in the field and monitoring from remote location<br>One-to-one presentations with much richer communication<br>Automatic translation for delivery of instructions in many languages (possible)<br>Simultaneous collaborative group work<br>Electronic-based assignment delivery<br>E-delivery of assignment at any place and time<br>Instructor's time used to offer individualized instructions and help |

Source: Mehdipour and Zerehkafi (2013)

## 6 Electricity Supply

One of the utmost challenges to the development of Nigeria is electricity. Electricity supply was not in tune with the geometric increase in the population of the country, and because of that, some locations may not witness up to 5-h electric supply in a day and that is a challenge to the use of mobile devices that requires constant electricity of at least eight hours in a day. In the study conducted by

Osang et al. (2013), it was reviewed that 64 out of the 80 respondents (educators) identified power supply in the country as a major challenge to the implementation of mobile learning in Nigeria.

According to Mohamad et al. (2012), change is difficult to introduce and implement because it sometimes disempowered than empower people, and causing them to learn new skills requires personal investment of time, effort, and sometimes finances. According to Mohamad et al. (2012), organization of mobile learning is time consuming.

It was further stated by Crompton (2013) that one of the issues of mobile learning implementation into the schools is that the lecturers have to change their everyday behaviors to incorporate technologies into tasks that they previously did without digital technology, and this has been perceived as a different change for many lecturers.

## 7 Management and Maintenance of Mobile Devices

One of the perceived issues and challenges in the implementation of mobile learning in conventional universities in Nigeria is the issue of management and maintenance of mobile technologies. In the research conducted by Mohamad et al (2012), it was revealed that the organization of mobile learning is time consuming and there is perceived cost in deploying mobile phones for teaching and learning.

According to Naismith et al. (2004), as mobile devices encourage learning outside a classroom environment being managed by the lecturer, it is therefore necessary for the learners (Students) to have some effective tools like MP3 and Webinars to record, organize, and reflect in their learning experiences. Therefore, the experience and epileptic nature of data connections in Nigeria would be a major challenge.

For instance, out of the 38 federal universities in Nigeria, the University of Ilorin is still the only university that has a fiber-optic internet connection, and up till now, it is the lecturers that have to source for internet connection for themselves in some of the universities in Nigeria. Therefore, the inability to rely on the devices and mobile network connections have made it difficult for mobile learning to move more quickly into mainstream education (Kukulska-Hulme 2005).

## 8 Acceptability by Both the Lecturers and the Student

The success of mobile teaching and learning implementation lies on the lecturers and students readiness to use the new technology. Research has shown that large population of the lecturer does not really have the enthusiasm for teaching with technology as this will extend their workload through inclusion of course website, classroom technology as well as learning the technology (Osang et al 2013; Crompton 2013). It was also revealed that students prefer to be on net for social networking, online chatting, listening to music, and other social networking activities that distract their attention from studying rather than moving into the mobile space for their course work.

The researchers conducted a random sampling of 50 fresh students that was given a tablet PC in the University of Ilorin, and it was discovered that 31 (62 %) of the students use it for social networking (Facebook, chatting, 2go, Skype, WhatsApp) rather than using it for studies, although it was explained by the students that social networking is less expensive on the tablet compared with the data bundle required for educational purposes.

This is also in line with the study conducted by Mohamad et al (2012) where the respondents also believed that the stakeholders' attitude might be a challenge to implement mobile learning in Malaysia. This challenge might arise from the students, teachers, parents, and the community.

## 9 Affordability of Mobile Device

The cost of mobile learning devices ranging from programs used for the development of the mobile-based system and the devices used to run the mobile application is one of the issues in the implementation of mobile teaching and learning. In an interview that was conducted among the students of the University of Ilorin, it was revealed that the model of a power determines the capacity of what the power can be used for and according to them, not many of them have the financial resources to purchase a good mobile learning compatible phone.

## 10 Little Knowledge About Some of the Mobile Teaching Applications

There is low awareness of mobile learning applications on the part of students and even lecturers. Fifty students and 10 lecturers were interviewed. Table 4 shows the types of the usage of some mobile learning applications the students and lecturers uses and their purpose of being in that forum.

As stressed by Croop (2008), the limitations of mobile learning implementation are classified as technical and pedagogical challenges. The technical challenges are in relations to the input and output functions of the mobile devices. According to Motiwalla (2007) and Ramsden (2005), entering text using the keyboards on mobile appliances is at times very difficult and represents dissuasion to using the devices in learning activities, and also the small size of the viewing screen has been noticed as a limitation (Riva and Villani 2005; Fisher and Baird 2006). Fozdar and Kumar (2007) identified the difficulty that arises in reading from the mobile devices when in sunlight. Furthermore, Heath et al. (2005) wrote about the inability with many mobile devices for the learner to send output to a printer.

However, the issues of limited bandwidth of wireless cellular, the slow broadband network connections (Rekkedal and Dye 2007; Riva and Villani 2005), and small memory storage are the contributing factors to the slow nature of mobile device facilitated learning activities (Kukulska-Hulme 2005, 2007). Other technical issues and challenges in mobile learning according to Croop (2008) include short or

**Table 4** Uses of mobile learning applications by samples students and lecturers in the University of Ilorin

| Mobile learning applications | Usage of application by the students | Lecturers' usage of the application | Application usage | | | |
|---|---|---|---|---|---|---|
| | | | Academic usage | | Connections/social networking usage | |
| | | | Student | Lecturer | Student | Lecturer |
| Facebook | 42 | 7 | 3 | 1 | 39 | 6 |
| LinkedIn | 21 | 8 | 3 | 7 | 21 | 4 |
| SlideShare | 3 | 5 | 1 | 5 | – | – |
| Skype | 16 | 1 | – | – | 16 | 1 |
| WhatsApp | 39 | 6 | – | – | 39 | 6 |

Source: Data collected for this study

inadequate battery life (Corbeil and Valdes-Corbeil 2007; Kukulska-Hulme 2005; Riva and Villani 2005), difficult-to-use interfaces (Mottiwalla 2007), the lack of a standard mobile operating platform and a risky security environment (Riva and Villani 2005), inability to mark text (Yarnall et al. 2007), and difficult or impossible cut and paste operations (Kukulska-Hulme 2005).

Other issues and challenges in the implementation of mobile learning were highlighted by Croop (2008) which are the pedagogical issues that include: the use of text messaging by its nature may contribute to students not knowing and/or not caring how to spell (Attewell and Savill-Smith 2004); the students might be overwhelmed with information overload (Motiwalla 2007); it may be easier to cheat (Corbeil and Valdes-Corbeil 2007); and according to Fozdar and Kumar (2007), if not used properly, mobile learning can be counterproductive and there is the possibility of misuse via MMS, Bluetooth, and cyber bullying.

## 11 How to Address the Identified Issues and Challenges

In order to address the above-highlighted challenges toward the implementation of mobile learning in universities in Nigeria, the following measures are suggested:

1. The school leader should create an encouraged atmosphere to both the students and the staff in order to arise their willingness toward mobile learning through seminars and workshops on the values and usage of some of the educational social networking like LinkedIn, Facebook, SlideShare, etc., so that the students can see them as a way of improving their learning rather than using it for social connection and other illegal activities. The school leaders should also provide strong internet facilities to the students especially when on campus. The school management can also encourage the university community by providing them their desired mobile device, for them to be paying it back on installment basis depending on the school capabilities.
2. The lectures should encourage the learners by creating an educational page in some of the networking forums like Facebook, and they should encourage one

another in joining some of the professional LinkedIn group on the internet to improve themselves and discussing any challenge faced in their process of lecture delivery of professional growth.

3. It is also suggested that mobile phones that have parental features to control students through limiting the phone functionality will be necessary.
4. The government needs to amend some of it policies regarding ICT usage in higher education.
5. The school should have industrial-university collaboration with some of this mobile device manufacturer to discuss the specifications of mobile device they need as well as organization workshops for both the lecturers and the students on the usage of those devices to build self-confidence in them. The collaboration will also help in terms of getting those devices secure as each device will be customized with the users detail to avoid theft.

## 12 Future Directions

The role of mobile learning in reducing the rate of low access to university education by Nigerian student will be a welcomed development in responding to inadequate lecture rooms, personnel, and other facilities needed by the schools to accommodate more students. As students are more used to mobile devices, if such tools are being converted as learning device, it will increase their enthusiasm toward learning. However, for successful implementation of mobile learning especially in conventional universities in Nigeria, the students, the school leaders, the parents, as well as the government have a role to play in addressing the likely challenges of mobile learning.

## 13 Cross-References

▶ Characteristics of Mobile Teaching and Learning
▶ Design of Mobile Teaching and Learning in Higher Education: Introduction
▶ Expectations from Future Technologies and E-Learning in Higher Education in Albania
▶ Mobile Technologies for Teaching and Learning

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# Smart Lab Technologies

# 62

Hu Yin

## Contents



**Abstract**

A smart lab system (based on a traditional IT laboratory, with additional Internet of Things (IOT) technology and mobile application technology) is based on IOT and mobile application technologies and aims to provide a practice platform for university students learning IOT concepts and mobile application technology. It provides a real smart environment for a university to help improve campus management in the Internet era.

## 1 Introduction: Why Students Need a Smart Laboratory

With advances in computer science and Internet technologies, an increasing number of universities have established their own information technology (IT) institutes. Today, information technology is a basic skill required in many fields, which is why so many students take IT courses. Unlike in the 1980s, IT is no longer solely based on computer science but also on Internet technologies. With the

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evolution of Internet technologies, the concept of the computer has expanded to include small devices such as the mobile phone, which is now a high-performance computing and networking device (Zhang et al. 2009).

Students who want to become professional software developers must have adequate practice in that work while still in university. Therefore, universities need to offer professional IT laboratories in addition to computer labs. A network IT lab has become the standard configuration of most IT institutes. With the right equipment, environment, and courses, students can study and practice many experiments in a network IT lab, including TCP/IP stacks, different types of OS development, and Internet development based on B/S (browser/server) and C/S (client/server) architectures.

In the past 15 years, a new concept, the Internet of Things (IOT), has developed rapidly. Embedded and SOC (system on chip) technology allows many of the electrical devices around us to have a small and smart "brain," making it possible for not only computers but also electrical devices to comprise a network. Every device has its own identity and can be accessed by other entities in the network (▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). All of these devices can be the nodes of an IOT network.

Students today need to learn more knowledge than ever before. For IT students, programming embedded and mobile OS systems, such as iOS (the iPhone/iPad operating system (OS) of Apple, Inc.), Android (a popular smartphone OS from Google), and embedded Linux, has become an efficient way to improve their competitive strength (Zdziarshi 2009; ▶ Chap. 19, "Tutors in Pockets for Economics").

A smart laboratory provides more types of IOT nodes (smart devices with SOC or ARM cores that can communicate with each other by wireless technologies, such as Wi-Fi, ZigBee, Bluetooth, and so on) and development platforms to students than traditional network laboratories. In a traditional network laboratory, only PCs and network devices (such as routers, gateways, and so on) are provided for students. Thus, students only are able to practice PC-based network programming. It is often difficult to convey to students the relationship between their programming practices and real life. For example, one student asked why an iPhone app should be used to control lights and air conditioners in an office when it was easier to program with C/C++ or Java, and it was difficult to realize the control functions on a mobile phone. A smart laboratory helps students to become familiar with and practice programming for an IOT network. Students will acquire some practice in courses on the theory and usage of several concepts, including network construction and programming, wireless communication and programming, mobile platforms and programming, and IOT node management and programming

As universities become bigger, new management problems appear. A city based on a university is not a phenomenon found only in developed countries. Managing the huge number of electrical systems and devices in a university has become a real problem (▶ Chap. 19, "Tutors in Pockets for Economics"). Another problem is power saving (▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). It is difficult to monitor all subsystems such as lighting, heating, and air-conditioning

**Table 1** Comparison between traditional and smart IOT labs

| Knowledge | Traditional network lab | Smart IOT lab |
|---|---|---|
| Computer network | ✓ | ✓ |
| Internet structure | ✓ | ✓ |
| Internet of Things (IOT) | | ✓ |
| Network security | ✓ | ✓ |
| Wireless technology | | ✓ |
| Mobile platform (iOS/Android) | | ✓ |

systems. But if these are left running indiscriminately, energy will be wasted. Different function zones of a university run in different ways, adding to the complexity of energy management. Even when people can check the status of these subsystems, controlling the devices in these subsystems remotely and periodically is also a problem.

IOT technology is a proper method for resolving these problems. Smart devices of the IOT can be used to replace some traditional devices so that subsystem devices will connect to each other to build an IOT network. With a certain set of communication protocols, a university can build a smart environment campus. With a smart campus, UI (user interface) utilities are necessary to access and control smart devices. Mobile phones are the best equipment for running UI software.

The IOT network on campus will allow students to practice course experiments and self-designed IOT applications on any type of mobile phone platform, so that they can master the real application method of IOT. A smart lab system is used to provide a smart campus to a university and provide courses in IOT technology to students. A comparison between a traditional network laboratory and a smart IOT laboratory is provided in Table 1.

## 2 The SmartLab System

The SmartLab system is designed for a university that provides courses in IOT technology via smart IOT laboratories. It was developed in 2010 and has been deployed in several universities in China. The system provides IOT node hardware and software for building smart IOT labs and including smart technology in other buildings in a university. The logic structure of SmartLab is illustrated in Fig. 1.

In the intranet (or Internet) of a university, several subsystems of the campus are deployed by IOT nodes. The subsystems include the lighting, air conditioning, heating, audio/video, control switches, and security. Because an IOT node is actually an embedded computer device, it is programmable and network accessible.

A smart control host device is used to communicate with all the nodes belonging to it. Because IPv4 is now the primary technology used for networks, smart control hosts must be used for management of the last 20 m of IOT nodes. In the future, however, when IPv6 becomes more popular, every IOT node will have its own IP address and thus smart control hosts will be not necessary in a SmartLab system.

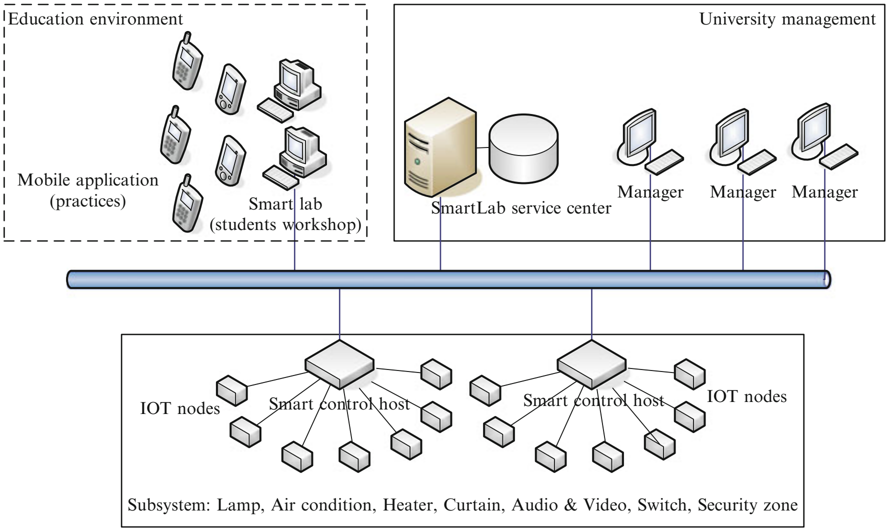


**Fig. 1** Logic structure of SmartLab (Source: The author)

A SmartLab service center serves as the database center and applications supporting center. Managers of a university will use a desktop utility or manage web pages to manage all subsystem devices and maintain different areas of the university.

For students, the SmartLab environment provides dedicated workshop tools and a software library for programming self-designed IOT applications. Most of the applications will be developed on mobile platforms such as iOS and Android. These mobile platforms are the best choice for running IOT user interaction applications (▶ Chaps. 2, "Characteristics of Mobile Teaching and Learning," ▶ 25, "Mobile Education via Social Media: Case Study on WeChat", and ▶ 49, "Student Feedback in Mobile Teaching and Learning").

A university may build multiple smart laboratories, but only one SmartLab service center is necessary.

## 2.1 IOT Nodes

The SmartLab system is designed for managing several types of subsystems of a university, including lighting, air conditioning, heating, audio/video, control switches, and security. IOT nodes are the key devices in those subsystems. One may wonder what the difference is between IOT nodes and traditional nodes. A common light control in a house is simple and is illustrated in Fig. 2a. As shown in Fig. 2b, an IOT smart light panel has its own embedded CPU so that it is programmable. Based on the SOC system, it also supports wireless communication with other devices such as the smart control host. While the smart control host

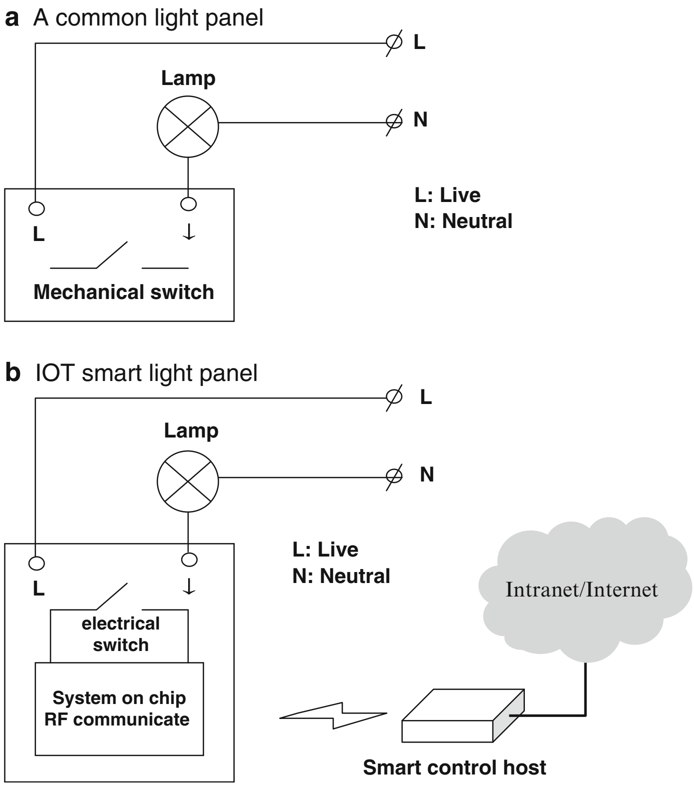


**Fig. 2** IOT nodes (Source: The author)

is connected into an IP network, the smart light panel can be accessed by any application through the IP network.

Though a smart panel has a complex micro system inside, the panel has exactly the same wiring interface as a common (traditional) light control panel! This is an important feature because there is no necessity to destroy the original wires when updating a common lighting system to a smart lighting system. Wireless commands exchanging between a smart light panel and smart control host will operate the electrical switch inside the smart light panel to switch on and off the lights. With the same mechanism, every subsystem of a university can be supported by a SmartLab system with the appropriate IOT node device.

As a gateway between IOT nodes and the intranet/Internet of a university, a smart control host is used to manage any IOT node device that belongs to it. A smart control host is an embedded computer with various types of ports and wireless communication methods. One smart control host can arrange and manage numerous IOT nodes distributed throughout a building. Figure 3 illustrates a deployment in a house. Some IOT nodes, such as the curtain control panel, are almost the same as the smart light control panel in the SmartLab system.

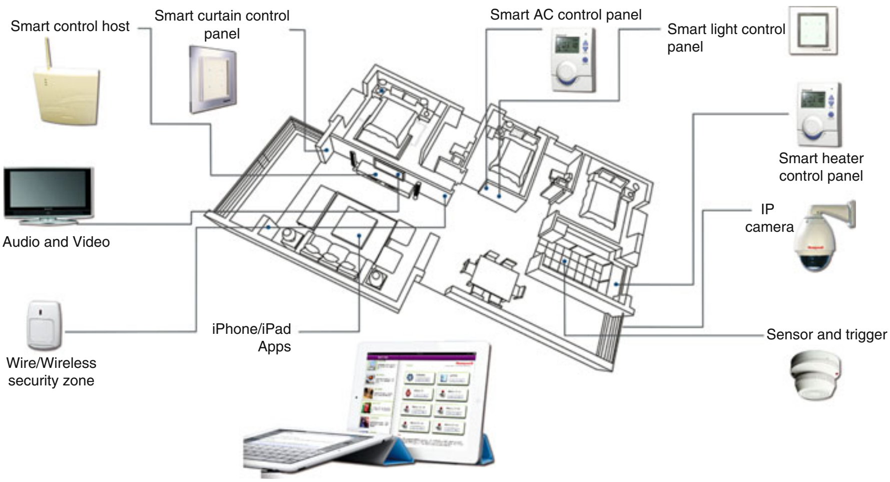


**Fig. 3** Smart control in a house (Source: The author)

Smart air conditioning and heating control panels have their own embedded SOC, too, but unlike the lighting system, they always use a RS485 bus to connect the building's air conditioning and heating system with the smart control host. Thus, air conditioning and heating control panels in a SmartLab are not wirelessly deployable.

With the audio and video subsystems installed in university classrooms, teachers usually use IR (infrared ray) remote controllers to operate such devices as televisions, projectors, curtains, DVD players, amplifiers, and so on. It is common to find more than three remote controllers in one classroom, and teachers may be confused by having to switch between several controllers.

In a SmartLab system, an IOT device called an IR repeater is used to integrate all types of IR remote controllers together. Thus, a teacher can control any audio/video devices just by using an application on a mobile phone. The IOT node IR repeater works as shown in Fig. 4.

Other types of IOT node devices that use wireless technology, such as IR and RF (radiofrequency) technology, are IR detectors used for smart security zones and sensor/trigger areas. However, in this situation, IR technology is not used for remote control but for movement detection. Any valid motion detection will inform the smart control host by RF communication channel.

Based on the various types of IOT nodes and powerful smart control hosts, the SmartLab was designed not only to construct a smart environment in a university but also to be used by students to learn and practice IOT technology and applications. All IOT nodes in the SmartLab system, except the IR repeater, are read-writable, that is, they can be controlled remotely and automatically, and current status can also be read remotely.

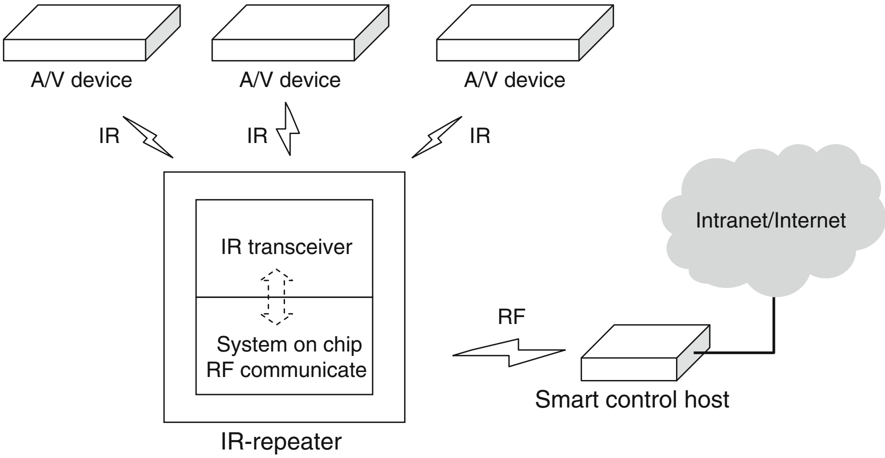


**Fig. 4** SmartLab IR repeater (Source: The author)

For energy-sensitive subsystems such as lighting, air conditioning, and heating, it is especially important that the nodes can be read. With real-time read data from these subsystems, a SmartLab system allows them to run in an efficient way, thus saving energy.

## 2.2 SmartLab Management

In a SmartLab system, the IOT network and nodes are the main physical part of the system. The other essential part is the area configuration and management, which is the logical part of a SmartLab system.

A large number of IOT nodes can be deployed in any part of a university campus. Each area of the university serves its own functionality. Each area covers a different part of campus and will need to manage numerous, different IOT nodes in its range. For example, public areas of campus always have smart lighting, air conditioning, heating, and security zones, but a teaching building has more subsystems, such as audio/video, curtain, and sensor (trigger) systems.

It is not difficult to understand that management utilities are needed by university managers to control a huge number of IOT nodes and areas.

The SmartLab system has a powerful platform running in the background to provide multiple services for configuring and managing a complex IOT environment.

In Fig. 1, all of the IOT node data is saved in the core database of the SmartLab system. Managers can map any node to any area they want by using the SmartLab manager software running on a PC. Within this manager software, they can also manage (add, delete, and modify) user-defined areas of the campus, then fetch node data from the database and map certain nodes into certain areas. The area defined by a manager may be a real area on campus or can be a virtual area just for IOT courses. This will be described later.

Only university administrators are able to access the database and manager software system. Students never access this software and data directly.

### 2.3 Mobile Apps for SmartLab

After configuring and arranging subsystems of SmartLab, campus users need convenient tools to operate IOT network objects. Though the manager software on a manager's PC can remotely access IOT nodes, it is not safe or convenient enough. The SmartLab system provides a set of mobile applications and development libraries for university customers and students. As mentioned before, the mobile platform is now powerful enough to run multiple functions. It is the most suitable platform for running operating tools of an IOT network.

Standard mobile applications are developed and released on the iOS platform. Campus users such as teachers and managers can download them freely from the iPhone/iPad App Store.

With corresponding authority, different members can operate only the IOT nodes in the area of which they are in charge. For example, a teacher using these apps can only operate IOT nodes in the classrooms where he or she lectures. However, a manager who maintains an office building will be allowed to operate all IOT nodes in the building. Of course, the management routines running in background of SmartLab will manage all the relationships.

The iPhone app for SmartLab control is called "iSmartHome2" (BOCC 2012). It runs on iPhone and iPad, with iOS versions later than 5.0. Users can find and download the application from the Apple App Store. The UI of iSmartHome2 is shown in Fig. 5. There is also an iPad version of the utility called "iSmartControl" (BOCC 2010) available from the App Store (Fig. 6).

These mobile applications can be used by the people who operate and manage IOT nodes in a university. Students usually will not use these utilities on their mobile phones. In fact, the SmartLab system has prepared a series of courses for students to learn how to design, manage, and program within an IOT environment. The SmartLab IOT developer library is part of these courses. The library can be used for students to program self-designed apps for an IOT network. Several types of mobile applications in a SmartLab deployed university are illustrated in Fig. 7.

Students practice in a smart laboratory, where many IOT nodes are installed and managed by the SmartLab system. Through the IOT courses, students learn how to develop applications on a mobile platform using the SmartLab IOT developer library. Student-developed applications are allowed to operate and manage all IOT nodes only in the smart laboratory, so there will be no security problem created by students' practice work.


**Fig. 5** iSmartHome2 user interface (Source: The author)

## 2.4 Courses for Students

The SmartLab courses were designed particularly to provide practice with IOT technology. Coordinated with the lessons on IOT theory, the practice work helps students understand the key points of IOT theory. Table 2 lists the main content of SmartLab practice courses.

# 3 Benefits of Using the SmartLab System

## 3.1 Benefits for the University

The SmartLab offers many benefits to a university. It allows everything to be under control. A SmartLab server running in IDC (Internet Data Center) provides data access and remote operating services to any manager on the campus. It is a quick and convenient way to check or respond to any issues with devices on campus. The integrated desktop utilities allow managers to operate any devices remotely and immediately.

Another benefit is smart energy management for a campus. Real-time power monitors and user-definable auto running modes for IOT nodes help managers at the university to learn to operate the campus in the most energy-efficient mode.


**Fig. 6** iSmartControl for iPad (Source: The author)

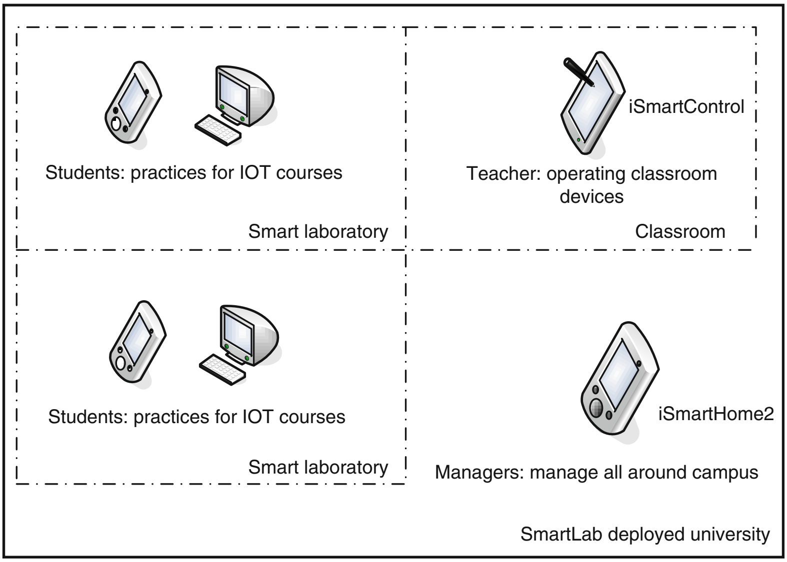


**Fig. 7** University SmartLab (Source: The author)

**Table 2** Content of SmartLab courses

| Content of SmartLab courses | | |
|---|---|---|
| IOT nodes | Wireless technology | RF communication<br>RFID of IOT nodes<br>IR-repeater learning mode<br>Wifi network configuration |
| | Sensor | Motion sensor and detector<br>Gas sensor and detector |
| IOT service | Network communication | TCP/IP program |
| | | Client/Server program |
| | | Browser/Server program |
| | | Network protocol |
| | | Data exchange (XML/JSON/. . .) |
| | Database | IOT nodes management |
| User Interface | Embedded front | Scenarios design and program |
| | | iOS SDK program |
| | | SmartLab apps development |

Source: The author

The other important benefit of SmartLab is for teachers. It gives teachers a new way to keep their attention on the lecture instead of on operating devices in a classroom. For example, without SmartLab, if a teacher wants to begin a lecture by showing some PPT pages on a curtain with projector, the teacher must stop the lecture, power on the projector, pull down the curtain, connect the projector to the correct input video channel, and then show the PPT page on screen. But with SmartLab's help, the teacher does not need to stop talking. He or she can just press one button (perhaps named "begin a PPT") on his or her iPad screen, then the serial of actions on these devices will be executed automatically.

The function of "begin a PPT" button is called a "scenario" in the SmartLab system. A scenario means a set of actions on a set of IOT nodes, so that one touch of a scenario button will cause a serial of commands executing in order to get the current environment to reach a target status. Scenarios are user definable, so that in a complex IOT network, any number of scenarios can be defined and used to build a smart environment. There are some predefined scenarios in SmartLab to help teachers and managers work in a smart campus. For teachers, some predefined scenarios are listed in Table 3. For students, scenario design and programming is included in their practice.

### 3.2 Benefits for Students

In a smart network laboratory managed by a SmartLab system, students have the opportunity to learn and practice most of the technology used in an IOT. Network structure and program practices allow students to gain the basic and important knowledge of the Internet. Students will learn some key IOT concepts and

**Table 3** Scenarios and sequences

| Scenario name | Commands sequence |
|---|---|
| Begin a PPT | Power on projector<br>Pull down curtain<br>Connect projector to AV1 channel<br>Power on speakers<br>Close nearby curtains of classroom. |
| End a PPT | Reverse steps of “Begin a PPT” |
| Bright environment | Switch on all lamps of the classroom |
| General environment | Switch on half lamps<br>Open all curtains<br>Set AC to 26 °C in summer/Set heater to 20 °C in winter |
| Power saving | Switch off all lamps<br>Open all curtains<br>Set AC to standby status |
| Leave classroom | Power saving scenario plus power off projector |

Source: The author

technology, such as IOT node theory, wireless communication, sensors and triggers, and how to connect an IOT node to an IP network.

There are many programming practices that can be done by students on a mobile platform. The iOS platform is now the primary platform recommended by SmartLab. Students enjoy using their imagination to construct their own visual area in the laboratory, composing smart and creative scenarios and creating their own mobile applications for using in their visual area. After SmartLab courses are completed, the teacher can arrange a contest for students to encourage students to try using more IOT technology with their original ideas.

## 4 Potential of the SmartLab System

With the development of IOT technology, cities around the world will face or are facing an evolution from the Internet of computers to the Internet of things. The computing capability will reach to the furthest corners of our living environment. This will bring us a new generation of IT and will require more people who are familiar and creative with IOT technology.

The SmartLab system is a platform that will generate good engineers of IOT. Though SmartLab is currently deployed only in the university environment, it can also be used in any part of a city: a smart city, smart building, smart hotel, smart office, or smart home. The basic structure and configuration principle would be the same when using such a smart system in other parts of our city life. SmartLab offers a powerful study and learning tool that will help students become real developers who are full of IOT knowledge and new ideas for IOT applications. A demonstration of a smart home design based on the SmartLab system is described below.

Assume a student has already finished the SmartLab IOT courses and experiments and wants to realize a real smart home system. The aims of the smart home

**Table 4** Aim of smart home

| | |
|---|---|
| **Schedulable energy management** | 0:00 am ~ 9:00 am AC set to 26 °C<br>9:00 am ~ 5:00 pm AC standby (nobody in house)<br>5:00 pm ~ 0:00 pm AC set to 22 °C |
| **Wireless control** | Use mobile phone to control smart home devices |
| **One touch controlling** | Design serial of scenarios for living in smart home<br>Leave home scenario: power off all lights and AC standby<br>Back home scenario: AC set to 22 °C, living room light on<br>Sleep mode scenario: All lights off, AC set to 26 °C<br>Get up in night: bedroom light and washroom light on |
| **Event responding** | If somebody enters washroom, light auto switch on.<br>While no motion detected for 10 min, washroom light will auto switch off. |

Source: The author

system include schedulable energy management, wireless management, one touch controlling, and automatic event responding. First, in a SmartLab laboratory, the student will choose a certain smart control host as the gateway of his or her smart home (a visual area). Then, his or her program via the SmartLab IOT development library can manage all of the IOT nodes managed by this host. Next, in the visual area, IOT nodes will be allocated to different parts of the smart home, such as the living room, bedroom, kitchen, and washroom. There are three types of IOT nodes in this smart home: lights, air conditioning, and triggers (IR). Every room has its own light and AC panel; one motion detector (trigger) is assigned to the washroom. The list in Table 4 shows the aim of the smart home.

The student's program could read information for all lights, AC panels, and trigger objects (Kochan 2009). An iOS-based project would use Xcode (the official integrated development environment for iOS and Mac OS software programing) and plug-ins from the SmartLab IOT development library. It would include a proper header program, with the help of classes in Objective-C (the primary program language for iOS and Mac OS software development). Every IOT object has its own identity number that will be used in further access.

According to the aims described in Table 4, timers and event delegate routine codes are programmed by the student. Using objects and methods provided by the SmartLab library, the student program can operate all the IOT objects in field. After the coding and testing work, an iOS application is made for this smart home. It will control the smart home environment automatically and in a user-friendly manner. It also illustrates that, with SmartLab's help, it is easy to construct a new type of smart environment, not only on campus.

## 5 Future Directions

IOT terminals, such as smart home devices and especially wireless accessible devices, are more popular than ever (▶ Chap. 2, "Characteristics of Mobile Teaching and Learning"). These devices are called "smart" because they are more clever than normal single-chip devices. They always have an ARM-based CPU inside. They can easily be connected to a network, and they are always programmable and accessible. For this reason, a SmartLab network laboratory is now a necessity for universities offering IT education.

With the rapid development of IOT technology, PC programming courses alone are not enough. A SmartLab course provides hardware and software tools that will help students construct a real IOT environment and develop in it. Without such a system, students may need several years to learn IOT concepts and master programming methods on different platforms.

## 6 Cross-References

► Characteristics of Mobile Teaching and Learning
► Mobile Education via Social Media: Case Study on WeChat
► Student Feedback in Mobile Teaching and Learning
► Tutors in Pockets for Economics

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# Retraction Note to: Designing a Mobile Applications Curriculum: An Overview Voice Device

Deanne Cranford-Wesley

The Editor-in-Chief has decided to retract this entry from the Handbook of Mobile Learning and Teaching (DOI 10.1007/978-3-642-54146-9). Upon investigation carried out according to the Committee on Publication Ethics guidelines, it has been found that substantial parts were duplicated from the following entry:

Patten, K.P., and M.A. Harris. 2013. The need to address mobile device security in the higher education IT curriculum. *Journal of Information Systems Education* 24(1):41–52.

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Y.A. Zhang (ed.), *Handbook of Mobile Teaching and Learning*,
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# Index





Y.A. Zhang (ed.), *Handbook of Mobile Teaching and Learning*,
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