Education Innovation

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Innovations in Open and Flexible Education

Springer

Education Innovation Series

Series Editor

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Aims and Scope – Springer Education Innovation Book Series

Education holds the key to unlock human resources that a society needs to survive and flourish. This is particularly salient in a borderless knowledge economy. For the past decades, the sterling performance of economies such as Hong Kong, Finland, Japan, Singapore and Taiwan in international studies (e.g., TIMSS, PIRLS and PISA) has attracted much attention internationally.

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The audience of the edited volumes and monographs published in this series includes researchers, policy makers, practitioners and students in the fields of education and teacher education, and public policies related to learning and human resources.

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ISSN 2211-4874 ISSN 2211-4882 (electronic)
Education Innovation Series
ISBN 978-981-10-7994-8 ISBN 978-981-10-7995-5 (eBook)
https://doi.org/10.1007/978-981-10-7995-5

Library of Congress Control Number: 2018933176

Printed on acid-free paper

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd. part of Springer Nature.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Foreword

The Springer's Education Innovation Series was introduced in 2014, with an aim to capture the latest educational innovations that emerged alongside the changing scenarios and landscapes in education to address many of the emerging demands in the twenty-first century, a century characterized by the advent of knowledge economy, the need for lifelong learning to cope with all the uncertainties brought about the radical economic restructuring mainly because knowledge economy, as a post-modern and post-industrialization era phenomenon, is fundamentally different from the economic shapes of the past. What we can witness today is that the life cycle of a job can be as short as 3 years or even less. Knowledge and creativity is more powerful in earning income, as compared with the need of manufactured products in the old industrial era. Knowledge and creativity provide more abstract products, or more correctly services, that replace the tangible products in the old economies. In this context, an individual's ability of lifelong learning (continuously) is necessary to survive in the new economic scenarios. Today's learners are required to learn flexibly, adaptively, innovatively, collaboratively, informally, and ubiquitously, in order to meet the new demands and requirements in the new economies. The winners in the new economies are those who are smart enough to innovate and create new needs, new conceptual products, new frameworks that can attract real investments, purchases and consumptions. Today, we can see the power of Apps that has created new ways of doing business unconceivable 10 or 20 years ago, such as those taxi apps and hotel/hostel/bnb Apps. Today, you don't need to own vehicles to run taxi companies, and likewise, you don't need to build hotels to run hotel business. The design is conceptual (and abstract), but the service is real, and the payment is also real.

As mentioned, today's learners are expected to be learning flexibly, adaptively, innovatively, collaboratively, informally, and ubiquitously in a lifelong learning manner. What about the education providers? Are they offering simultaneous provisions to allow our students in the new era to learn in new ways? The excitement of this new book, the 12th volume in the Education Innovation Series, entitled *Innovations in Open and Flexible Education* is that it will say "Yes" to this question. It is

a collection of papers to share with readers that corresponding new pedagogies are also emerging in a similar manner. While the responsibilities of lifelong learning rests on the individuals, thus it seems that we have less concern about whether the learner is successful in picking up the new ways of learning – and after all, they will succeed if they can master the new learning, or they will fail, if they cannot. However, the issues are much more complex and complicated when we look at the provisions of new pedagogies from education institutions, as it is always known that schools, as an institution, are most difficult to change, and teachers are living in a 'protected' environment insulated from the latest market change and economic restructuring, and thus they are relatively less sensitive towards to need to change.

The good news that this book brings about is that this collection of papers shows that there is no short of forward-looking education institutions and educators that have spent tremendous efforts in providing learning resources, programmes and approaches that would facilitate open and flexible learning for students of today. This book provides many real cases deployed in various higher institutions that have offered open and flexible learning programmes, and open and flexible learning resources and facilities. The book will be very interesting to readers who are interested in this field, as it provides a range of different kinds of attempts from pedagogical experiments by individual teachers to programme planning at institutional levels. The cases can be as small as using Whatsapps and Instant Messaging, and as big as big data maneuvering. This book is also conceptually rich, as the book has offered various analyses on terminologies and concepts prevalent in the field of open and flexible learning, such as "open education", "flexible education", "m-learning" (mobile learning), "u-learning" (ubiquitous learning), "OER" (open educational resources), "MOOCs" (massive open online courses) and "flipped classrooms".

The concept of MOOCs has been widely welcomed by the public, but it is not unanimously welcomed by offering institutions, as the situation will be complicated if learners want to accumulate credits and obtain certain qualifications out of attending MOOCs. Moreover, it can be very costly to prepare a MOOC class. The book has a couple of chapters touching on these issues and offer some practical solutions. Readers interested in flipped classroom will find this book useful as well, as there are a couple of chapters sharing teachers' experience of conducting learning in flipped classroom, not in the setting of higher education, but in primary and secondary schools – and if flipped classroom learning can penetrate to the school sector and be widely adopted, this will lead to overhaul changes in the classroom landscapes and pedagogical practices in school.

All in all, this is a timely book, which shows the efforts of many educators to provide *open and flexible education for all*, by offering open access, open educational resources, and sharing the experience of new attempts. By doing all this, the

new ideal for educational provision is indeed to create a favourable environment to achieve *lifelong learning for all* as well. I wish you would enjoy reading the efforts made by the authors of this collection of works on "Open and Flexible" education and learning.

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Introduction to the Book

Openness and flexibility are two major trends in contemporary education, particularly at the tertiary level, which influence the whole spectrum of education institutions across the globe. Open and distance learning universities embrace openness in terms of open admission, multiple exit points for studies, easy access to learning resources and flexible modes of learning. Conventional tertiary institutions are following suit by providing free course contents to learners as open courseware (the OCW movement); offering MOOCs as free online courses; and practising blended learning and 'flipped classrooms'. All these changes are made possible through technological advancement and breakthroughs in information and communication technologies. We see a worldwide trend away from seeing knowledge as a restrictive entity only accessible by the privileged towards regarding it as something that should be openly accessible, by means of designing open source software and open source publications (such as Wikipedia). Modes of learning and teaching are also becoming more open and flexible in terms of time, space, curriculum contents, organisation, pedagogical methods, infrastructure and requirements.

This book, *Innovations in Open and Flexible Education*, offers a wealth of practical experience and research in the area of open and flexible education. It includes a total of 23 papers from authors with unique experiences and perspectives from Asian countries (taking Australia to be a part of the Asian circle), most of which were papers presented in at the Second International Conference on Open and Flexible Education (ICOFE2015), organised by the Open University of Hong Kong (OUHK) in July 2015. The conference presented a Best Paper Award, and most papers in this book came from the shortlisted papers for the Award chosen by the Best Paper Award Selection Committee. In the process of assessing the papers for the Award, the committee found that many papers were of high quality and worthy of publication, thus recommending the publication of this book. Taking over the manuscripts, the editors further scrutinised the papers, and requested the authors

to further substantiate and improve their papers to ensure the collection is coherent and will adequately cover the themes of the book.

We believe that this book will shed light on new modes of learning and teaching in tertiary education.

The papers in the book are grouped into four themes, viz.

Part 1:
Open/flexible curriculum and pedagogy
Part 2:
Mobile and ubiquitous learning
Part 3:
Digitised media and open educational resources
Part 4:
Tracking and analysis of student learning.

Accelerating innovations and advances in technology are bringing about a paradigm shift in education that opens up education and improves learning effectiveness by enabling learning to be conducted at any time and from anywhere. In a flexible and personalised mode of education, the flipped classroom, the educational use of social media, mobile learning (m-learning), ubiquitous learning (u-learning), open educational resources (OERs) and massive open online courses (MOOCs) are examples of how educators are applying the latest technologies to cater for the diverse needs of different learning communities.

This book interprets and analyses a range of highly effective educational modes of learning. It allows professors, academics, researchers, students, education practitioners and administrators in international education corporations to keep abreast of the empirical research results and good practices in open and flexible education. For example, administrators in educational institutions can understand the latest developments in the field that can help them to make decisions and develop business plans; academics can relate their research interests closely to their choices of teaching modes; and students can identify learning modes which match their needs — including the means and the media to go through course contents, the learning resources available, and ways of engaging physically, cognitively and emotionally with their study programmes.

The papers selected for inclusion in this book cover a wide range of research methodologies, including qualitative and quantitative research studies, empirical and social case studies, experiments with statistical analyses, descriptive surveys, and interviews. As far as possible, we encouraged authors to provide illustrations such as figures and tables to present the data and findings. Overall, *Innovations in Open and Flexible Education* is a book that intends to provide readers with the latest academic thinking and research in the field of open and flexible education. The case studies and practical applications illustrate the effectiveness of new modes of education in which the latest technologies and innovations are widely used in the global context. The research results can develop readers' awareness of the related insights and

implications, thus advancing their understanding and stimulating critical thinking as to how new technologies will enhance and empower learning and teaching in different educational settings.

We very much hope that this book will provide a platform for sharing research, practices and views relevant to open and flexible education; for facilitating networking and cross-institutional collaboration among researchers and educators in both open and conventional universities; and for promoting open and flexible education to enhance educational access and quality.

Part I of the book is on open/flexible curriculum development and pedagogy.

The first paper by Li and Wong on revisiting flexible learning examines how the quality of education has been enhanced and addressed diverse student needs through such practices. The authors adopt a semantic approach by differentiating flexible learning from its associated terminologies which have been used interchangeably with the term flexible learning, such as open learning, technology-mediated learning, and distance learning. The authors also analyse flexible learning in terms of various dimensions, namely time, content, entry requirement, delivery, instructional approach, assessment, and research support, etc. Li and Wong's analysis show that the term flexible learning covers very broad meaning indeed, from entry requirement, to distance learning and technology-mediated learning. The term flexibly learning is being used really flexibly by people in the field. Notwithstanding its possible confusion, from a constructive perspective, this richness in meaning shows the development of the field, and how today's educational providers are trying to provide a more helpful learning environment, so that there are more opportunities for learners to get access to learning, and be engaged more meaningfully in learning.

Yoko Hirata's paper shares her experience in innovative curriculum planning through the organisation of student interviews, in order to understand students' perspectives of flexible learning. Their findings suggest the importance of providing students with the opportunities to express their honest opinions openly and directly to their teachers. It is only when teachers know whether their teaching is useful to students then they can improve their teaching methods and materials, and shape the curriculum and pedagogy to meet students' needs.

Lee's paper is the only paper in this book that analyses the significance of budget planning to provide flexible learning especially in self-financing institutions because they have a totally different set of criteria to follow in the planning process as compared with the government-funded institutions. Lee points out that the goals of flexible learning is to achieve equity, efficiency and effectiveness in educational provision, thus careful and responsible budget planning to achieve these goals is not only important, but these three goals can be competing and easily compromising if budget planning is not meticulous and forwarded looking.

Wong et al.'s paper is focused on needs assessment to support academic research in order to achieve flexible learning that would attain the above-mentioned goals of equity, efficiency and effectiveness. Even though most flexible learning providers, such as open and distance learning institutions are mainly teaching institutions,

research on pedagogies and technology-mediated learning are particularly important for these institutions if we want to serve the purpose. Thus, Wong et al's paper functions like an honest and blunt warning to these institutions that they do need to invest in academic research that can provide a timely reference for successful offering of open and flexible learning.

Yoshiro Hirata's paper compares different models of the 'flipped classroom' in Japanese educational settings and discusses the benefits and limitations of each. This paper provides refreshing information and perspectives in regard to how flipped classrooms have taken place in Asian classrooms for quite some time, even though they practise this with a very low profile. Particularly alarming from this paper is that it describes flipped classroom in primary and secondary schools – thus flipped classroom is not the monopoly of more advanced students. The flipped classroom can be applied to any classroom at any level of learning. It casts on the innovative teaching reform in Japanese education, and offers food for thought for readers who are planning to implement a 'flipped teaching approach'.

While most paper in this volume are reports from individual counties, Wong and Wong's paper provides an analysis of cross-country profiling in adopting open and flexible learning. Profiling the characteristics of a large number of open and flexible learning institutions in Asia, their paper addresses the strengths and opportunities of these institutions, with recommendations given for further development of open and flexible learning in the continent. In particular, they captured the exponential penetration of the Internet in Asian countries, which allows open and flexible learning institutions to reach a broader range of learners.

Lambert and Alony provides a positive answer to whether or not to include MOOCs as part of a programme's curriculum. Based on a small-scale pilot study, the authors describe how MOOCs have been used to address skills shortage among university students, and to engage staff in hybrid learning. Their findings are that once MOOCs is introduced, they witness the dynamism of curriculum transformation. The main element conducive to academics' engagement in adopting MOOCs is that the MOOC's delivery can be scaffolded for repeated use of the prototype to fit the learning needs of the students. Despite the initial *high* costs of developing the MOOCs prototype, its customised repeated use becomes minimal expenses. Thus, self-financing open learning institutions can budget MOOCs as an upfront investment for future adaptive use that can achieve various purposes – in the long run, the average costs of producing MOOCs will be decreased and affordable.

Part II of this book is devoted to studies on teaching and learning which involve the use of mobile devices.

Ng and Lam's paper is focused on the use of mobile technologies in vocational education and training (VET). While mobile and flexible technologies emphasise self-paced online and virtual learning experiences, VET stresses the mastery of hands-on skills and practices in authentic workplaces. The findings of this study show that, despite the need for innovative pedagogical practices, an increase in the

effectiveness of mobile and flexible technologies relies on the instructional design of the trade-specific learning and teaching materials, as well as the readiness of students, teachers and workplace mentors. They specifically highlight the significance of Augmented Reality and Virtual Reality as a learning experience. Augmented reality and virtual reality (AR/VR) learning would arouse students' interest, according to their learning preferences. AR provides learning experiences in immersive environments for a live direct or indirect view to generate physical, real-world experiences augmented by sound, videos, graphics or animation. VR uses virtual or simulated environments produced by computer to enable students' presence in the virtual environments.

The paper by Li et al. looks at the preference and readiness for nursing students for mobile learning in the context of the Open University of Hong Kong. Their study found that nursing students would like to access their learning materials anytime and anywhere. The nursing students considered 'ease of reading' and 'ease of note-taking and highlighting' as the most important factors that determined their use of electronic learning materials. They further considered 'level of comfort in reading', 'portability', and 'input and output capabilities' as the three most important factors in using a mobile device for learning. Among the different study topics, they highly preferred to have body systems and diseases as well as medical terminology to be provided in multimedia materials in the mobile device. These findings will help future design of the curriculum for mobile learning to ensure receptiveness by the students and effective use of the mobile learning resources.

The study of Singh et al. reports on a pilot project which investigates students' use of WhatsApp Messenger to communicate images, audio and videos, as well as texts, during the study of a course. Their paper outlines the Open University Malaysia (OUM)'s efforts and processes for implementing the WhatsApp as a tool for mobile learning support, and its effectiveness. They found that although WhatsApp Messenger is primarily used for chatting with friends and accepted as a medium for social networking, it has great potential for use as a tool to facilitate learning or provide support for it. The findings of Singh et al 's study are that the mobile learning support via WhatsApp Messenger helped the majority of the learners. They considered the messages to be useful and worthy of their time and attention. The ubiquitous nature of WhatsApp with appropriate mobile learning instructional strategies can help to further advance the support for course-specific content.

After a survey of students' needs, Zhang et al. specifically designed a mobile 'App' to assist students' learning. Their paper describes the use and benefits of the App and learners' satisfaction is reported. Their paper points out the major contribution of introducing ubiquitous learning (u-learning) and mobile learning (m-learning) in the digital age. In sum, under the u-learning and m-learning environment, students can get access to rich media and information relevant to learning; they can share information with each other to achieve peer and collaborative learning; they can take control of their lives. Students may encounter uncertainty

about the truthfulness of the information obtained from the Internet, but this is part of the training of mediate education that can help them to identify truth (and fact) from opinion.

Cheng and Siow's paper focuses on the impact of mobile technology on learning management science and the development of problem-solving skills. Their study found that mobile technology plays an important role in enhancing students' understanding. On the other hand, they have mixed findings about whether a learning management system was useful in enhancing their learning, as sometimes the students expressed that the process even retarded their learning. The students' reactions to m-learning described here need to be addressed for their sake; and m-learning should be implemented in MS subjects, as well as across the undergraduate curriculum.

Part III of the book shares the innovative use and analysis of digitised media and open educational resources.

To explore the benefits of digital game-based learning for younger learners, Tso and Lau report on how a free, open-for-all digital game package was designed and integrated into regular primary school mathematics education. They found that digital game-based learning can increase learners' motivation, develop learners' autonomy, and improve their academic performance. It is not only useful in eliciting learners' motivation and enhancing learner's self-directed learning skills, but also significant in improving learners' academic performance. As digital experience has come to play a central role in modern life, educators should reflect upon what they can do to help students train up their digital literacy, problem-solving, self-directed learning, and readiness for lifelong learning, so as to become competitive and well-equipped for their future.

Chen and Wu's paper introduces the concept of 'flipped' MOOC classes teaching college physics. This paper provides detailed statistical analysis, comparing the teaching and learning effects in conventional didactic classes and the 'flipped' MOOC classes. The statistical analysis showed that the average exam score in the 'flipped' MOOC class was better than the average exam score in the conventional class, and the *t*-test suggested significant differences in score between them. However, there was not a significant difference in procedure scores. Nonetheless the 'flipped' MOOC class did not just enhance students' knowledge. The students also learned cooperative, self-management, communicative and organisational skills, and so the 'flipped' MOOC class has good prospects.

Yuen and Li's paper evaluates Hong Kong's First Open Textbooks project. This is actually a draft report of the project, which introduces open textbooks for primary and secondary schools in Hong Kong, as a form of introducing Open Educational Resources (OER) in Hong Kong. It is encouraging to note that most teachers who used the open textbooks have developed a sense of ownership of the books because of the possibility of customisation as part of the design of the open textbooks. Ownership is the first step for teachers' involvement in future modification of the

open textbooks. Their findings are in line with those of open textbooks projects in other countries, suggesting that apart from the investment at the beginning of the project, further customisation for school-based and student-centre teaching and learning does not require further substantial financial resources, and thus OER is a sustainable textbook for ongoing customisation according to the needs of the students. In addition, the good news to parents is that they no longer need to worry about annual increase in the price of textbooks. An additional benefit is that online textbooks can lessen the students' burden of carrying heavy copies of the books to and from school (Petrides et al. 2011).

Banerjee's paper lists the various ways in which OER can be incorporated into the infrastructure and pedagogy for promoting ubiquitous learning. The author examines how teachers, learner profiles, assessment tools, social platforms and Internet connectivity play a role in promoting ubiquitous learning and remove the boundaries of education. To involve the teachers in this approach is a challenge which can be met by providing them with the required technical knowhow, and also training them professionally in the newer paradigms of instructional design and pedagogy which are required for ubiquitous learning. As a result of this change in instructional design, the learners shift from being knowledge receptors to knowledge actors.

Wong and Wong's paper discusses how videos could be used in blended learning. They have provided a comprehensive discussion on the concept of blended learning, especially how different stakeholders can see blended learning in quite different ways, both in terms of its function and application, and how blended learning can be integrated into the main curriculum. In addition to identifying how blending learning can help to make learning more effective, their paper also explores the pitfalls and success factors that will affect the successful design and implementation of blended learning. One major contribution of this chapter is the provision of evaluation of blended learning from a dimensional perspective. The authors provide a framework that helps to clarify the role and functions of using videos in blended learning, namely the narrative role, the communicative role, the adaptive role and productive role. The list of success factors is also useful for educational stakeholders to take into consideration to enhance the successful opportunities of adopting blended learning in their course delivery.

He's paper identifies the factors which contribute to media literacy in young students, through the implementation of a questionnaire survey and statistical analysis, and correlational analysis in particular. The author found that students from various schools in Beijing were significantly different in terms of the cognitive dimension of media literacy. Secondly, age and gender were important factors affecting the level of media literacy of young students, and the students' age was inversely proportional to their cognitive level. Thirdly, the results showed that the higher the frequencies of the students' use of computers and networks, the better their performance at the technical level. The use of computers and networks thus had a positive impact on students' cognitive abilities. By increasing the use of computers and networks, both within and outside the school environment, students are expected to enhance their media literacy at the cognitive level.

Part IV of this book is on tracking and analysing student learning. With innovations in open and flexible teaching and the use of new educational technologies, their influence on student learning has to be tracked and analysed to reveal their effectiveness.

Learning analytics (LA) and the use of big data in education are gaining attention in academic research. It has been found that big data analysis and learning analytics are not only useful at the institutional level in terms of providing information on students' learning outcomes and learning preference. They are also useful for teaching improvement in classroom learning and teaching, as the information is also useful for the design of learning tasks and classroom activities.

The paper by Lv et al. focuses on the use of big data in the context of teaching, learning and evaluating college physics experiments. This paper analyses research results on mobile learning (m-learning), ubiquitous learning (u-learning) and educational big data mining. Their analyses deal with the promotion of personalised adaptive learning, where educational data mining and learning analytics can be used to help students find the best learning methods and resources for physics experiments. Their study also looks at the digitising of a university physics experiment course for recording resource usage and the experimental operation process. It casts light on how teachers provide rich e-learning resources and a useful communication platform for recording the data produced by students, and adjust their teaching methods and strategies for different students. The paper discusses the possibility of adopting blended learning that combines informal after-class learning and formal classroom experiment learning, and uses the prediction function of big data to change students' learning method for different experiments. Finally, the paper looks at the reform of the evaluation method for physics experiments to reflect more objectively students' actual levels of performance by analysing the whole process.

Yue's paper studies the use of instant messaging (IM) for tutoring undergraduate students. The paper analyses how the instant messages are used among students and their tutor to explain their assessment results, and examines factors influencing the message exchange. Yue's study found that the students who exchanged instant messages (all related to the completion of their written assignment) with their tutor are likely to understand the requirements of the assignment better. Their completed assignments were of a better quality and therefore obtained higher marks than the students who had not contacted their tutor using IM. Those students who were involved in IM with their tutor under a tutor-centred teaching method scored higher in their assignments than those under a student-centred method. This could be due to the fact that, under the tutor-centred method, more explanations were given by the tutor in the tutorial classes. Under the student-centred method, the students' oral presentations took up some class time, leaving less time for the tutor to elaborate on the answers to the tutorial exercise questions and discuss the final written assignment the students have to complete.

Lim's paper investigates the use of an experience application programming interface (xAPI) to track learning in a mobile and flexible learning environment, and discusses the advantages of using it. One major contribution of this paper is Lim's observation and findings that the development of learning technology has been found difficult mainly because of the confinement of content-based approach to learning, which has strongly influenced by the emphasis on cognitive learning, and has dominated the education ecology for centuries. The breakthrough of this paper is the attempt to switch to xAPI by educational technologists. xAPI no longer relies on content-based learning to track the learning progress. Interaction and engagement in the process of learning can be taken into account, and Lim's observation is that with xAPI, educators can monitor students' learning progress by means of interaction and process, without necessary referring to how much content a learner has grasped. Thus the switch xAPI has groundbreaking potential of discovering a new way of tracking and defining learning.

The paper by Choi and Lam explores how reinforcement learning (RL) can be employed to address the sequential decision problem involved in the LA process, and proposes an RL framework integrated with LA stages. So far, research efforts have focused mostly on studying independent research questions involved in individual stages. In this paper, the authors attempt to look at the whole LA progress instead. They discuss how RL, a sub-field of machine learning, can be employed to address the sequential decision problem involved in the LA process. In particular, they integrate the LA stages with an RL framework consisting of state space, action space, transition function and reward function, and illustrate this with examples of how the three most studied optimality criteria in RL – finite horizon, discounted infinite horizon and the average reward model – can be applied to the LA process. Overall, the authors argue that RL provides a rigorous and yet flexible model for formulating the learning analytics process.

This book is concluded by Wong et al's paper, which is their report on how smartphones and low-cost modern electronics can be used to design data logging devices and a modelling tool for high school students doing physics experiments. The authors tried to design data-logging devices and a modelling tool for high school physics labs with low-cost modern electronics, including smartphones, Lego Mindstorms NXT and Arduino, equipped with an ultrasonic sensor. For NXT and smartphones, experimental data were first logged in the devices and then manually copied to a personal computer for data analysis. For Arduino, experimental data were transmitted to a PC via Bluetooth in real time. With the data in a PC, each student used a modelling tool on a Web browser to try to find an equation that fitted the data with a small error. The equation was a function that related one variable to another. Based on the visual plot and the error information, the students can then try to reduce the error by revising the equation. The results indicated that both students and the instructor enjoyed using the modern data loggers and the acquired data to find equations that fitted the data well.

The four themes of papers in this book enable readers to become familiar with the latest academic thinking and research on how to make open and flexible education with proper educational technologies and big data analysis. We hope that the research, practices and views shared in this book will provide useful insights and guidance for advancement in this field.

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Part I
Open/Flexible Curriculum and Pedagogy

Chapter 1
Revisiting the Definitions and Implementation of Flexible Learning

Kam Cheong Li and Beryl Yuen Yee Wong

Abstract For decades, flexibility has been a focus of attention and efforts in the field of education. Flexibility in learning, which emphasises student choice, has been considered one key to enhancing education quality and satisfying highly diverse student needs. It is often associated with the terms 'open learning', 'distance learning', and 'e-learning'. With the increasing application of information and communication technologies in the field of education, flexible learning has been especially closely associated with e-learning and sometimes is considered to be the essence of the term. Since the ambiguity of the term could be counterproductive in discussions of flexible learning, a systematic review of the relevant literature is badly needed to put the meanings of the term in perspective. This paper provides a critical review of the literature relevant to flexible learning. The development of the use of 'flexible learning' and the implementation of the term are summarised. In this paper, the term 'flexible learning' is redefined with an aim to clarify its relationship with relevant terms and a proposed system of its dimensions. Suggestions for future research are also provided.

Keywords Flexible learning · Flexible education · Open learning · Distance learning · E-learning

Development of the Use of Flexible Learning

In the early 1970s, when Britain and other advanced economies went into a post-Fordist era, the economic paradigm was often referred to as 'flexible production'. It was then when the education systems were required to become more flexible responding to the new economic paradigm (Chalkley, 1997). The term 'flexible

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_1

learning' originated in the United States during the 1970s, and the term started to appear in the literature in Britain during the early 1980s (Bell, Bowden, & Trott, 1997). In the late twentieth century, the word 'flexible' became highly frequently used (Nunan, 1999). The twenty-first century witnesses a more rapid increase in the interest in flexible learning. This is reflected in the number of papers on the topic. From a search done in June 2015 on the topic of 'flexible learning' in the Web of Science, results show that there were 431 papers on flexible learning in 1980–2000. During the following 5 years, another 409 papers on flexible learning were published. The number of papers in 2006–2010 increased to 1301 and then 1943 in 2011–2015.

The growing use of 'flexible learning' has raised such questions as 'What does "flexible learning" mean' (Roebuck, 1987) and 'what does flexible learning look like in practice' (e.g. Hudson, Maslin-Prothero, & Oates, 1997; Lindberg & Olofsson, 2006; Sadler-Smith & Smith, 2004; Wade, Hodgkinson, Smith, & Arfield, 1994). Analysing the way the term 'flexible learning' is used, it is found that learners are often put in the centre (Collis & Moonen, 2002a, 2002b; Li, 2014; Moran & Myringer, 1999). For example, flexible learning is defined as a teaching and learning approach which is learner-centred (Moran & Myringer, 1999) or as an approach revolving around the provision of learning options based on students' specific needs and preferences (Demetriadis & Pombortsis, 2007).

Since its conception, flexible learning was used as a term which was closely associated with 'open learning' and 'distance learning'. It was also associated with information technology with its boom at the end of the twentieth century. As Ellington (1997) noted, flexible learning was interpreted very loosely at that time, but Ellington suggested that we should not aim to overly define the term but should let practitioners interpret and develop its meanings when they adopt and implement flexible learning. Despite various attempts to define the term during the last few decades, up to now, defining flexible learning is still a highly perplexing task. There is still no universally accepted definition for the term (Casey & Wilson, 2005; Tucker & Morris, 2011). In addition to its association with open learning and distance learning, flexible learning is now also closely associated with e-learning or technology-mediated learning.

Despite its haziness and indistinctness in meaning, flexible learning has been pursued by many educators and researchers. As Collis and Mooner (2002a, 2002b) point out, 'Flexible learning is becoming somewhat a buzzword: everyone is for it, but often people have not thought further about it' (p. 218). However, the ambiguity of the term is sometimes counterproductive, as this may lead to confusion among teaching staff in regard to what flexible learning refers to technically (Kirkpatrick, 1997). Thus, there are ongoing efforts to clarify the definition of flexible learning and its semantic dimensions.

Meaning and Semantic Dimensions

Flexible Learning and Open Learning

One way to clarify the meaning of flexible learning is to distinguish it from the terms that it is often associated and used interchangeably with. Although both open learning and flexible learning try to minimise constraints of access, time and place, pace, and methods of study (Kember, 2007; Khan, 2005), open learning targets at democratisation of access to education by not requiring entry qualifications (Olakulehin & Singh, 2013), while flexible learning targets at providing learning flexibility to satisfy diverse student needs. According to Demetriadis and Pombortsis (2007), flexible learning refers to the learning where 'learners are offered a variety of options for personalising the learning experience based on their specific needs and preferences' (p. 148).

Learning equity, or having equal opportunities to receive education, is the core concern of open learning (Perraton, 2007), while learners' choice of the learning approach that suit them is the crux of flexible learning (Collis & Moonen, 2002a, 2002b). As Collis and Moonen (2001) suggested, to increase flexibility, students should be allowed to choose what is best for them as the key dimensions of learning. Entry requirements could be one aspect of flexibility (Collis & Moonen, 2002a, 2002b; Li, 2014; Tucker & Morris, 2011), but flexible learning should cover many more aspects in the learning process (Collis & van der Wende, 2002).

Flexible Learning and Distance Learning

Besides 'open learning', 'distance learning' is often associated with flexible learning. From this perspective, flexible learning 'has replaced distance education as a means of servicing the needs of geographically distant or remote students' (Kirkpatrick, 1997, p. 160). However, flexibility does not necessarily refer to distance, and there is a lot more than distance that flexible learning refers to. As Collis and Moonen (2002a, 2002b) note:

> There are many ways to make education more flexible that can benefit students who are in full-time residence on a campus and even benefit those who are in the same room together. Flexibility can involve options in course resources, in types of learning activities, in media to support learning, and many other possibilities. There is more than distance that can vary. (p. 218)

Although many efforts in flexible learning focused on allowing and facilitating students to learn at a place which is at a distance from the teacher or teaching

institution (e.g. Cartier, 2014; Casey & Wilson, 2005; Drennan, Pisarski, & Kennedy, 2005; Lindberg & Olofsson, 2006), flexibility also covers students' learning on campus or in classrooms, with the provision of flexible learning time, learning contents, and instructional approaches (e.g. Casey & Wilson, 2005; de Boer & Collis, 2005).

Flexible Learning and Technology Mediated Learning

Sometimes, technology-mediated learning is used synonymously with flexible learning (Irvine & Cossham, 2011), and there is a widespread perception that flexible learning means the use of technology (Cybinski & Selvanathan, 2005; Kirkpatrick, 1997), or technology is at least a main component in the provision of flexible learning (Collis & Moonen, 2002a, 2002b; Khan, 2005; Sadler-Smith & Smith, 2004). With the development of information and communication technologies in the field of education, flexibility is often associated specifically with e-learning (Khan, 2005). Not only academic researchers but also teaching academics see flexible learning as 'learning that was carried by information technologies' (Kirkpatrick, 1997, p. 170). However, concerns have been addressed about the appropriateness of overweighting the role of technology in flexible learning (Casey & Wilson, 2005). Casey and Wilson (2005) argue:

> It is much better to regard technology as a set of generic 'services' or tools that may be called on to support flexibility, and instead concentrate our efforts on the far more profound issues of designing for flexible learning. (p. 3)

It is inappropriate to take flexible learning as the use of technology in learning, though technology is an important enabling factor of flexible learning (Casey & Wilson, 2005; Kirkpatrick, 1997). As much as flexible learning means more than distance learning and open learning, flexible learning embraces technology but means much more than the use of technology.

Dimensions of Flexible Learning

Identifying dimensions or components of a term is an effective way to comprehend and operationalise a concept with broad connotation. Table 1.1 summarises the components of flexible learning proposed in previous works and reorganises these components in a multidimensional system.

In addition to the above-mentioned efforts to understand the meanings of flexible learning by comparing and contrasting it with associated terms such as distance learning, open learning and e-learning attempts have been made to clarify the term 'flexible learning' by analysing the dimensions that flexible learning may cover, such as time, contents, entry requirements, instructional approaches, assessment,

Table 1.1 Components of flexible learning

Time	*Time and date to start or finish the course/module* (Collis & Moonen, 2002a, 2002b; Goodyear, 2008; Hart, 2000; Li, 2014; Race, 1988; Tucker & Morris, 2011)
	Pace of learning in a course (Collis & Moonen, 2002a, 2002b; Goodyear, 2008; Li, 2014; Ling et al., 2001; Race, 1988; Tucker & Morris, 2011)
Content	*Level of difficulty of module content* (Hart, 2000; Race, 1988; Tucker & Morris, 2011)
	Sequence in which topics are covered (Chen, 2003; Collis & Moonen, 2002a, 2002b; Li, 2014; Tucker & Morris, 2011)
	Topic to learn (Collis & Moonen, 2002a, 2002b; Hart, 2000)
Entry requirement	*Prerequisites for module/course participation* (Collis & Moonen, 2002a, 2002b; Goodyear, 2008; Hart, 2000; Li, 2014; Tucker & Morris, 2011)
Delivery	*Channels for course information* (Collis & Moonen, 2002a, 2002b; Li, 2014; Tucker & Morris, 2011)
	Place for learning (Chen, 2003; Collis & Moonen, 2002a, 2002b; Goodyear, 2008; Hart, 2000; Li, 2014; Ling et al., 2001; Race, 1988; Tucker & Morris, 2011)
Instructional approach	*Amount of learning activities* (Goodyear, 2008; li, 2014; Tucker & Morris, 2011)
	Instructional language (Collis & Moonen, 2002a, 2002b; Li, 2014; Tucker & Morris, 2011)
	Modes and structures of presentation (Sadler-Smith & Smith, 2004)
	Social organisation of learning (group or individual) (Collis & Moonen, 2002a, 2002b; Goodyear, 2008; Hart, 2000; Li, 2014; Ling et al., 2001; Race, 1988; Tucker & Morris, 2011)
	Time and duration of learning activities (Chen, 2003; Collis & Moonen, 2002a, 2002b; Goodyear, 2008)
	Type of learning activities (Collis & Moonen, 2002a, 2002b; Goodyear, 2008; Hart, 2000)
Assessment	*Assessment mode* (Chen, 2003; Hart, 2000; Ling et al., 2001)
	Assessment standard (Collis & Moonen, 2002a, 2002b; Tucker & Morris, 2011)
	Assignment requirement (de Boer & Collis, 2005)
	Weighting of assignments and examination in the course result (Li, 2014)
	Examination dates and assignment deadline (Collis & Moonen, 2002a, 2002b; Tucker & Morris, 2011)
Resource and support	*Amount of learning materials, tools, and support* (Race, 1988)
	Method of obtaining learning materials, tools, and support (Collis & Moonen, 2002a, 2002b; Tucker & Morris, 2011)
	Place where learning materials, tools, and support are available (Li, 2014; Tucker & Morris, 2011)
	Time available for support (Hart, 2000; Li, 2014; Tucker & Morris, 2011)
	Type of learning materials, tools, and support (Chen, 2003; Collis & Moonen, 2002a, 2002b; Goodyear, 2008; Hart, 2000; Li, 2014; Tucker & Morris, 2011)
Orientation or goal	*Orientation of the course* (theoretical, practical) (Collis & Moonen, 2002a, 2002b)
	Goal of learning the course (Goodyear, 2008)

resource and support provided, the goal of learning, etc. (e.g. Collis & Moonen, 2002a, 2002b; Goodyear, 2008; Li, 2014; Ling et al., 2001; Race, 1988; Tucker & Morris, 2011). Yet those who analyse the dimensions of flexible learning tend to look at only certain dimensions rather than all possible dimensions from a holistic view. Thus different scholars comment on different dimensions, and it may not be easy to add all these dimensions together in a comparable manner.

Implementation of Flexible Learning

It is not realistic to expect that all the dimensions/components should be involved to implement flexible learning. The dimensions listed in Table 1.1 are only our effort to enlist the dimensions we have found in process of the literature review. More work is required to align these dimensions into a certain framework in order to arrive at a holistic view. As Chen (2003) argued, flexibility should not be always presumed good, and 'flexibility is but one way to approach learning' (p. 27). Collis and Moonen (2002a, 2002b) suggest when carrying out flexible learning in practice, an institution needs to decide which dimensions and what range of options within these dimensions it will focus on. For example, Li (2014) and Tucker and Morris (2011) take into consideration the perceptions of practitioners and learners when they choose to provide and develop certain dimensions of flexible learning. Great efforts have been made to discuss the implementation of flexible learning in terms of dimensions of learning (e.g. Cavus & Al-Momani, 2011; de Boer & Collis, 2005; Demetriadis & Pombortsis, 2007; Dorrian & Wache, 2009; Sadler-Smith & Smith, 2004; Wilkinson, Forbes, Bloomfield, & Gee, 2004). An example of implementing flexibility with respect to language is allowing international students to do assignments in their own mother languages (de Boer & Collis, 2005). Examples of implementing flexibility regarding channels for module/course information are providing a wide range of alternative delivery mechanisms (Sadler-Smith & Smith, 2004), creating online learning environment (Ash, 2012; de Boer & Collis, 2005), reducing physical meetings (Olakulehin & Singh, 2013), etc. We have identified 20 papers discussing the implementation of flexible learning. The numbers of cases described in these papers are presented in Table 1.2. These cases reflect the implementation of specific dimensions of flexible learning.

Table 1.2 indicates that among the dimensions proposed in Table 1.1, 'delivery', 'assessment', and 'resource and support' are the ones that are implemented by most of the studies reviewed. As regards components, 'place for learning', 'channels for course information', and 'type of learning materials, tools and support' are implemented the most often according to the studies reviewed. No study is found to implement flexibility regarding the dimension of 'entry requirement'. Some components of flexibility are not implemented in the studies either, which include 'amount of learning activities', 'time and duration of learning activities', 'level of difficulty of module content', 'sequence in which topics are covered', and 'pre-requisites for module/course participation'.

Table 1.2 Number of cases of implementation of flexible dimensions and components

Dimension	Component	N
Delivery	Place for learning (Ash, 2012; Casey & Wilson, 2005; Cybinski & Selvanathan, 2005; Herat, 2000; Lutteroth & Luxton-Reilly, 2008; Phillips, 2004; Wilkinson et al., 2004)	7
	Channels for module/course information (Ash, 2012; de Boer & Collis, 2005; Dowling, Godfrey, & Gyles, 2003; Gutl, Chang, & Freudenthaler, 2010; Lindberg & Olofsson, 2006; Nisselle, Hanns, Green, & Jones, 2012; Richardson, 2009; Sadler-Smith & Smith, 2004)	8
	Total	15
Assessment	Examination dates and assignment deadline (de Boer & Collis, 2005; Dorrian & Wache, 2009; Lindberg & Olofsson, 2006)	3
	Assessment mode (Barron & Whitford, 2004; Cybinski & Selvanathan, 2005; Lutteroth & Luxton-Reilly, 2008; Wilkinson et al., 2004)	4
	Assessment standard (de Boer & Collis, 2005; Lutteroth & Luxton-Reilly, 2008)	2
	Assignment requirement (de Boer & Collis, 2005)	1
	Way of submitting assignment (Phillips, 2004)	1
	Weighting of assignments and examination in the course result (Barron & Whitford, 2004; Cybinski & Selvanathan, 2005)	2
	Total	13
Resource and support	Type of learning materials, tools, and support (Collis & Moonen, 2002b; Cornelius, Gordon, & Ackland, 2011; Cybinski & Selvanathan, 2005; de Boer & Collis, 2005; Lutteroth & Luxton-Reilly, 2008; Richardson, 2009; Sadler-Smith & Smith, 2004; Wilkinson et al., 2004)	8
	Amount of learning materials, tools, and support (Harper, Oliver, & Agostinho, 2001)	1
	Method of obtaining learning materials, tools, and support (Phillips, 2004; Wilkinson et al., 2004)	2
	Time available for support (Ash, 2012)	1
	Place where learning materials, tools, and support are available (Ash, 2012; Cornelius et al., 2011; Dorrian & Wache, 2009; Herat, 2000)	4
	Total	16
Content	Topic to learn (Barron & Whitford, 2004; Casey & Wilson, 2005; Sadler-Smith & Smith, 2004)	4
	Total	4
Instructional approach	Social organisation of learning (Barron & Whitford, 2004; Cornelius et al., 2011; de Boer & Collis, 2005; Sadler-Smith & Smith, 2004)	4
	Type of learning activities (Herat, 2000; Sadler-Smith & Smith, 2004)	2
	Modes and structures of presentation (Sadler-Smith & Smith, 2004)	1
	Language (de Boer & Collis, 2005)	1
	Total	8
Time	Time and date to start or finish the course/module (Ash, 2012; Casey & Wilson, 2005; Richardson, 2009)	4
	Pace of learning in a course (Ash, 2012; Casey & Wilson, 2005)	3
	Total	7
Orientation or goal	Orientation of the course (de Boer & Collis, 2005)	1
	Goal of learning the course (Herat, 2000)	1
	Total	2

Note: N = number of cases

Conclusion and Suggestion

The past three decades has witnessed an increasing growth of research on flexible learning. Efforts to pursue flexible learning have been made by not only researchers but also practitioners. However, the term is often used in an unclear way. As assumed in most relevant literature, 'flexible learning' is closely associated with 'open learning', 'distance learning', and 'e-learning'. However, the connotations of 'flexible learning' should contain more than these associated terms.

Based on the literature reviewed, the current paper proposes a multidimensional system of flexible learning. The dimensions of flexible learning include time (time and date to start or finish the course/module and pace of learning in a course), content (level of difficulty of module content, sequence in which topics are covered, and topic to learn), entry requirement (prerequisites for module/course participation), delivery (channels for course information and place for learning), instructional approach (amount of learning activities, instructional language, modes and structures of presentation, social organisation of learning, time and duration of learning activities, and type of learning activities), assessment (assessment mode, assessment standard, assignment requirement, weighting of assignments and examination in the course result, and examination dates and assignment deadline), resource and support (amount of learning materials, tools, and support; method of obtaining learning materials, tools, and support; place where learning materials, tools, and support are available; time available for support; and type of learning materials, tools, and support), and orientation or goal of the course.

Among the dimensions and components, some have been the focus of most researchers when discussing the implementation of flexible learning, but some have not attracted much interest. Future studies on flexible learning could be devoted to the dimensions and components which have attracted less attention.

Acknowledgements The work described in this paper was partially supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (UGC/IDS16/15).

References

Ash, K. (2012). Flexible learning a motivator: Students work through online courses at their own pace with classroom support. *Education Week, 32*(9), 10–13.

Barron, P., & Whitford, M. (2004). An evaluation of event management education. *Journal of Teaching in Travel & Tourism, 4*(2), 19–43.

Bell, C., Bowden, M., & Trott, A. (1997). *Implementing flexible learning*. London: Kogan Page Ltd.

Cartier, L. C. (2014). The flexible learning lab. *Knowledge Quest, 42*(4), 58–63.

Casey, J., & Wilson, P. (2005). *A practical guide to providing flexible learning in further and higher education. Quality assurance agency for higher education*. Scotland: Glasgow. Retrieved from http://qmwww.enhancementthemes.ac.uk/docs/publications/a-practical-guide-to-providing-flexible-learning-in-further-and-higher-education.pdf

Cavus, N., & Al-Momani, M. M. (2011). Mobile system for flexible education. *Procedia Computer Science, 3*, 1475–1479.

Chalkley, B. (1997). Flexible learning or learning to be flexible? In C. Bell, M. Bowden, & A. Trott (Eds.), *Implementing flexible learning* (pp. 15–23). London: Kogan Page Limited.

Chen, D. T. (2003). Uncovering the provisos behind flexible learning. *Educational Technology and Society, 6*(2), 25–30.

Collis, B., & Moonen, J. (2001). *Flexible learning in a digital world: Experiences and expectations*. London: Kogan Page Ltd.

Collis, B., & Moonen, J. (2002a). Flexible learning in a digital world. *Open Learning, 17*(3), 217–230.

Collis, B., & Moonen, J. (2002b). The contributing student: A pedagogy for flexible learning. *Computers in the Schools: Interdisciplinary Journal of Practice, Theory, and Applied Research, 19*(3/4), 9.

Collis, B., & van der Wende, M. (2002). *Models of technology and change in higher education: An international comparative survey on the current and future use of ICT in higher education*. Enschede: Center for Higher Education Policy Studies. University of Twente. Retrieved from http://doc.utwente.nl/44610/1/ictrapport.pdf

Cornelius, S., Gordon, C., & Ackland, A. (2011). Towards flexible learning for adult learners in professional contexts: An activity-focused course design. *Interactive Learning Environments, 19*(4), 381–393.

Cybinski, P., & Selvanathan, S. (2005). Learning experience and learning effectiveness in undergraduate Statistics: Modeling performance in traditional and flexible learning environments. *Decision Sciences Journal of Innovative Education, 3*(2), 251–271.

De Boer, W., & Collis, B. (2005). Becoming more systematic about flexible learning: Beyond time and distance. *Research in Learning Technology, 13*(1), 33–48.

Demetriadis, S., & Pombortsis, A. (2007). E-lectures for flexible learning: A study on their learning efficiency. *Educational Technology & Society, 10*, 147–157.

Dorrian, J., & Wache, D. (2009). Introduction of an online approach to flexible learning for on-campus and distance education students: Lessons learned and ways forward. *Nurse Education Today, 29*(2), 157–167.

Dowling, C., Godfrey, J., & Gyles, N. (2003). Do hybrid flexible delivery teaching methods improve accounting students' learning outcomes? *Accounting Education, 12*(4), 373–391.

Drennan, J., Pisarski, A., & Kennedy, J. (2005). Factors affecting student attitudes toward flexible online learning in management education. *The Journal of Educational Research, 98*(6), 331–338.

Ellington, H. (1997). Flexible learning – Your flexible friend! In C. Bell, M. Bowden, & A. Trott (Eds.), *Implementing flexible learning* (pp. 3–13). London: Kogan Page Limited.

Goodyear, P. (2008). Flexible learning and the architecture of learning places. In J. M. Spector, M. D. Merrill, J. van Merrienboer, & M. P. Driscoll (Eds.), *Handbook of research on educational communications and technology* (3rd ed., pp. 251–257). New York: Taylor & Francis Group.

Gutl, C., Chang, V., & Freudenthaler, S. (2010). How to support more flexible learning settings in second life. In M. E. Auer & J. Schreurs (Eds.), *The 13th international conference on interactive computer aided learning* (pp. 129–141). Hasselt, Belgium: Kassel University Press.

Harper, B., Oliver, R., & Agostinho, S. (2001). Developing generic tools for use in flexible learning: A preliminary progress report. In *Meeting at the crossroads. Proceedings of the 18th Annual*

Conference of the Australian Society for Computers in Learning in Tertiary Education (pp. 253–262). Melbourne, Australia: Biomedical Multimedia Unit, The University of Melbourne.

Hart, I. (2000). Learning and the 'F' word. *Educational Media International, 37*(2), 98–101.

Herat, S. (2000). Education and training for cleaner production: A flexible learning approach. *Journal of Cleaner Production, 8*(5), 361–364.

Hudson, R., Maslin-Prothero, S., & Oates, L. (1997). *Flexible learning in action: Case studies in higher education*. London: Kogan Page Limited.

Irvine, J., & Cossham, A. (2011). Flexible learning: Reflecting on a decade of library and information studies programmes at the Open Polytechnic of New Zealand. *Library Review, 60*(8), 712–722.

Kember, D. (2007). *Reconsidering open & distance learning in the developing world*. London/New York: Routledge.

Khan, B. H. (2005). Learning features in an open, flexible and distributed environment. *AACE Journal, 13*(2), 137–153.

Kirkpatrick, D. (1997). Becoming flexible: Contested territory. *Studies in Continuing Education, 19*(2), 160–173.

Li, K. C. (2014). How flexible do students prefer their learning to be? *AAOU Journal, 9*(1), 35–46.

Lindberg, J. O., & Olofsson, A. D. (2006). Individual and flexible: Working conditions in the practice of Swedish distance-based teacher education. *International Education Journal, 7*(5), 699–708.

Ling, P., Arger, G., Smallwood, H., Toomey, R., Kirkpatrick, D., & Barnard, I. (2001). *The effectiveness of models of flexible provision of higher education*. Canberra, Australia: Department of Education, Training and Youth Affairs.

Lutteroth, C., & Luxton-Reilly, A. (2008). Flexible learning in CS2: A case study. In *Proceedings of the 21st annual conference of the national advisory committee on computing qualifications* (pp. 77–83). Computing and Information Technology Research and Education New Zealand (CITRENZ), Auckland, New Zealand.

Moran, L., & Myringer, B. (1999). Flexible learning and university change. In *Higher education through open and distance learning* (pp. 57–71). London: Routledge.

Nisselle, A., Hanns, S., Green, J., & Jones, T. (2012). Accessing flexible learning opportunities: Children's and young people's use of laptops in a paediatric hospital. *Technology, Pedagogy and Education, 21*(1), 3–20.

Nunan, T. (1999). Exploring the concept of flexibility. In V. Jakupec & J. Garrick (Eds.), *Flexible learning, human resource and organisational development: Putting theory to work* (p. 47). Florence, KY: Routledge.

Olakulehin, F. K., & Singh, G. (2013). Widening access through openness in higher education in the developing world: A Bourdieusian field analysis of experiences from the National Open University of Nigeria. *Open Praxis, 5*(1), 31–40.

Perraton, H. (2007). *Open and distance learning in the developing world* (2nd ed.). London: Routledge.

Phillips, R. (2004). Rethinking flexible learning in a distributed learning environment: A university-wide initiative. *Educational Media International, 41*(3), 195–205.

Race, P. (1988). Approaches to flexible learning. In H. Mathias, N. Rushby, & R. Budgett (Eds.), *Aspects of educational technology* (pp. 225–232). London: Kogan Page Limited.

Richardson, A. M. (2009). Crossing the chasm – Introducing flexible learning into the Botswana technical education programme: From policy to action. *International Review of Research in Open and Distance* Learning, *10*(4). Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/700/1327

Roebuck, M. (1987). Flexible learning: Developments and implications in education. In F. Percival, D. Craig, & S. E. Earl (Eds.), *Aspects of educational technology* (Vol. XX, pp. 326–332). London: Kogan Page Ltd.

Sadler-Smith, E., & Smith, P. J. (2004). Strategies for accommodating individuals' styles and preferences in flexible learning programmes. *British Journal of Educational Technology, 35*(4), 395–412.

Tucker, R., & Morris, G. (2011). Anytime, anywhere, anyplace: Articulating the meaning of flexible delivery in built environment education. *British Journal of Educational Technology, 42*(6), 904–915.

Wade, W., Hodgkinson, K., Smith, A., & Arfield, J. (Eds.). (1994). *Flexible learning in higher education*. London/Philadelphia: Kogan Page Ltd.

Wilkinson, A., Forbes, A., Bloomfield, J., & Gee, C. F. (2004). An exploration of four web-based open and flexible learning modules in post-registration nurse education. *International Journal of Nursing Studies, 41*(4), 411–424.

Chapter 2
Planning for Better Instruction: Learner Interviews for Flefxible Education in a Japanese Tertiary Curriculum

Yoko Hirata

Abstract This paper outlines a series of face-to-face semi-structured interviews conducted in a Japanese tertiary-level English classroom. It begins with an explanation of the background search underlying the chosen interview process and how the interview data were analysed and followed by how a description of the major characteristics of the students' feedback changed over the course of the academic year. The findings illustrate the importance of providing students with opportunities to express their honest opinions openly and directly to their instructors so that the instructors can improve their teaching methods and materials and shape their curricula.

Keywords Flexible education · Japanese students · English teaching

Introduction

In educational institutions throughout the world, various types of research methodology have been used to collect students' comments and opinions on various aspects of their learning activities. For example, questionnaires and surveys have been employed to gather quantitative information on students. These tools have also been frequently used to assess teaching qualities and students' degree of satisfaction. On the other hand, researchers and educational professionals have utilized interviews as another effective assessment technique to collect students' comments and opinions in qualitative ways on various aspects of their learning activities (Ajayi, 2015; Gilliland, 2015). Interviews are suitable for collecting data from small numbers of respondents and examining various issues through back-and-forth discussion among students and their instructors.

As Watson and Noble (2014) claim, semi-structured interviews are effective in enabling respondents to lead the discussion in any direction they wish (p. 46). Unlike

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_2

'interactive diaries' (Gary, 1998) and blogs (Amir, Ismail & Hussin, 2011; Ducate & Lomicka, 2005), these small-scale interviews are effective in providing respondents with enough time to think about the questions given and to locate specific problems which are not easily noticeable in the classroom. In addition, close personal contact between interviewees and interviewers and interviewees' gestures and other visual clues are of great benefit to interviewers for clarifying unresolved issues. At the same time, students can learn more about their instructors and build better student-teacher relations. The ultimate goal of semi-structured interviews is to assist instructors in understanding their students' needs and determining appropriate revisions to their lesson plans and teaching methods. However, there is a lack of research on how to best structure these interviews and how to utilize them to bring about maximal constructive, positive changes for better curricula.

Purpose of the Study

The purpose of this study is to examine Japanese undergraduate students' feedback on their English studies – especially the teaching methods and materials – and to demonstrate how such feedback changed over the course of an academic year.

Research Questions

1. What are the distinctive characteristics of students' feedback on teaching methods and materials?
2. How does students' willingness to express opinions change over the course of an academic year?

Japanese Students

Japanese education employs a teacher-centred approach, which encourages teachers to provide information and students to take notes passively. Therefore, in the school curriculum, there are few group activities such as debates and discussions. Instead, schools implement exam-oriented drill exercises, such as fill-in-the-blanks, which are graded on a point-deduction scoring system and result in students having an extreme fear of making common mistakes and being forced into a counterproductive pursuit of performance (Sugawara, 2013).

Students' difficulty in speaking up for themselves is a major problem in language learning settings in Japan, as Japanese students often remain silent when asked questions, even when the questions are in their native language. Since this behaviour is unusual in the classrooms of Western countries, native English instructors in Japan

are often confused and frustrated by their students' silence (Korst, 1997). Research on Japanese students' reticence indicates that, in general, they lack confidence in self-expression (Harumi, 2011). This problem results from their anxiety about whether or not their ideas are different from those of their co-learners (Harumi, 2011). Japanese silence, divided by Lebra (2007) into four separate (but sometimes interconnected) dimensions – truthfulness, social discretion, embarrassment and defiance – plays an important role in understanding everyday communication in Japan as follows.

Truthfulness

This idea arises from Buddhism, where silence is valued more than the spoken word. Remaining silent has been, and continues to be, an effective technique for avoiding unnecessary conflicts and keeping oneself safe from being isolated by one's social groups. In addition, the inner self, or private ideas, should be kept hidden as often as possible (Jones, 2011). Remaining silent is also the way to show respect to older or hierarchically superior people.

Social Discretion

This idea comes from the Japanese prioritization of maintaining harmony with other people at all costs. Expressing strong emotions has conventionally been forbidden. The Japanese do not like to be kept alone or to do things differently from other Japanese. Constant socialization is the norm: eating, working and travelling in groups are socially optimal, and following others provides the Japanese with a sense of security.

Embarrassment

This idea is closely related to the prevention of loss of dignity or self-esteem. To function better in a situation where they are embarrassed or may be made to look bad, the Japanese remain silent. This technique is often used when a person feels that he or she has not been accepted into a social group.

Defiance

Defiant silence conveys many different emotional messages depending on the situation, although these are all negative – for example, showing anger or unhappiness or refusing to be friendly.

Japanese silence has various meanings depending on the context and the ideas behind it are interconnected. As a result, this norm prevents language learners in Japan from being able to communicate smoothly when language courses use controversial or otherwise opinion-centric topics in their activities.

Methodology

Setting and Student Profiles

The subjects of this study were 22 Japanese university students aged 18–20 years, 86% of whom were males. All the students had previously studied English for 6 years, and the survey carried out at the beginning of their course indicated that they had attained a lower-intermediate level of proficiency. These students were majoring in Japanese literature, law, economics and engineering. They were accustomed to teacher-centred language learning in large lecture-type classrooms, and their secondary school English-learning experiences were examination-oriented.

This study was conducted during a year-round elective communication course. The aim of the course was to help students to develop their communication skills in English. Students engaged in simulation activities which helped them to acquire English creatively and communicatively (Elgar, 2002). They were expected to learn a variety of lexical and grammatical patterns included in the textbook through activities. They also learned how the language works by understanding communicative functions, such as checking information and making requests. Sociolinguistic and contextual meaning was of high importance. In order to help students to become more competent at communicating, concordance lines (lines of text taken from a large language database) were given to them for their reference. These materials helped them to understand the meaning of the contexts in which the target words and expressions were used more easily than a list of words in isolation. Students did simulation activities based on learned words and expressions. As Littlejohn (1990, p.125) claims, these activities were intended to replicate the situations in which students would have to use the target language.

Semi-structured Interviews for This Study

After each simulation activity, the instructor used a Dictaphone to interview each group about their performance and the dialogues they had created. Before the interviews were conducted, the instructor explained the goal of the interview, its length and the topics to be discussed. The instructor also asked the students for their consent and reminded them that their comments would be kept confidential and used for research purposes only.

The interviews were conducted in Japanese so that the students could understand the questions and express their honest opinions without any language impediments. The average duration of each interview was 10 min. Of primary interest in this study was how well students were able to create their dialogues for the simulation activities and perform them.

Prior to the interviews, the instructor developed semi-structured questions to provoke discussion. The questions were broadly divided into three topics: simulation activities, creating dialogues and others. The recordings were transcribed into English, and what the students said was summarized. The basic questions for each category were as follows.

Simulation Activities:
How was your performance?
Did you enjoy your performance?
Compared with your last performance, did you see any differences?

Creating Dialogues:
What made it difficult for you to write your script?
How much time did you spend creating dialogues?
How did you feel about writing a script in English?

Others:
Do you have any requests for your next assignment?
Would you like to change the group you're working with?
Do you think your English skills have improved?

There were no specific rules about the number and kinds of questions asked in the interviews. For example, students were also asked whether or not they were taking an English reading course.

Findings

The feedback obtained from the interviews was useful for the instructor to determine what students thought about the activities and their performances. The major findings gained from the interviews, together with samples of the interview extracts, are as follows.

First and Second Interviews
Students didn't have confidence in expressing themselves. They often remained silent when they were asked a question, e.g.:

Instructor: When you wrote your script, did you refer to anything, such as dictionaries or the materials I gave you?
Nobody says anything.
Instructor: None of you used them?
S1: You told us to review what we'd done in the previous lessons so I tried to look back at what we've done so far.

Students didn't say anything in response to the first question because they thought that was best for the group. In addition, they waited to see how things went in order to maintain group harmony as follows.

Instructor: Did you have any difficulties in writing your script?
S2: I didn't think it was that difficult.
Instructor: How much time did you spend creating dialogues?
Nobody says anything.
Instructor: About two hours?
S2: Yes, that's about it.

Students had emotional difficulty in expressing how much time they had spent on creating scripts. This was because they didn't want to reveal how much they had worked on them since they weren't sure about the appropriate length of time they should have spent.

The following is from an interview on scripts containing dialogues about coats:

Instructor: I think you said you had a 4500 yen coat and an 8000 yen coat, but later you only said you had a 7000 yen coat. I was wondering what happened to the first two coats.
S3 doesn't say anything.
Instructor: OK. What did you think about the concordance lines? Were they useful for your English studies?
S3 doesn't say anything.
Instructor: Was it difficult for you to read the lines?
S3: Yes, it was difficult.

Since student 3 was extremly concerned about opinions from others, he had nothing to do but to keep quiet. As LoCastro (1996) points out, this is an example

of 'a tendency towards perfectionism' as one of the characteristics of Japanese culture.

In addition, hierarchical differences, such as those between the instructor and the students, often prevented them from giving honest opinions, e.g.:

Instructor: I think for all of us, we're better able to deal with situations we're comfortable with.
Nobody says anything.
Instructor: Are there any requests you'd like to make for your next performance? You'll have one more chance to do this performance.
Nobody says anything.
Instructor: Would you like to change the group you're working with?
S4: Well, as this was my first experience working with friends I don't care who I work with next time.

It's difficult for students to ask the instructor to change the way the course is conducted. Silence in response to a question made by the instructor frequently occurred at the beginning of the course. Similarly, students often made a gesture to demonstrate their opinion instead of responding to the instructor's questions:

Instructor: You still don't know how to use these concordance lines?
S5 and S6 don't say anything.
Instructor: I see. OK. Are there any requests you want to make for the next semester? Are you going to take my course in the second semester?
S5 and S6 nod.

Third and Fourth Interviews

In spite of the need to maintain harmony, as the course progressed, students became more willing to express independent reactions:

Instructor: Good. So, let me get it straight. S7, you wrote a script for the three of you all by yourself. Right?
S7: Right.
Instructor: I have to make a note of that. Well, S7, was it easy for you to write it?
S7: It was difficult for me to include all the keywords, especially the medical terms, into the script. I also had difficulty with the phrase 'pick someone up around...' I should have referred to the lines you gave me, but I forgot.
Instructor: I see. But I don't think that phrase was a problem for you.
S7: Actually, writing the script was difficult for me, but it was better than the one I wrote for the second performance.
Instructor: OK. So, S7, when you wrote the script, did you refer to the materials I gave to you? I mean the concordance lines.
S7: Oh, I referred to the lines including the word *hurt*. I checked the language patterns including the transitive and intransitive ways of using the word *hurt*.
Instructor: I see. Did you look up any word in your dictionary?

S8: Yes. I looked up several words I needed for writing other parts of our script. I had to add other sentences to complete our dialogue.
Instructor: Oh, yes, of course.
S9: Since it was a conversation in a clinic, it was easy for us to imagine the situation, so, we didn't really have to consult a dictionary. I consulted my dictionary when I wrote our script less than the previous time when I wrote scripts.
Instructor: So, you mean, it was easier than before for you to write a script this time.
S9: Yes, simply because the setting was a clinic. The setting was quite limiting.

The students had no reservations about giving their opinions. Their attitudes and comments weren't predicated on the conventional obedient character of Japanese students.

This change was also applicable to the instructor. During the first and second interviews, the instructor asked only conventional, closed-ended questions:

Instructor: Well, first of all, how was your performance? What score out of 100 points do you think you can give to your performance?
S10: I would say, 60 points.
S11: 50 points.
Instructor: Are you sure you're going to give only 50 points?
S11: Yes.

In the later interview, the instructor tried to empathize with how the students felt about their assignments, including their performance and activities, e.g.:

Instructor: Do you feel embarrassed when you make a mistake in your performance?
S12: Yes. I feel embarrassed or sorry for what I've done wrong during a performance. It's up to everybody to remember his own part, so I feel terrible when I don't remember my own lines perfectly.
Instructor: I understand what you mean. But my policy is this: as long as you can use the required words and phrases, and communicate with your group members using them, any mistake is acceptable. I don't want to call any of your lines or words mistakes. I don't believe you need to memorize your lines perfectly. You don't have to follow your script as long as you communicate with your group members using the required words. I'm not a strict teacher. But, I know, if you write a script, you're more likely to try to follow it, aren't you?
S13: Yes, you're right.

In addition, in the third interviews, the instructor asked more specific and elaborate questions about the way the students utilized the materials, e.g.:

Instructor: What are your problems studying English? What do you think you need to work on the most?
S14: Acting skills.
Instructor: Acting skills have nothing to do with this course.
S14: I mean, when I speak English, the accent and intonation is pretty like Japanese. It's very monotonous.

Instructor: When you read the instructions including the keywords and key phrases, did you instantly realize that these words and phrases were written in the textbook?
S15: I could vaguely remember where they were.

At the end of the course, the students had the opportunity to think critically about what they had learned.

S16: I feel I've gained something from this course. This course is worthwhile.
Instructor: Worthwhile... Good. S17?
S17: I think I learned how to convey what I want to say more effectively in conversations. I can use the right expressions in the right situations now.
Instructor: Good. How about you, S18?
S18: Compared with the beginning of this course, I can speak English more smoothly.
Instructor: OK.

Discussion

The sample size of the project outlined in this study is too small to allow any generalization of Japanese students' responses during an interview process. However, the characteristics of the responses represented in this study provide interesting insights and implications for how semi-structured interviews can be used to elicit students' opinions on their language learning, as well as their needs and preferences with regard to teaching methods and materials. One of the major benefits of semi-structured interviews is that, as Roulston (2014) claims, this retrospective method allows students to express their views on the materials, activities and teaching approaches in their own terms openly and directly. In addition, this study clearly indicates that such an approach promotes smoother communication between the instructor and students and therefore contributes to a productive teaching environment.

The above findings also suggest students' attitudes towards having a discussion, and exchanging ideas are strongly influenced by their cultural backgrounds. It was clear that, at the beginning of the course, students' cultural norms (avoiding social confrontation and maintaining harmony) simply discouraged them from expressing their own opinions. In addition, students were often silent either because of embarrassment or an unwillingness to draw attention to themselves. However, it became clear that, if they were provided with an environment conducive to expressing their opinions and sufficient time to get used to it, the level of their anxiety about expressing their views was lower. The findings also show that, as the course progressed, students realized the importance of verbalizing their feelings and thoughts. Since students' readiness and confidence in expressing their opinions markedly increased after several interviews, enough opportunities for them to do so should be provided in the course of language studies.

From the instructor's perspective, conducting interviews in a language course was time-consuming. In addition, interviews often required the instructor to be patient in dealing with students' pauses and silences, which often slowed the pace of the interview. However, the findings have indicated that, compared with structured interviews where the degree of freedom is limited (Smith, 1995), the partly open-ended format of semi-structured interviews is a more efficient and practical way of gauging how students critically reflect on what they have studied in the classroom. These interviews helped enhance the instructor's awareness of how to maximize students' learning potential.

Conclusion

This paper demonstrates a series of semi-structured interviews conducted in an English course in a Japanese tertiary institution. From the results of this study, there is no doubt that semi-structured interviews encourage mutual communication between the instructor and students and help instructors to develop better teaching methods and materials and shape their curricula. It is also important to note that instructors should determine to what extent students' social and cultural backgrounds influence their communication styles. Although it is often difficult for instructors to recognize students' language-learning issues arising from their various cultural characteristics, interviews are effective in providing instructors with an opportunity to change their teaching styles and solve students' problems.

Further research with a larger sample size should be conducted to determine how the instructor can better facilitate interviews to improve students' language proficiency. It is also essential to provide students with an environment which enables them to transcend the confines of their cultural norms, thereby enhancing their confidence and flexibility in learning new languages.

References

Ajayi, L. (2015). Vocabulary instruction and Mexican-American bilingual students: How two high school teachers integrate multiple strategies to build word consciousness in English language arts classrooms. *International Journal of Bilingual Education and Bilingualism, 18*(4), 463–484.

Amir, Z., Ismail, K., & Hussin, S. (2011). Blogs in language learning: Maximizing students' collaborative writing. *Procedia Social and Behavioral Sciences, 18*, 537–543.

Ducate, L., & Lomicka, L. (2005). Exploring the blogosphere: Use of blogs in the foreign language classroom. *Foreign Language Annals, 38*(3), 410–421.

Elgar, A. G. (2002). Student playwriting for language development. *ELT Journal, 56*(1), 22–28.

Gary, J. (1998). The language learner as teacher: The use of interactive diaries in teacher training. *ELT Journal, 52*, 29–37.

Gilliland, B. (2015). High school teacher perspectives and practices: Second language writing and language development. *Language and Education, 29*(4), 287–301.

Harumi, S. (2011). Classroom silence: Voices from Japanese EFL learners. *ELT Journal, 65*(3), 260–269.

Jones, S. (2011). Speech is silver, silence is golden: The cultural importance of silence in Japan. *The Australian National University Undergraduate Research Journal, 3*, 17–27.

Korst, T. J. (1997). Answer, please answer! A perspective on Japanese university students' silent response to questions. *JALT Journal, 19*(2), 279–291.

Lebra, T. (2007). The cultural significance of silence in Japanese communication. In T. Lebra (Ed.), *Identity, gender, and status in Japan: Collected papers of Takie Lebra*. Folkestone/Kent, UK: Global Oriental.

Littlejohn, A. (1990). Testing: The use of simulation/games as a language testing device. In D. Crookall & R. L. Oxford (Eds.), *Simulation, gaming, and language learning* (pp. 125–133). New York: Newbury House.

LoCastro, V. (1996). English language education in Japan. In H. Coleman (Ed.), *Society and the language classroom* (pp. 40–63). Cambridge, UK: Cambridge University Press.

Roulston, K. (2014). *Reflective interviewing. A guide to theory & practice*. London: Sage..

Smith, J. A. (1995). Semi-structured interviewing and qualitative analysis. In J. A. Smith, S. R. Harre, & L. V. Langenhove (Eds.), *Rethinking methods in psychology* (pp. 9–26). Thousand Oaks, CA: Sage.

Sugawara, H. (2013). Akademikku Ko-chinngu ni yoru Daigaku Kyouiku Kaikaku no Kokoromi [An evolution of university education through academic coaching]. *Kaihatsu Ronsyu, 92*, 1–13.

Watson, T., & Noble, P. (2014). *Evaluating public relations: A guide to planning, research and measurement*. London: Kogan Page Ltd.

Chapter 3
Budgetary Planning for Self-Financing Open and Flexible Education

Linda Yin King Lee

Abstract This paper illustrates the issues and implications of involving stakeholders in budgetary planning in a self-financing university which provides open and flexible education – The Open University of Hong Kong (OUHK). The budgetary planning mechanism of the OUHK is characterised by having multiple administrative levels and involves multiple stakeholders. The heads of academic units are invited to identify new programmes or the expansion of existing ones and project student number for the coming academic year; and the heads of administrative units are required to estimate the expected expenditure for each financial year. It is demonstrated that the involvement of stakeholders in the budgetary process facilitates the development of a realistic budget for meeting operational needs and sustaining the growth of the university.

Keywords Open and flexible education · Budget planning · Self-financing university

Introduction

A budget is a quantified financial plan for a forthcoming specified period that helps to facilitate the planning of actual operations by forcing an organisation to consider in advance where the income comes from and how it will be distributed. It controls resources, communicates plans to various parties within the organisation, evaluates its financial performance, and provides visibility for its performance (Glover & Levačić, 2007). Budgeting is the planned allocation of available financial resources to each unit within an organisation. It ensures that adequate resources are allocated to areas that generate significant income and prevents overspending in less productive areas (Glover & Levačić, 2007; McAleese, 2000). Budgeting is important for an

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_3

educational institution because it provides a process which translates educational goals and programmes into financial plans (Brimley, Verstegen, & Garfield, 2012).

Open and flexible education responds to the desire for educational opportunities from people at all levels. It offers open access and adopts a variety of teaching modalities, thereby helping the students to study in a flexible way (Ambe-Uva & Adegbola, 2009). As in most tertiary educational institutions which are providing open and flexible education, The Open University of Hong Kong (OUHK) is a self-financing university. It is expected to use resources wisely and demonstrate value for money to its stakeholders. In order to support effective operations and student enrolment – and, most importantly, to excel in the university's mission of making higher education available to all – sound budgeting is necessary. Over the past 25 years, OUHK has successfully tackled the challenges of running a self-financing educational institution within limited financial resources through well-planned financial budgeting. The budgetary planning mechanism of the university is characterised by having multiple administrative levels and involves multiple stakeholders at each level. With reference to the situation in OUHK, this paper examines the issues and implications of involving stakeholders in budgetary planning in a self-financing university providing open and flexible education in Hong Kong.

A Budgetary Planning Mechanism that Involves Multiple Administrative Levels and Multiple Stakeholders

OUHK was established by the government under an ordinance but is financially independent. The major source of income is tuition fees (96%). Revenues from investment, donation, sponsorship, and matching grant contribute to a part of the income (4%). The government offers financial support through tax exemption. As an educational institution with a high degree of self-management, it has the authority to approve its own budget. To exercise this authority, formal structures have been developed at three levels.

The first level is the Budget Committee, which is responsible for overseeing the financial resources of the university and ensures that its objectives are achieved. The Budget Committee develops the budgetary timetable, offers guidelines and information for the preparation of budgets, and resolves problems that may arise during the budgetary process. The Budget Committee is chaired by the President, with the Director of the Finance Unit acting as the secretary. Members of the committee include the Vice President (Academic), Vice President (Administration and Development), a Dean from the academic units, a head from the administrative units, and a Senate representative. In practice, the Budget Committee initiates the budget planning exercise around 8 months before the start of each financial year. The committee invites the heads (budget holders) of all academic units to project student enrolments for the next 3 financial years. The Planning Unit and Public Affairs Unit are then involved to give their views on the rate of the tuition fee from the planning and

marketing perspectives, respectively. Afterwards, the Vice President (Academic), Registrar, and the Director of the Finance Unit meet the heads of individual academic units to review and finalise the enrolment projections, which is then forwarded to all administration units to project their level of activity. Finally, the Budget Committee reviews the entire budget and makes recommendations to the Management Board, which advises the President on the financial management and financial control of various units. Once the budget is endorsed by the Management Board, it is passed to the next level. Although no external input exists at this level, the proposal will be reviewed by external parties in the subsequent levels. During the planning of the budget, issues of equity, efficiency, and effectiveness are considered. The analysis is presented in the next section of this paper.

The second level is the Finance Committee and Executive Committee, both of which are Council Committees. The Finance Committee administers financial stewardship on behalf of the Council, which is the supreme governing body of the university. It advises and provides recommendations to the Council on budgets and monitors expenditure against approved budgets. The Finance Committee is chaired by the Treasurer of the Council, with the Director of the Finance Unit acting as the secretary. Members of the committee include the President, a Senate representative, five members of the Council, and co-opted members of the Finance Committee. The Executive Committee is responsible for considering and providing recommendations to the Council on matters that are referred to the Council by its committees. The Executive Committee is chaired by the Chair of the Council. The Secretary to the Council acts as the secretary. The committee members include the Deputy Chairman of the Council, the Treasurer of the Council, Chairmen of other Council Committees, and the President. When the budget is endorsed by these two committees, it can be passed to the next level.

The third level is the Council, which has general control over the administration of the university. The Council's composition includes an appointed Chair and members, who are community leaders or respected professionals, the President, the Vice President (Academic) and/or Vice President (Administration and Development), and staff representatives. The Council is responsible for the final approval of the budget that has been endorsed by the Finance Committee and Executive Committee.

From a theoretical perspective, the mechanism for formulating the budget in OUHK is sound. Consideration focuses on the three dimensions of the budget – educational programme, the cost of programmes, and a revenue plan (Brimley et al., 2012). The educational plan is decided before the tuition fee is presented, which is then followed by determining the required revenues. The philosophy adopted is that educational programmes should be determined by the needs of students rather than the availability of funds.

From an operational perspective, the mechanism is rational. Instead of using the previous year's budget as the sole reference in developing the budget for the coming year, stakeholders are involved in every annual budgeting exercise. Simply adjusting each area of last year's budget by the same percentage to develop the present year's budget is not viewed as a rational approach (Brimley et al., 2012) as the previous

year's budget may not be perfect, and each part of it may have changed during the year. Moreover, there should be a system that ensures that the budget is evaluated regularly so that there is an opportunity to resolve its limitations. Lastly, the right and responsibility of the stakeholders to continuously evaluate the budget for improvements should be respected (Brimley et al., 2012).

The existing mechanism is also stringent and realistic. It is operated within a system with multiple administrative levels and involves multiple stakeholders, both within and outside the university. The involvement of internal stakeholders – the heads of various units and few staff representatives – is basically at the first level. The involvement of external stakeholders increases as the level rises. Although the frontline teachers and students, who are major stakeholders in education, are not directly involved in the decision-making process, they can convey their opinions through other indirect mechanisms, such as meetings held by individual academic units, student surveys, and informal sharing of views. It is understood that when more stakeholders are involved in the budgetary planning, more resources are required to support the stakeholders who may not be knowledgeable about financial management. Consequently, more time and effort is needed to arrive at a consensus. For a self-financing educational institution that has limited resources, such an impact is particularly significant, and the underlying difficulty should be taken into consideration.

The Effect of Involving Stakeholders in Budgetary Planning on Practice and Outcomes for Teachers

The present mechanism for budgetary planning involves internal stakeholders from academic and administrative units. Such a practice promotes identification of the gap between needs and practice (Weindling, 1997). The mechanism also ensures that the preferences of the ultimate recipients of resources are taken into account (Glover & Levačić, 2007). For example, the academic units are in a better position to understand the demands of particular educational programmes and help to give a realistic projection of student numbers. The Planning Unit investigates the financial situation of the potential students and develops a reasonable proposal for the tuition fee. The other supporting units work out the expenditure for supportive items, such as human resources, the infrastructure, the library holding, and computers and information technology. When income and expenditure are planned carefully and the preferences of the stakeholders are considered, the budget becomes practical and realistic. A reasonable amount of resources can be allocated to support various teaching-related activities. In a university that has a designated budget to support teaching in a comprehensive way, teachers are able to conduct better quality teaching activities and develop their potential without great concern about financial restrictions.

The mechanism for budgetary planning includes both internal and external stakeholders in the decision-making. The internal stakeholders, who are staff of

the university, contribute from an operational perspective, while the external stakeholders, who are mainly appointed community leaders and professionals, contribute from an administrative and governance perspective. Such a combination, with input from diverse perspectives, enhances the budget development. In a working environment that has a well-developed mechanism for budgeting and a stable financial situation, teachers are more likely to develop long-term and large-scale educational initiatives.

The involvement of stakeholders in the budgetary planning improves the transparency and accountability of governance (Glover & Levačić, 2007), which facilitates budget holders to maximise the assigned budget according to their original plans. Consequently, the chance of having unused budget and the need to carry it forward to the next financial year is reduced. More importantly, the intended quality of teaching will not be compromised.

Nevertheless, the wide involvement of stakeholders may lengthen the decision-making process. The impact is particularly significant in situations where difficult decisions are needed (Glover & Levačić, 2007). If teachers are involved in the budgetary process, they should be prepared for it to be lengthy, which is going to use up part of their time for teaching.

Equity, Efficiency, and Effectiveness

Given that education provided by OUHK is not for profit, the assessment of the financial report cannot adequately reflect the achievement of the educational outcomes (Capaldi, 2011). A financial report can reveal where money is spent but cannot fully convey the important indicators of resource usage, such as equity, efficiency, and effectiveness. These indicators are highly relevant to open and flexible education which has emerged as a major form of education (Ambe-Uva & Adegbola, 2009). The following analysis attempts to adopt these three indicators as its focus.

Equity

'Equity' refers to the extent to which every individual is treated fairly. Equity is different from 'equality', which means treating every individual in the same way (Brimley et al., 2012). In education, equity can be interpreted in terms of equal access to education, equal educational treatment, and equal educational outcomes (Garner, 2004). However, providing access alone cannot guarantee that students receive equal educational treatment; and giving equal educational treatment does not automatically generate the expected educational outcomes. Different stakeholders have different preferences on particular aspects of equity, and achieving complete equity is difficult because students have different abilities, expectations, and needs.

Moreover, the provision of financial resources alone cannot legitimately achieve equity in education. Therefore, addressing the issue of equity in education through budgeting is complex and is sometimes considered as a dilemma (Brimley et al., 2012).

Under the equal access principle, the concept of 'education for all' is crucial. Open and flexible education aims to increase access to education for those who cannot get access to it within the mainstream (Ambe-Uva & Adegbola, 2009). Consistently, the mission of OUHK is to make higher education, through open and flexible education, available to all who aspire for it. Nevertheless, this mission is valueless until it is converted into dollar costs. To achieve equal access to education, the OUHK has adopted a number of strategies. Being a non-profit-making organisation, it is exempted from taxation which, to a certain extent, relieves the university's financial burden and prevents charging students very expensive tuition fees. The university has also established bursaries and other forms of financial assistance from donations. Over the years, OUHK has managed to keep the tuition fee at a level that is comparable with government-funded universities, thereby offering study opportunities to students who cannot afford very expensive tuition fees. Nevertheless, the demand for financial assistance remains high so that the limited Student Assistance Fund has to be shared among deserving students.

Equal access is believed to be ineffective if students do not receive equal treatment (Garner, 2004). However, the provision of identical education for all students is not an appropriate approach for achieving equal treatment because some students, such as those with special needs, require more support than others to complete their studies. This is particularly true for open and flexible education which operates by making education delivery flexible for the students and meeting their needs (Ambe-Uva & Adegbola, 2009). Therefore, additional resources must be made available for those students with special needs.

The equal treatment principle implies the provision of the essentials and does not rule out spending more money for students with more needs. An equitable educational programme should provide students with similar abilities with equal educational treatment (horizontal equity) and provide students with unequal needs, such as those with financial difficulty, disabilities, or limited language proficiency, with 'unequal' educational treatment (vertical equity) (Brimley et al., 2012; Garner, 2004). A budget is required to ensure an optimal learning environment among all students. In government-funded universities, it is a common practice to have a certain portion of expenditures designated as bursaries for students with financial difficulties and as a support service for those with disabilities. For a self-financing university that relies mainly on students' tuition fees as income, a dilemma arises when it attempts to maintain horizontal and vertical equity simultaneously. The involvement of stakeholders in budgeting does not only ensure that the needs of special groups are drawn to attention but also contributes to a balance between maintaining horizontal and vertical equity within limited resources.

On top of providing students with equal access to education and ensuring that they receive equal treatment, schools in general are increasingly expected to ensure that students achieve a specified level of competence. Under the equal outcome

principle, the financial policy in education nowadays is tied to educational quality, which is defined in terms of improvement in educational outcomes (Garner, 2004). Obviously, a considerably larger amount of money is required to enable students to attain a certain level of achievement than the money for the provision of equal access or treatment. However, the infusion of money does not necessarily result in equal outcomes (Garner, 2004). Many factors such as working culture and leadership, students' intelligence and motivation, parents' expectation, and the community's attitudes towards a particular programme affect educational outcomes as well. For example, some of the above factors can create a better working environment to attract and retain good teachers and administrators. As a result, students gain more benefits from them and achieve better performance (Brimley et al., 2012).

Despite the fact that the involvement of stakeholders in budgeting has its advantages, different stakeholders may hold different opinions about equity. Those who advocate equal access may suggest that the budget should be allocated evenly to support more students. Stakeholders who espouse excellence may suggest giving extra resources to reward outstanding programmes/units, reinforce their performance, and support further improvement. As resources are limited and priorities for their use have to be set, the university tends to emphasise the provision of quality education. The outcomes will certainly differ due to a combination of confounding factors.

Efficiency

'Efficiency' refers to the extent to which an output is produced from the costs of the input. Efficiency is achieved when a given quantity or value of output is generated from minimum cost (Levačić, 2000). Although educational efficiency can be achieved easily by increasing the tuition fee, this strategy will probably induce inequity as poor students will be less likely to be able to gain access to education. Therefore, educational efficiency has to be achieved through other means.

In a university, the major cost relates to personnel rather than programmes (Capaldi, 2011). A university is considered more efficient when its teachers are teaching more programmes or when it manages to introduce new programmes without adding new teachers. Over the past 25 years, the increase in academic programmes, student numbers, and degrees awarded in OUHK has outweighed the increase in the number of teachers. From this perspective, the operation of the OUHK can be considered efficient.

Moreover, a university is operated by its academic and administrative units rather than programmes (Capaldi, 2011). Instead of involving the heads of individual programmes, the university involves the heads of academic and administrative units in budgetary planning. This approach is congruent with the concept of efficiency, which supports operating in a collective way and encourages maximisation when using resources.

Effectiveness

'Effectiveness' refers to the extent to which the intended outcomes are met, regardless of costs. Effectiveness is closely related to the objectives that have been set (Levačić, 2000). One of the objectives of OUHK is to provide highly affordable and high-quality programmes across disciplines and at a variety of levels to meet the needs of lifelong learners. To achieve this objective, the university has successfully launched programmes in different discipline areas, while the tuition fee is set at an affordable level. Some disciplines, such as Humanities and Social Sciences, are generating more revenue; but other disciplines, such as Engineering and Sciences, are generating less revenue because of the expenses for the faculty, laboratories, equipment, and small class sizes. Even though the latter programmes do not produce much revenue, they contribute to a main portion of the existing programmes. Another example is related to offering of research-based programmes at master's and doctoral levels. Obviously, running research and doctoral education is expensive (Capaldi, 2011). As regards efficiency, the programmes which generate low revenue should not be offered – but with regard to effectiveness, such programmes contribute to meeting the objectives of the university and their existence is fully justified. The university manages to prepare a budget and establishes a balance between efficiency and effectiveness.

With persistent effort in financial management and the upholding of educational quality, OUHK gained self-accrediting status from the Hong Kong Government in 1996. Since then, it is able to validate its own programmes and have its degrees recognised. The ability of the university to maintain educational effectiveness within budget is evident.

The Way Ahead

Working with all stakeholders is believed to be essential in achieving desirable planning. Therefore, it is suggested that OUHK's Budget Committee can consider including representatives of more stakeholders in the university. At present, the composition does not include representatives from frontline teachers and students. If they are included, their opinions and concerns can help the university to make more responsible decisions. However, an effort should be made to operate the committee with members of diverse backgrounds. Although decision-making works on a group basis, individual members may have their own interests and biases. Clarifying the goal of the committee and communicating the strategic goal of the university among members are essential, thereby promoting a smooth operation and the establishment of consensus.

Being financially literate is a quality that can maximise a staff member's contribution to the budgeting process. At present, many staff in the university do not have a background in financial management. The dearth of related knowledge and skill

limits their ability to construct an effective budget. It is suggested that training packages for staff in different ranks/positions should be developed to increase their awareness of financial management and understanding of their role in budgeting. When they are better prepared, they can function in a more effective way.

The aim of having different levels of committees for approving budgets is to strengthen the quality assurance mechanism. Nevertheless, the overlapping of membership between committees can weaken the intended effectiveness. In OUHK, some members of the Budget Committee are also members of the Finance Committee or Council. If a member of staff is involved in two or more committees, he/she is likely to be less critical towards the financial monitoring and control measures of the university (Mestry & Naidoo, 2009). Such a practice may also weaken the ability of the university to achieve equity and ensure fairness in all budgetary headings. Therefore, overlapping membership should be avoided as far as possible. To guide the selection of members, there could be a special requirement in the terms of reference of the various committees. If overlapping of membership is necessary, the roles of these members in different committees should be specified clearly.

With increasing frequency, teachers in the USA are invited to request budgets for an optimal programme in addition to an ordinary one (Brimley et al., 2012). By doing so, administrators can get an idea about how much money is needed to provide the best possible programme. It is worthwhile to adopt this practice in the local setting because it provides the university with an opportunity to carefully consider available alternatives. In terms of equity, the university is moving towards achieving equal educational outcomes. As regards efficiency, the teachers will be more willing to actualise the optimal programme because it is a programme they desire. In terms of effectiveness, the university can identify better ways to achieve university objectives.

Conclusions

In an educational institution, income is used to meet operational needs and to foster educational development. Budgeting is an integral part of financial management. For a self-financing university, sound budgeting is particularly necessary to support effective operations and student enrolment. The present scenario of a self-financing university providing open and flexible education illustrates how stakeholders are involved in the budgetary process. The heads of academic units are invited to identify new development and project student number for the coming academic year, and the heads of administrative units are required to estimate the expected expenditure. The budget is then subjected to approval by a number of committees at different administrative levels. The outcome is evaluated in terms of equity, efficiency, and effectiveness in achieving educational objectives. Some difficulties to achieve all these aspects are identified in this paper. Although the availability of financial resources is a prerequisite for desirable outcomes, it should be accompanied by a supportive policy and sound financial management. The involvement of

stakeholders in the budgetary process will facilitate the development of a realistic budget for meeting operational needs and sustaining the growth of the university. The present experience may shed light on the management of financial resources through budgeting in self-financing universities worldwide.

References

Ambe-Uva, T., & Adegbola, E. (2009). Open flexible learning as a strategy for enhancing human security in Nigeria. *International Journal of Education and Development Using Information and Communication Technology, 5*, 148–156.

Brimley, V., Verstegen, D. A., & Garfield, R. R. (2012). *Financing education in a climate of change* (11th ed.). Boston: Pearson.

Capaldi, E. D. (2011). Budget cut and educational quality. *Academe, 97*, 10–13.

Garner, C. W. (2004). *Education finance for school leaders: Strategic planning and administration*. Upper Saddle River, NJ: Pearson.

Glover, D., & Levačić, R. (2007). *Educational resource management: An international perspective*. London: University of London.

Levačić, R. (2000). Linking resources to learning outcomes. In M. Coleman & L. Anderson (Eds.), *Managing finance and resources in education* (pp. 3–23). London: Paul Chapman Publishing.

McAleese, K. (2000). Budgeting in schools. In M. Coleman & L. Anderson (Eds.), *Managing finance and resources in education* (pp. 132–147). London: Paul Chapman Publishing.

Mestry, R., & Naidoo, G. (2009). Budget monitoring and control in South African township schools. *Educational Management Administration & Leadership, 27*, 107–125.

Weindling, D. (1997). Strategic planning in schools: Some practical techniques. In M. Preedy, R. Glatter, & R. Levačić (Eds.), *Educational management: Strategy, quality and resources* (pp. 218–233). Buckingham: Open University Press.

Chapter 4
A Needs Assessment Study to Support Academic Research: The Experience of the Open University of Hong Kong

Billy Tak Ming Wong and Beryl Yuen Yee Wong

Abstract Research support will significantly affect the research development of an institution. To provide proper research support services, it relies on an effective channel for collecting feedback from academics on their needs and stakeholders on the impact of research. This paper presents a needs assessment study conducted by the Open University of Hong Kong to identify its academics' needs for research support. The study aims to identify the extent to which current research support of the university is adequate for the academics and whether other kinds of support are preferred by them. It includes three sessions of focus group discussions, covering academics from a broad range of disciplines and at different levels of activeness in research. Following the Researcher Skill Development framework (Willison J, O'Regan K: The researcher skill development framework. Accessed from http://www.adelaide.edu.au/rsd/framework/rsd7/, 2008), the needs of participating academics in different facets of research, from initiating a research study to presenting research findings, were shared and discussed systematically in the focus group sessions. Results show the diverse needs of academics at different levels of activeness in research. There were needs highlighted by research-active academics such as activities for generating research ideas and identifying partners for research collaboration. Academics who were previously not active in research expressed wishes to have more activities for experience sharing of research and successful funding applications. There were also suggestions made by all groups of participants, such as provision of training on research software and quantitative data analysis. Based on their feedback, new or refined research support services have been provided to cater for academics' research needs.

Keywords Needs assessment · Research support · Researcher Skill Development framework · Research development

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_4

Introduction

Research support is an integral part of the research development of a higher education institution. To deliver proper research support, it must take into account the diverse needs of academics in research. There has to be an effective channel for collecting feedback from academics on their specific needs.

This paper reports a needs assessment for research support of the Open University of Hong Kong (OUHK). As a university featuring provision of open and flexible learning, OUHK has planned to systematically develop its research capacity. It is expected that its academic staff members, through engaging more in research, will keep themselves abreast of the developments of their disciplines and transfer new knowledge into teaching and learning. The diverse profile of academics, however, presents challenge in formulating policy of research support. For example, there are research-active academics, experienced teachers not having involved in research for many years as well as junior academics without much research experience.

The needs assessment attempted to identify the various needs of academics in research. It covered a wide range of areas related to the research environment of OUHK. Academics participated in the study shared their views and provided suggestions on aspects such as the research culture, infrastructure and resources of the university and needs of research support. Findings of the study will facilitate formulation of appropriate research support policy and provision of relevant services that may be applicable to institutions in virtually all parts of the world sharing similar background.

Related Studies

There have been many needs assessment studies (or needs analysis) reported in the literature, usually conducted together with programmes related to research development. As stated in Zaščerinska and Melnikova (2015), 'needs analysis provides the crucial information to ensure that education and/or professional development is purposeful, appropriate, valid and relevant' (p. 216). Bazeley (1994) also expressed that it is necessary to 'identify first where staff felt they were 'at' with regard to research, and what their research development needs were' (p. 122), before devoting resources to the development of a research culture and research capability of academics.

Previous studies of needs assessment have suggested a broad range of dimensions for identifying academics' needs of research development. For example, they can be used to examine participants' perception of their development needs. Wood (1990) reported how academics conducted and perceived their research, for determining the issues for development of a research policy. Conrad (1998) presented a needs analysis which came together with a research development programme. It consisted

of interviews with senior faculty members to determine their perceptions of staff development needs and seek advice on how the needs might be met.

Needs assessment helps to determine the motivation factors and resources required for research promotion. For example, Gething and Leelarthaepin (2000) illustrated a needs assessment as the first step to promote research participation. It explored the proportion of work time academics spent on research and their self-evaluation on their level of research skills. The results served as a basis for the development and implementation of a series of strategies to promote research. Akerjordet, Lode and Severinsson (2012) examined the participants' interest in and motivation for research and identified the management and organisational resources required in order to improve their research capacity.

It also serves to identify the training needs of participants. For instance, Lee, Gowers, Ellis and Bellantuonoa (2010) assessed the training needs of researchers and claimed that such assessment is important to 'establish what skills should be improved and as a benchmark to relate back when measuring progress' (p. 270). Ekeroma, Kenealy, Shulruf, Nosa and Hill (2015) also presented a needs analysis to inform and refine the objectives and curriculum of a training workshop.

These needs assessments served as part of development programmes and inform the programmes the specific needs of the participants. Their dimensions covered were taken into account in the present study.

Framework

This study adopted the seven-level Researcher Skill Development framework (RSD7) (Willison & O'Regan, 2008). The framework addresses the needs of researchers at different stages of research. It is designed as 'a conceptual tool for diagnosis and planning, promoting understanding and interpretation of ... research skill development' (Willison & O'Regan, 2007, p. 401). The framework covers six aspects of research:

- Embark and clarify—respond to or initiate research and clarify or determine the knowledge required.
- Find and generate—find and generate the information or data required using appropriate methodology.
- Evaluate and reflect—determine and critique the credibility of selected sources, information and data and reflect on the research processes.
- Organise and manage—organise the information and data to reveal patterns and themes and manage research teams and research processes.
- Analyse and synthesise—analyse the information and data and synthesise new knowledge.
- Communicate and apply ethically—write, present and perform the processes, understandings and applications of the research and respond to feedback, accounting for ethical, social and cultural issues (Willison & O'Regan, 2008).

In addition to RSD7 for identifying the needs of academics in research, the research culture and research infrastructure and resources of the university were also included as part of the needs assessment.

Research Method

The study aimed to explore the following questions:

- To what extent is current research support of the university adequate for academic staff to conduct research?
- What kinds of further research support are preferred by academics?

There were altogether three focus group sessions conducted in January 2015, with a total of 17 full-time academic staff members participating in the group sessions. Each session consisted of five to six participants. All the participants were at the rank of assistant lecturer or above, from the four schools of the OUHK.

The participants were categorised into three groups based on their activeness in research, according to their number of submission of research funding applications in the past 3 years:

- Group 1 (active in research)—submitted two or more research funding applications, with at least one to the Research Grants Council (RGC) of the Hong Kong Government
- Group 2 (semi-active in research)—submitted one application to the RGC or one or more applications to the OUHK's internal research funding
- Group 3 (inactive in research)—did not submit any research funding application in the past 3 years

This categorisation helps us to understand various needs of research support among academics from diverse backgrounds, with different degree of prior experience in research.

The participants shared views and opinions regarding (1) the research culture of the university, (2) the infrastructure and resources for research and (3) the research support services preferred. The RSD7 was adopted to understand participants' needs of research support in different facets of research.

Findings

Research Culture

As summarised in Table 4.1, the participants shared their views of the research culture of the university, which revolves around the areas of teaching, collaboration, funding and administrative support.

Table 4.1 Academics' views of research culture

Category	Subcategory	G1	G2	G3
Teaching	Teaching load	✓	✓	✓
	Teaching quality			✓
Collaboration	Collaborations across disciplines	✓	✓	
	Establishment of research teams			✓
Funding	Sufficiency of research funding	✓	✓	✓
Administrative support	Research funding policies	✓		✓
	Administrative procedures	✓	✓	

G1, active in research; G2, semi-active in research; G3, inactive in research

Teaching

All groups of participants expressed their concern about teaching duties, which is regarded as a major challenge to promote the research culture of the university. As a teaching-oriented institution providing various education modes, academic staff of the OUHK are well-prepared to devote most of their time in teaching. Some of them have to teach both full-time and distance-learning courses throughout a year, without any specific period of time in a year (e.g. summer break) for them to concentrate on research. Given this background, most participants shared the challenge to reallocate their work time to conduct research. Some academics shared their experience that it is hard for them to attend the seminars or other training activities for research development.

Participants also raised their concern to achieve a balance between teaching and research. Academics from the inactive group expressed their worry that putting more effort in research may affect their teaching quality.

Collaboration

Academics from the active and semi-active groups in general appreciated the research environment of the OUHK that, being a relatively small-scale institution, they can easily reach and find colleagues as collaboration partners across disciplines.

For those from the inactive group, they suggested that intra-unit research teams could be formed to encourage academic staff to engage in research.

Funding

All groups of participants recognised the increasing availability of research funding available to apply, which is conducive to promote research participation. As the amount of internal funding may not be sufficient for time-consuming tasks such as interviews and transcriptions, the availability of external funding would be essential

support for large scale and in-depth studies. Updated information on external sources funding was regarded as important by the participants.

Administrative Support

The academics raised enquiries about research funding policies. For example, some of them were not familiar with the differences between policies of various funding on issues such as recruitment of research support staff. This suggests a need to strengthen relevant administrative support to assist academics to be familiar with the research funding policies.

The participants from the active and semi-active groups also indicated their insufficient familiarity with the administrative procedures relevant to research, such as recruitment of student helpers and purchase of equipment and experimental tools. Further administrative support for this aspect is needed.

Research Infrastructure and Resources

Table 4.2 summarises the participants' opinions of their needs for research infrastructure and resources, which are grouped into facilities, IT resources and library resources.

Facilities

All groups of participants agreed that one of the major challenges is the work space for research support staff. More research support staff are expected to be hired as a result of the university's increasing engagement in research. Some research-active participants commented that more storage space is needed for physical research data and documents such as completed questionnaires; as such records have to be kept for a number of years. For laboratory space for research, all groups of academics

Table 4.2 Academics' views of research infrastructure/resources

Category	Subcategory	G1	G2	G3
Facilities	Work space	✓	✓	✓
	Storage space	✓		
	Laboratory space		✓	✓
IT	Sufficiency of computers and licences of research software tools	✓	✓	✓
	Computing power	✓	✓	
Library	Library resources			✓

G1, active in research; G2, semi-active in research; G3, inactive in research

considered that the space is very limited. A further constraint was that staff members have to share the laboratory facilities with students.

IT Resources

All groups of academics raised the need for central provision of computers and software licences for research. At present, some academic staff may have to share their computers with their research support staff due to the limited number of software licences. Academics conducting computation intensive research may need more powerful computers for heavy data processing.

Library Resources

Along with the growth of the university, the academics of the university are conducting more research projects, and thus they have a greater need for library resources. Participants from the inactive group indicated their need to have access to academic journals and field-specific resources which are currently not subscribed nor provided by the library.

Research Support Needs

Table 4.3 summarises the research support needs raised by the participants, which are grouped following the various facets of research in the RSD7 framework.

Embark and Clarify

Academics from the research-active group would like to receive notifications of the updates of library databases. Participants from the semi-active and inactive groups preferred to have further support, such as seminars sharing research ideas in various disciplines and research software tools and relevant trainings (e.g. EndNote for bibliographic management).

Find and Generate

It was suggested that approaches of data collection in various disciplines could be introduced. For example, participants from the field of drama education presented the challenge of conducting research in their field. They wished to know how data could be collected from activities such as drama plays.

Table 4.3 Academics' research support needs

Category	Subcategory	G1	G2	G3
Embark and clarify	Notifications of updates of library databases	✓		
	Sharing research ideas of various disciplines		✓	✓
	Provision of and training in software for referencing		✓	
Find and generate	Approaches of data collection in various disciplines		✓	
Evaluate and reflect	Information/training of software for transcription	✓	✓	✓
	Information/training of software for statistical analysis	✓	✓	
Organise and manage	Consultancy on research project management		✓	
	Platform for research collaboration		✓	
	Identification of potential research partners		✓	
Analyse and synthesis	Consultancy on statistical modelling	✓	✓	✓
	Field-specific sharing of qualitative research experiences			✓
Communicate and apply ethically	Language editing	✓	✓	✓
	Skills sharing of constructing high-quality proposals		✓	✓
	Experiences sharing of successful funding applications		✓	✓

G1, active in research; G2, semi-active in research; G3, inactive in research

Evaluate and Reflect

Academic staff reflected that they would like to have more information and training of research software for both qualitative and quantitative studies, such as software for transcription and that for statistical analysis.

Organise and Manage

Academics from the semi-active group would like to have consultation service on research project management. They also wished to have a platform for research discussion and collaboration across disciplines and identification of potential research partners.

Analyse and Synthesise

Participants from all groups suggested that they need support in quantitative data analysis especially statistical modelling. The inactive group participants wished to have experience sharing of field-specific qualitative research.

Communicate and Apply Ethically

Participants of all groups showed a strong desire to have language editing service. They indicated the needs to have manuscripts edited following convention of language use in specific disciplines and formatted for requirements of different publications. Participants would like to have activities for experience and skills sharing of writing proposals and applying research funding.

Discussion

This study has revealed the diverse needs of academics at different levels of activeness in research, which contribute to determine proper research support services. The importance of research support was illustrated from our research findings. The academics who were previously not active in research also expressed wishes to have more activities for experience sharing of research and research funding applications. This suggests that they may be willing to engage more in research when proper research support services are provided.

The diverse needs of academics also present how provision of specific research support is necessary to cater for their needs. For example, for generating research ideas, the research-active academics preferred to have updates of library databases, while the inactive ones (who are mostly junior academics in this study) wished to have more opportunities to attend activities that share research ideas in various disciplines, as they were looking for good exemplars to follow in order to achieve utmost performances in their research projects. The academics previously inactive in research also indicated their interests in opportunities to consult forming research teams in order to learn from them. As suggested in the relevant literature (Hanover Research, 2014), support for research collaboration can be offered for these academics which helps to develop an active research culture.

The wide range of academics' needs involves cooperative endeavours by various units in the university to provide relevant support (DFID, 2010). For example, the administrative policies and procedures have to be explained to academics by different relevant units. Provision and coordination of research facilities and resources also involve collaboration of various units.

Given the limitation of resources, it is unrealistic that all the needs and issues raised by the academics will be met and resolved. Among the various suggestions, we have to set priorities, such as promoting the research culture, providing training of using research software tools and research skills and facilitating research collaboration.

Conclusion

As an integral part of research capacity development, this needs assessment helps to ensure that the research support services would be 'purposeful, appropriate, valid and relevant' (Zaščerinska & Melnikova, 2015, p. 216).

Based on the findings of the study, relevant research resources and support are being provided systematically. For example, the software tool for bibliographic management has been purchased for academics' use with relevant training provided. Regular roundtable meetings are being organised for gathering academics to generate research ideas and facilitate research collaboration. A series of seminars and workshops for quantitative data analysis are being held, which have been well-participated by academics. Their positive feedback suggests that the implementation of the research capacity development programme at the OUHK is on the right direction.

As the academics gradually develop their research capacity, it is expected that their needs of research support may change, and new needs may emerge. Periodic needs assessment will be required to update their latest developments and adjust the provision of research support accordingly.

Acknowledgements The work described in this paper was partially supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (UGC/IDS16/14).

References

Akerjordet, K., Lode, K., & Severinsson, E. (2012). Clinical nurses' attitudes towards research, management and organisational resources in a university hospital: Part 1. *Journal of Nursing Management, 20*(6), 814–823.

Bazeley, P. (1994). From vocational college to new university: The research profile and development needs of academic staff in a period of transition. *Higher Education Research and Development, 13*(2), 121–132.

Conrad, L. (1998). Enhancing research through academic staff development. *The International Journal for Academic Development, 3*(2), 114–123.

DFID. (2010). *How to note: Capacity building in research*. Department for International Development, Overseas Aid Effectiveness. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/187568/HTN_Capacity_Building_Final_21_06_10.pdf

Ekeroma, A. J., Kenealy, T., Shulruf, B., Nosa, V., & Hill, A. (2015). Building capacity for research and audit: Outcomes of a training workshop for Pacific physicians and nurses. *Journal of Education and Training Studies, 3*(4), 179–192.

Gething, L., & Leelarthaepin, B. (2000). Strategies for promoting research participation among nurses employed as academics in the university sector. *Nurse Education Today, 20*(2), 147–154.

Lee, L. J., Gowers, I., Ellis, L., & Bellantuonoa, I. (2010). Well rounded postdoctoral researchers with initiative, who are not always 'tied to the bench' are more successful academically. *International Journal for Researcher Development, 1*(4), 269–289.

Hanover Research. (2014). *Building a culture of research: Recommended practices*. Academy Administration Practice. Retrieved from http://www.hanoverresearch.com/media/Building-a-Culture-of-Research-Recommended-Practices.pdf

Willison, J., & O'Regan, K. (2007). Commonly known, commonly not known, totally unknown: A framework for students becoming researchers. *Higher Education Research & Development, 26*(4), 393–409.

Willison, J., & O'Regan, K. (2008). *The Researcher Skill Development framework*. Accessed from http://www.adelaide.edu.au/rsd/framework/rsd7/

Wood, F. (1990). Factors influencing research performance of university academic staff. *Higher Education, 19*(1), 81–100.

Zaščerinska, J., & Melnikova, J. (2015). Adults' need for foreign language competence as a factor of well-being: A comparative study of Latvia and Lithuania's cases. *Andragogy, 5*, 214–225.

Chapter 5
In Search of an Effective Model of the 'Flipped Classroom' in Japan

Yoshihiro Hirata

Abstract The benefits of the flipped teaching approach, which merges conventional learning with the continuously advancing world of online learning, are enormous for both students and instructors. Although various combinations and applications of this model have been implemented, little research has been conducted on which models are more effective for enhancing students' motivation and encouraging them to take control of their learning. This study looks at the development and evaluation of flipped classroom approaches in various Japanese educational settings and discusses the benefits and limitations revealed thus far.

Keywords Flipped classroom · Japan · Flexible education

Introduction

Flipped teaching models have recently been incorporated by educational professionals as one of the most effective teaching approaches for providing students with more time to study at their own pace and prepare to participate in class activities before each class (Watanabe, 2014). The students in flipped classrooms watch video-recorded lectures as homework outside the class, and they often communicate with other students and the instructor via online discussion forums (Tucker, 2011). During class time, the students have discussions with each other under the guidance of their instructor. The students found that this mode of learning was helpful for them to improve their understanding of, and enhances their familiarity with, the lecture topic. Flipped teaching models differ from prior techniques in many ways. For example, compared to the conventional classroom, this model gives students more time to study at their convenience and prepare questions in advance.

This flipped approach has several benefits in teaching, for both students and instructors (Fulton, 2012). For example, it helps students in the face-to-face

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_5

classroom to engage more actively in what they have already learned at home. This enables the instructor to utilise class activities more efficiently than in the conventional classroom. In addition, this model enables students to access different videos of lectures created by various instructors, which helps them to appreciate diverse styles of teaching and increases their exposure to various academic topics. There are, however, some limitations or drawbacks with this model. For instance, watching digital lectures in advance is effective only for self-motivated students (Butzler, 2014)—not for those who are less motivated and less engaged. In addition, in a classroom with students having different proficiency levels, it is difficult for the instructor to ensure that they are all learning at the same pace (Chen, Wang, Kinshuk, & Chen, 2014).

This teaching model has become popular since it was demonstrated by Khan (2011) and Bergmann & Sams (2012). However, various evaluations of flipped models of teaching in Japan found that there is a lack of research on how to best structure and utilise this model for maximising Japanese students' learning.

Purpose of the Study

The purpose of this study is to examine the development of, and students' reaction to, flipped classroom approaches as implemented in various Japanese educational settings and to discuss their benefits and limitations.

Research Questions

1. What are the distinctive characteristics of flipped classroom models in Japan in terms of teaching methods and materials?
2. What are students' and instructors' perceptions of this model?

Methodology

Overview of the Research Papers Examined

In this study, eight research papers and related reports were selected for evaluation. The flipped teaching methods described in these papers were recently introduced into classrooms around Japan. Most of this research was conducted in secondary schools and tertiary institutions.

Elementary Schools

Higashi Koyodai Elementary School (Sato, Inagaki, Yokota, & Asakawa, 2015)

Participants: Approximately 30 sixth-grade students

Methodologies

Students were given iPads to take home, which were leased to the school by Fujitsu. They were asked to use them to watch an instructional video about 'ratios and proportionality' in mathematics and to take notes. The video was about 2–3 min long. The time students spent watching and taking notes ranged from 30 min to an hour. Every student watched the video, thanks to the encouragement of their parents. Afterwards, during the class time, the instructor checked students' notes and assisted further those who hadn't yet fully understood the examples presented in the video. The students also helped each other in groups. After the introduction of this flipped approach, drill exercises, which had previously been assigned as homework, were instead given to students as classroom exercises.

Evaluation

Students' performance appeared to benefit significantly from this learning approach, and students reported 'a feeling of security' from being able to prepare before coming to the classroom. Approximately 80% of their parents were happy with the flipped classroom model because students studied more at home and they spent more time talking to their parents.

Elementary Schools in Takeo City (Matsubara, Shibusawa, Ogawa, & Iwade, 2014; Takeo City Board of Education, 2015)

Participants: Approximately 3000 students in 11 elementary schools

Methodologies

The project was called *School Movies Innovate the Live Education-Classroom* (SMILE). Each student was given a loan of an android tablet. Students from third to sixth grade in mathematics classes and from fourth to sixth grade in science classes participated in this flipped classroom project. Once every three classes, students were required to do a 3–6-min cartoon-based task at home in preparation for their regular class. Their teachers drew up rough drafts of their curricula, and, based on these drafts, in 3 months, two software companies created videos to be installed on the tablets. Students were also required to answer paper-based questions related to the task, as well as questionnaires, within 30 min.

Evaluation

In response to the question 'Did you understand what you learned through this model?', 94% of the students gave positive answers. Also, to the question 'Did you have a good time learning through this model?', 89% of the students gave positive responses. Approximately 70% of the teachers had a positive reaction to the flipped

teaching. In the 2014 survey, the teachers had a sense of accomplishment, although they became busier in preparing for the flipped classrooms; and in the 2015 survey, they had a stronger sense of accomplishment and were not as busy as before. The companies that developed the videos, however, reported that the cost of producing them was somewhat high.

Secondary Schools

Kinki University Secondary School (Gakken, 2014)

Participants: About 1000 students

Methodologies

Since 2013, students entering this secondary school have been required to purchase an iPad and utilise digital textbooks and materials via a learning management system. Flipped classroom models were introduced into mathematics and English courses.

In the mathematics courses, students studied by themselves by watching lectures at home on their iPads. In the classroom, in addition to studying independently or receiving lecture-type instruction, students also took part in cooperative learning sessions. In the English courses, students did lexical and read-aloud exercises at home using digital materials. In the classroom, the instructor reviewed these exercises, and in groups students did cooperative activities utilising what they had learned.

Evaluation

The chief benefit of the flipped method was that students were able to engage with the learning materials for longer periods than they would have just during class time, enabling slower students to take as much time as they needed to master the materials. As a result, the instructor was able to spend more time with students in the classroom. It was also interesting that, before the introduction of this new teaching method, the instructor had been spending a year on the prescribed textbook but, after introducing flipped teaching, the class managed to finish it in half a year. This study concluded that, with the flipped classroom approach, students were able to make significant improvements in mathematics and English compared to conventional lessons.

Sasayama-Higashi Secondary School (Benesse Educational Research & Development Institute, 2014)

Participants: Approximately 140 students

Methodologies

Instructors created 5–10-min videos and burned them onto DVDs for mathematics and English classes. Since some students did not have a computer at home and tablet computers for students were not readily available, the DVDs were distributed instead as most of them have DVD players at home. Students were required to watch these videos before each class. During the English classes, students did pair-work or group activities to learn expressions and phrases using paper-based materials.

Evaluation

Students highly appreciated this new teaching approach, and all of them were successful in understanding what they were expected to learn. This finding indicates that flipped teaching is possible without relying on tablet computers.

Tertiary Institutions

Hokkaido University (Shigeta, 2014)

Participants: 2600 students taking Information Science Course I

Methodologies

Flipped teaching approaches were implemented in eight classes over 3 months. In this course, an educational programme (*Justice*, produced by Prof. Michael J. Sandel of Harvard University) was used as the digital teaching material. This programme generated a lot of discussion and has been made available to the public through 'iTunes U' and through Tokyo University. *Justice* contains eight different topics; and several groups of four or five students select one of the topics and watch it outside the class in advance. In the classroom, students hold a discussion and then make a report about this and submit it to the instructor. Students evaluate their reports with each other. A questionnaire was given at the end of this flipped teaching project.

Evaluation

Approximately 90% of the students watched the digital materials, and more than 70% were interested in what they had learned. Approximately 60% of the students liked the peer-reviewing process, and more than 50% said that the group activities were useful in their studies. More than 70% of the students engaged enthusiastically in classroom discussions, unlike in conventional lecture-type lessons. The longer students watched the materials, the better were the evaluations of their final reports.

Waseda University (Kogo, Tominaga, & Ishikawa, 2012; Kogo & Ishikawa, 2014)

Participants: 298 students in 2008, 271 students in 2009 and 194 students in 2010

Methodologies

A flipped model was introduced into an elective course. The digital materials were created in 2008 by using materials from distance learning courses at Waseda University. In 2009, new digital materials were created by the instructor using a software called Camtasia. Each module was about 15 min long at most and involved the instructor giving a speech without any prepared scripts. Students accessed the materials either via a visual delivery system or a private YouTube account. After watching the video, the students did multiple-choice quizzes and tasks included in the materials and made short reports. In the classroom, several groups of five or six students discussed the tasks.

Evaluation

In order for students to tackle tasks seriously, the digital materials should include quizzes which can be automatically analysed. They should also involve tasks which require students to write 400-word reports. In addition, visual materials which were no more than 15 min long were important for students to maintain their interest in the flipped lessons. The flipped model in this project was as effective as conventional face-to-face lectures. Group discussions were also effective for students' job hunting as they promoted self-confidence in structured situations.

Kagawa University Medical School (Nishiya, Sumitani, & Okada, 2014)

Participants: 87 students in a medical management and administration course

Methodologies

A flipped teaching approach was introduced into a 75-min class. The instructor uploaded a 15-min digital lecture on 'bleeding tendencies' to an online system called Ub!Point, created by Fujitsu, and students were encouraged to watch it before the face-to-face class. During the class time, students recalled what they had seen in the video for approximately 10 min, and interactive dialogues between the instructor and students took place in the rest of the class. A questionnaire was given to students at the end of the class.

Evaluation

The results of the questionnaire revealed that 67% of the students watched the video, and they were satisfied with its duration and degree of difficulty. Sixty-nine percent watched the video at the university. Sixty-six percent thought the video was easy to understand, and 97% thought this teaching approach was helpful. Finally, 9% thought that all the courses they were taking should be based on flipped teaching approaches, and 83% thought these approaches should be introduced into more than half of their courses.

University of Yamanashi (Tamaru et al., 2014)

Participants: 50 students in a Computer Network course, 40 students in a Basic Statistics course and 50 students in a Telecommunications course.

Methodologies

Three instructors created digital materials using a screen capture and Internet delivery system developed by Fuji Xerox. This system enabled them to create digital materials with audio files. The students were asked to look at the materials before each class, take notes and submit the notes in the classroom. In the classes, groups of students discussed what they had learned from the materials and did some exercises together. They took midterm and final examinations and answered a questionnaire at the end of the course.

Evaluation

After the implementation of the flipped teaching approaches, students' scores increased considerably. In addition, the number of students with low scores decreased remarkably. The results of the questionnaire revealed that students actively engaged in the classwork and they now studied more before and after each class, leading to a sense of accomplishment.

Summary of the Findings

Overall most students, regardless of their educational settings, showed positive responses to the flipped teaching approaches they had experienced (see Appendix). Contrary to our expectations, only a few flipped classroom approaches have been implemented in elementary schools. This is because the teachers in elementary schools teach all subjects and do not have sufficient time to create a large volume of digital materials for flipped classrooms. The projects in the elementary schools mentioned in this paper are relatively new and very small. However, as shown in the elementary schools in Takeo City, both teachers and students valued highly this innovative approach. In Higashi Koyodai Elementary School, students' grades increased due to this approach, but not enough research has been conducted on this issue.

In secondary schools, one of the benefits of introducing flipped approaches was that they provided more time for teachers to spend on classwork and for students to discuss the lessons with other students (e.g. Kinki University Secondary School). Involving students in the classroom discussion is extremely important because secondary school curricula in Japan are heavily exam-oriented which encourage students to memorise a large amount of information for passing examinations. Therefore, as described in the previous section, students highly appreciate this innovative and unique approach. However, flipped classrooms have not been introduced into many secondary schools due to budget limitations for purchasing tablet

computers. In order to solve this problem, as shown in Sasayama-Higashi Secondary School, DVDs can be used as substitutes for tablet computers.

In tertiary institutions, although conventional lecture-type classes remain prevalent and instructors usually use commercial textbooks in classes, flipped approaches have been changing their ways of teaching. For example, in Waseda University and Hokkaido University, individual instructors created their own materials for the implementation of flipped approaches. A group of instructors in one large institute (the University of Yamanashi) cooperated in the development of materials and methodologies for better flipped classrooms. These self-developed materials are effective in helping students to learn better from classes.

The papers examined in this study focus mainly on improvements in student grades (e.g. University of Yamanashi) and group discussions in the classroom (e.g. Waseda University and Hokkaido University). Overall, students had positive response towards the flipped approaches.

Discussion

Shigeta (2014) points out three benefits of flipped classroom methods. Firstly, the flipped classroom enables students to increase their learning time. In conventional classrooms, the lessons presented are given during class time, but the flipped classroom enables students to use this time better to discuss lesson contents. Secondly, flipped methods provide students with opportunities to actually apply what they have learned from the digital materials they watch at home. In conventional classrooms, students learn passively, but the flipped classroom promotes active learning. Thirdly, in flipped classrooms, students' learning progressed faster and was more effective, as shown in the Kinki University Secondary School example mentioned above. Kogo and Ishikawa (2014) claim that these methods also help students to actively engage in group activities and explore new ideas as they deepen their understanding. In addition, they enable students to prepare questions to ask on anything they find unclear or confusing and to participate better in classroom discussion.

Flipped classrooms are also beneficial for instructors. As Nishiya et al. (2014) state, this model boosts face-to-face instruction time, which ensures that students fully understand topics. In addition, when students do their assignments in the classroom, instructors have new and better insights into their abilities, especially in identifying problem areas, and can customise and improve courses as needed. Class time is used more effectively and thus enhancing students' levels of achievement.

As above-described, the flipped teaching approaches implemented in Japanese educational settings are fundamentally similar—having students to recall what they read before a class and discuss during the class. These approaches have been

introduced into classrooms on an experimental basis, without clearly distinguishable features of flipped classes between them. There are also some problems with implementing flipped classroom methods. Shigeta (2014) points out the following three difficulties. Firstly, educational institutions require high-speed broadband Internet connections for students to access the digital materials. In addition, individual students need a computer or tablet, but many cannot afford to buy one. However, as in the case of Sasayama-Higashi Secondary School, DVDs can be used as a substitute for computers or tablets. Secondly, the instructor needs to have enough open resources or materials of good quality to be included in the digital lectures. Although many different open resources are available nowadays (such as Khan Academy), Japanese language resources are still being developed. Thirdly, the instructor must consider students' total homework load to determine whether or not they have enough time to watch digital materials in advance. The results from the questionnaires conducted by Shigeta (2014) indicate that the more time students spend on the digital materials, the higher marks they get. The instructor's role—as a facilitator in determining students' comprehension of what they have learned, supporting students individually and promoting cooperative learning—is important.

Conclusions

This study demonstrates different flipped classroom approaches implemented in various Japanese educational settings. The number of flipped classroom examples outlined is too small to allow any generalisation on the development and evaluation of the flipped classroom approaches implemented at various levels of educational settings (i.e. elementary, secondary and university) in Japan. However, the characteristics of the approaches demonstrated in this study provide interesting insights and implications about how they should be introduced in different educational settings. The findings suggest that flipped classrooms both provide students with opportunities to prepare better for participating in classwork and help them to learn more effectively. The results also indicate that flipped classrooms promote active discussion between the instructor and students and therefore contribute to a productive teaching environment. Instructors need to take into consideration ways to create digital materials suitable for students' needs, preferences and workload.

Further research on flipped classrooms should be conducted to determine how instructors should act effectively as facilitators in implementing flipped teaching approaches in order to enhance students' active learning. It is also essential for instructors to provide students with a collaborative learning environment which enables them to take the initiative and become ready to take charge of their own learning.

Appendix

Percentages of the students' responses to the question whether flipped teaching approach is effective for their study

Institutions	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	No answer
Higashi Koyodai Elementary School	8.8		5.9	85.3		0
Elementary schools in Takeo City	4.5	10.7	NA*	39.8	45.0	0
Kinki University Secondary School	1.2	1.2	16.5	35.3	20.0	25.8
Kagawa University Medical School	0	3.0	NA*	69.0	28.0	0

*indicates that a 4-point Likert scale was used in the evaluation

References

Benesse Educational Research & Development Institute. (2014). *Effectiveness of flipped classroom methods in improving teaching skills*. View21 (secondary school edition), 3, Retrieved from http://berd.benesse.jp/up_images/magazine/VIEW21_chu_2014_vol3-ALL.pdf

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. Eugene, OR: International Society for Technology in Education.

Butzler, K. B. (2014). *The effects of motivation on achievement and satisfaction in a flipped classroom learning environment*. Prescott Valley, AZ: Northcentral University.

Chen, Y., Wang, Y., Kinshuk, & Chen, N.-S. (2014). Is FLIP enough? Or should we use the FLIPPED model instead? *Computers & Education, 79*, 16–27.

Fulton, K. (2012). Upside down and inside out: Flip your classroom to improve student learning. *Learning & Leading with Technology, 39*(8), 12–17.

Gakken. (2014). A case study introducing flipped teaching at Kinki University secondary school. *Shingaku Joho.* Retrieved from http://www.gakuryoku.gakken.co.jp/pdf/articles/2014/8/p16-19.pdf

Khan, S. (2011). *Let's use video to reinvent education*. Retrieved from https://www.ted.com/talks/salman_khan_let_s_use_video_to_reinvent_education

Kogo, C., Tominaga, A., & Ishikawa, N. (2012). *Daigaku niokeru e-raaningu to guruupuwaaku wo kumiawaseta burendogatajugyou no sekkei to jissen* (Successful Implementation of University Blended Learning - Improvement of Higher Education and Faculty Development). *Japan journal of educational technology, 36*, 281–290.

Kogo, C., & Ishikawa, N. (2014). Hantenjugyou wo jissisuru tameno kufuu: on-demand to group work no sekkei to sono renkei (Effective methods for implementing flipped classroom approaches: Creating on-demand videos and group activities). In *Proceedings of 36th Annual Conference of the Japan Association for College and University Education*, pp. 220–221.

Matsubara, S., Shibusawa, K., Ogawa, C., & Iwade, K. (2014). Current situation and challenges in use of ICT for education: The ICT Education Research Project by Toyo University Institute of Social Sciences: First report. *The Journal of Contemporary Social Sciences, 12*, 61–72.

Nishiya, K., Sumitani, K., & Okada, H. (2014). Igakukyouiku niokeru handenjugyou trial (An experimental flipped classroom in medical education). *Journal of Higher Education and Research, 11*, 107–112.

Sato, Y., Inagaki, T., Yokota, T., & Asakawa, T. (2015). Syoggakou sansuuka niokeru hantenjugyou dounyuu no kouka no kentou (Study of the effects of flipped classroom introduced in elementary school mathematics). *Research report of JET Conferences, 15*(1), 231–236.

Shigeta, K. (2014). ICT niyoru kyouikukaikaku no sinten (Flipped classroom: educational reform utilizing information technology). *Joho kanri, 56*(10), 677–684.

Takeo City Board of Education. (2015). *Takeo City secondary verification report on education using ICT in 2014* (Abridged ed). Retrieved from https://www.city.takeo.lg.jp/kyouiku/docs/20150928kyouiku02.pdf (in Japanese)

Tamaru, E., Hanawa, M., Morisawa, M., Ando, H., Hinaga, T., Hirano, A., Nagamine, T., & Shinozaki, K. (2014). Trial runs of a flipped classroom using speech-synchronized screen-capture system for students to develop a sentence of agency. *Fuji Xerox Technical Report*, Fuji Xerox, *23*, 43–52. Retrieved from http://www.fujixerox.co.jp/company/technical/tr/2014/pdf/s_05.pdf

Tucker, C. (2011). Flip your classroom with online discussion!. Retrieved from http://catlintucker.com/2011/06/flip-your-classroom-with-online-discussions/

Watanabe, Y. (2014). Flipping a Japanese language classroom: Seeing its impact from a student survey and YouTube analytics. In B. Hegarty, J. McDonald, & S-K. Loke (Eds.), *Rhetoric and reality: Critical perspectives on educational technology*. Proceedings ascilite Dunedin 2014, (pp. 761–765). University of Otago.

Chapter 6
Open and Distance Learning in Asia: Status and Strengths

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Abstract This paper presents an overview of the current status of open and distance learning (ODL) in Asia—a continent regarded as a major region in which ODL flourishes. It profiles the member institutions of the Asian Association of Open Universities, covering diverse areas such as the countries/regions of the institutions, the years of establishment, the numbers of students and academic staff, the types of institutions and their levels of programmes. Against this background, the strengths of, and opportunities for, ODL in Asia are discussed from the perspectives of the potential number of students, growth in Internet users, expertise in distance education, government support and inter-institutional collaboration. Possible ways for further development are also suggested.

Keywords Open and distance learning (ODL) · Asian Association of Open Universities (AAOU) · Asia

Introduction

Asia has for long been a region where opportunities for education for its population have been badly needed. This is illustrated by its substantial and speedy population growth that will outpace the growth of educational provision which always require additional resources, organisational planning and approval procedures. Thus, the world literacy reports always point out that alongside the population growth, the illiterate population in Asia also continues to grow. It is projected that the population in this continent will not reach its peak until about the year 2050 (Gerland et al., 2014).

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_6

The Asian countries also feature diversity in their educational contexts. For example, the literacy rates in some Asian countries remain low,[1] while some others are at their most developed level. Also, while the Internet penetration rate in Asia—36.9% on average—is at a level similar to that in developing counties, certain Asian countries have the fastest Internet speed in the world (International Telecommunication Union, 2015).

The diverse educational contexts in Asia have shaped the ways in which open and distance learning (ODL is delivered. During the past decades, ODL) institutions have been established in various Asian regions but with different foci in terms of the levels of programme offered, class size and the reliance on private education. A profiling of such diversity is presented in this paper, against which the strengths of, and opportunities for, ODL in Asia are highlighted.

Methodology

This study covers a broad range of ODL institutions in Asia in order to present an overview of ODL development and analyse its potential. The data cover member institutions of the Asian Association of Open Universities (AAOU)—a non-profit organisation of higher learning institutions providing open and distance education. Among the 59 member institutions in the AAOU, 54 were selected for this study. They cover various Asian regions, ranging from Central Asia to East Asia and South Asia to Southeast Asia. As they include developed and developing countries and regions, they can be regarded as representative of the present status of ODL in Asia.

Information about these institutions was collected from various media obtained through Internet search engines, such as the institutions' official websites, booklets, prospectuses, annual reports, newsletters and brochures on enrolment. The information was categorised into five areas: (1) country/region, (2) year of establishment, (3) number of students and academic staff, (4) the public-private distinction of the institution and (5) level of programmes.

Profile of Selected ODL Institutions

Country/Region of the Institutions

Table 6.1 shows the country/region of the selected ODL institutions in Asia. The 54 selected AAOU member institutions cover a total of 22 countries/regions, with 25 (46.3%) of them located in India, China and Malaysia, while some are in

[1] According to *The World Factbook* (Central Intelligence Agency, n.d.), the literacy rates of more than 20% of the Asian countries are below the world average (86.3%).

Table 6.1 The country/region of the selected AAOU member institutions

Part of Asia	Country/region	Number of institutions
Eastern Asia	China	8
	Hong Kong	3
	Korea	2
	Taiwan	2
	Japan	1
	Mongolia	1
Southeast Asia	Malaysia	6
	Philippines	4
	Indonesia	2
	Vietnam	2
	Myanmar	1
	Singapore	1
	Thailand	1
Southern Asia	India	11
	Pakistan	2
	Bangladesh	1
	Iran	1
	Nepal	1
	Sri Lanka	1
Western Asia	Kuwait	1
	Palestine	1
	Turkey	1

developed countries, such as Japan, Korea and Singapore. Such geographical distribution shows that, despite the diversity of development status of the various localities, ODL has been practised throughout Asia.

Number of Institutions Established by Decade

Table 6.2 shows the numbers of selected ODL institutions established during the past decades. Among the institutions, the earliest ODL provider was established in the 1950s. Since then, there has been a clear upsurge of institutions providing ODL, and the number has kept increasing and peaked in the 1990s, during which 14 new institutions offering ODL being set up. The trend began to slow down since then, as only two institutions have been newly established and joined the AAOU in the 2010s. The figures also show different trends in ODL development in the regions. For example, the ODL institutions in China were established early from the 1950s to the 1970s; while, in India, the first institution began in the 1970s and others have been added in every decade since then.

Table 6.2 The numbers of selected AAOU member institutions established in various regions during the past decades

Period	Countries/regions (number of institutions established during the period)	Total
1950s	China (1), Hong Kong (1)	2
1960s	China (2), Malaysia (1), Philippines (1)	4
1970s	China (5), India (1), Korea (1), Pakistan (1), Thailand (1)	9
1980s	India (3), Hong Kong (2), Indonesia (1), Iran (1), Japan (1), Philippines (1), Sri Lanka (1), Taiwan, (1), Turkey (1)	12
1990s	India (3), Philippines (2), Vietnam (2), Bangladesh (1), Indonesia (1), Malaysia (1), Myanmar (1), Nepal (1), Palestine (1), Taiwan (1)	14
2000s	Malaysia (4), India (3), Korea (1), Kuwait (1), Pakistan (1), Singapore (1)	11
2010s	India (1), Mongolia (1)	2

Table 6.3 Numbers of students of the selected AAOU member institutions

Number of academic staff	Number of students					
	Below 10,000	10,001–100,000	100,001–1,000,000	Above 1,000,000	NA[a]	Total (%)
Below 100	2	7	1		2	12 (22.2%)
101–1000	5	8	4	1	1	19 (35.2%)
1001–2000		5	1			6 (11.1%)
2001–3000		2		2		4 (7.4%)
Above 3000		1	5	1		7 (13.0%)
NA[a]	1	3	1		1	6 (11.1%)
Total (%)	8 (14.8%)	26 (48.1%)	12 (22.2%)	4 (7.4%)	4 (7.4%)	54 (100%)

[a]Data are not available

Numbers of Students and Academic Staff

Table 6.3 illustrates the numbers of students and academic staff of the selected AAOU member institutions. Nearly half (48.1%) of them have 10,001–100,000 students; and 22.2% have 100,001–1,000,000 students. Also, 14.8% and 7.4% of the institutions are in the categories of below 10,000 and above 1,000,000 students, respectively. As regards the number of academic staff, a majority (57.4%) of the institutions have 1000 or below; 18.5% have 1000–3000; and 13% have more than 3000.

While there is a linear proportion between the numbers of student and academic staff overall, there are also institutions with relatively large or small ratios between students and staff. For example, the Open University of China has as many as 3.59 million registered students,[2] with 499 academic staff;[3] but in contrast the

[2]http://en.ouchn.edu.cn/index.php/about-v2/new-style-university

[3]http://www.ouchn.edu.cn/html/jzdh/x03.html (in Chinese)

Table 6.4 Public-private distinction among the selected AAOU member institutions

Type of institution	Number	Percentage
Public	40	74.1%
Private	14	25.9%
Total	54	100%

International Center for Academics in Nepal was a rather small setup, with just above 1200 students but 78 faculty members.[4] This shows the distinctive diversity of institutional provision of ODL across Asian countries and regions.

Public and Private Institutions

Table 6.4 shows the number of selected institutions which are publicly or privately established. As can be seen in the table, most of the institutions are established and owned by the government (74.1%). However, the public-private divide in ODL provision can be misleading, as, for example, the Open University of Hong Kong is a self-financed university established by the government and is accountable to public governance, but it relies mainly on its tuition fees as its funding source.[5]

Levels of Programmes

Table 6.5 presents the levels of programmes in the selected institutions in various countries/regions. The results show that the ODL institutions in some countries tend to provide programmes at a particular level. For example, those in Japan, India, Pakistan, Malaysia, Mongolia, Turkey, Nepal and Thailand offer mainly (i.e. above 50%) postgraduate programmes. In contrast, the ODL institutions in Myanmar, Palestine, Singapore, Vietnam, Indonesia, Taiwan, Korea and Iran provide a majority of undergraduate programmes. For diploma programmes, they are mainly provided by the ODL institutions in China, and in these institutions, diploma programmes constitute 71.4% of all programmes. The diverse profiles of levels of programmes reveal different market positions or goals of ODL delivered in these countries/regions.

[4] http://www.ica.edu.np/document/Brochure%20ICA.pdf

[5] http://www.ouhk.edu.hk/wcsprd/Satellite?pagename=OUHK/tcSubWeb&c=C_WCM2004&`cid=1385170191283&lang=eng&l=C_PAU&lid=1385172188417

Table 6.5 Levels of programmes of the selected AAOU member institutions in various countries/regions

Country/region	Levels of programmes[a]		
	Postgraduate	Undergraduate	Diploma[b]
Japan	*92.3%*	7.7%	0.0%
India	*72.9%*	16.4%	10.7%
Pakistan	*72.3%*	20.8%	6.9%
Malaysia	*64.0%*	30.1%	5.9%
Mongolia	*61.3%*	38.7%	0.0%
Turkey	*58.8%*	41.2%	0.0%
Nepal	*57.9%*	26.3%	15.8%
Thailand	*55.2%*	34.3%	10.4%
Myanmar	0%	*100%*	0.0%
Palestine	0.0%	*95.7%*	4.3%
Singapore	13.6%	*86.4%*	0.0%
Vietnam	20.0%	*80.0%*	0.0%
Indonesia	13.5%	*78.4%*	8.1%
Taiwan	0.0%	*70.6%*	29.4%
Korea	35.1%	*64.9%*	0.0%
Iran	47.6%	*52.4%*	0.0%
China	0.0%	28.6%	*71.4%*
Kuwait	0.0%	50.0%	50.0%
Hong Kong	24.8%	35.9%	39.3%
Bangladesh	35.3%	41.2%	23.5%
Sri Lanka	47.7%	31.8%	20.5%
Philippines	44.2%	49.8%	6.0%

[a]Percentages above 50% are in italic type
[b]Short courses and certificate programmes with duration of less than a year are excluded

Strengths and Opportunities

Given the profiles of Asian ODL institutions presented above, this section discusses the strengths of and opportunities for ODL in Asia, focusing on five areas: (1) potential number of students, (2) growth in Internet users, (3) expertise in distance education, (4) government support and (5) inter-institutional collaboration.

Potential Number of Students

Table 6.6 shows the United Nations' projection (2015) on continental population, where the population of most continents will keep growing and Asia will continue to be the continent with the largest population in the coming decades. It is emphasised that providing these massive populations with educational opportunities is one of pivotal foci of the post-2015 agenda (United Nations, 2015).

Table 6.6 Projection of continental population (United Nations, 2015)

Continent	Population (millions)				
	2015	2030 (Change compared with 2015)		2050 (Change compared with 2015)	
Africa	1186	1679	(41.6%)	2478	(108.9%)
Asia	4393	4923	(12.1%)	5267	(19.9%)
Europe	738	734	(−0.5%)	707	(−4.2%)
Latin America and the Caribbean	634	721	(13.7%)	784	(23.7%)
Northern America	358	396	(10.6%)	433	(20.9%)
Oceania	39	47	(20.5%)	57	(46.2%)

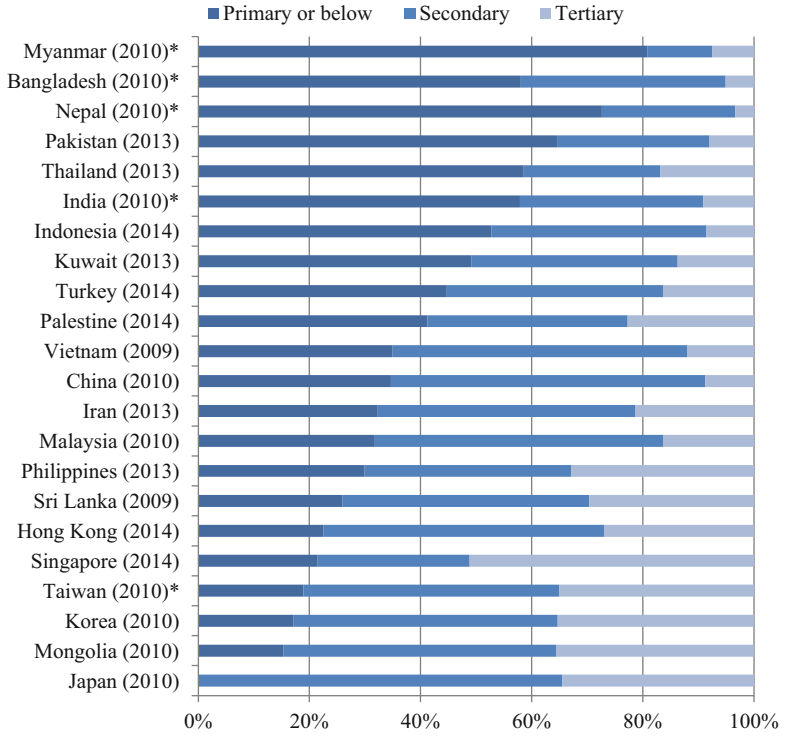

Fig. 6.1 Educational attainment for the countries/regions of the selected AAOU institutions (UNESCO Institute for Statistics; (http://www.uis.unesco.org/Education/Pages/educational-attainment-data-release.aspx) *Barro-Lee Educational Attainment Dataset (http://www.barrolee.com/))

The potential numbers of ODL students are also revealed in the educational attainment of the countries/regions in question. Figure 6.1 presents the percentage of educational attainment for the population of 25 year olds and above in the countries/regions of the selected AAOU member institutions. For nearly 30% (7/22) of the countries/regions have less than 10% of their population attaining tertiary level of education. It is also notable that above 40% of the population in

Table 6.7 Internet penetration rate in the selected countries/regions (2005 and 2015)

Country/ region	Internet penetration rate (2005)	Internet penetration rate (2015)	Change in percentage
Myanmar	0.07	21.80	33416%
Bangladesh	0.24	14.40	5959%
Nepal	0.83	17.58	2127%
Sri Lanka	1.79	29.99	1673%
India	2.39	26.00	1089%
Philippines	5.40	40.70	754%
Indonesia	3.60	21.98	610%
China	8.52	50.30	590%
Iran	8.10	44.08	544%
Vietnam	12.74	52.72	414%
Palestine	16.01	57.42	359%
Turkey	15.46	53.74	348%
Mongolia	6.20	21.44	346%
Kuwait	25.93	82.08	317%
Pakistan	6.33	18.00	284%
Thailand	15.03	39.32	262%
Taiwan	58.01	87.98	152%
Hong Kong	56.90	84.95	149%
Malaysia	48.63	71.06	146%
Japan	66.92	93.33	139%
Singapore	61.00	82.10	135%
Korea	73.50	89.90	122%

http://www.itu.int/en/ITU-D/Statistics/Pages/stat/

nearly half (10/22) of the countries/regions has obtained only primary education or below (i.e. incomplete primary education or no schooling). As this group consists mainly of working adults, the conventional face-to-face learning mode may not suit their needs; thus flexible ODL may serve as a better alternative for the public to get access to education.

The Growth in Internet Users in Asia

As one of the major modes of ODL delivery, the Internet penetration rate of a country/region is highly related to the opportunities for ODL institutions to reach more students. The establishment of network infrastructure and the number of Internet users thus serve as the enablers or barriers for ODL to flourish in a country/region.

Table 6.7 shows the data from the International Telecommunication Union about the Internet penetration rate of the countries/regions of the selected AAOU member institutions in 2005 and 2015. All these countries/regions experienced an astonishing

growth in the number of Internet users in the past decade. Comparing to the global average—that is, 21.83 (2005) and 49.14 (2015) for an increase of 225%—it is noteworthy that a majority of the countries/regions (16/22) have a higher growth in the Internet penetration rate. Although the percentage of Internet users remains relatively low in some developing countries—below 40% in eight countries—a rapid growth can be expected for these countries in the foreseeable future. The availability of Internet coverage thus allows ODL institutions to provide learning opportunity to a broader range of learners.

Expertise in Distance Education

As noted earlier, the selected AAOU member institutions were established in Asia from the 1950s. With decades of experience in ODL provision, most of these institutions have developed extensive expertise in delivering distance education in terms of the scale of their operation and instructional methods.

The ODL institutions have developed ways to deliver education on a massive scale while catering for students' diverse needs. A number of the institutions have branches or study centres established throughout a country/region. For instance, Indira Gandhi National Open University[6] has a total of 67 regional centres and 2667 learner support centres in India to serve its more than three million students; and the Open University of Sri Lanka[7] has 8 regional centres, 18 study centres and 6 teaching centres. These support branches provide face-to-face consultation sessions and tutorials on the basis of learners' needs as a supplement to distance learning, which are significant for effective ODL implementation.

Apart from the scale of operation, many ODL institutions have developed online systems with comprehensive functions tailored for distance education. For instance, Asia eUniversity in Malaysia features technology-enabled education which '[enhances] interactivity in learner-academic relationship; allows personalised, flexible learning from anywhere; [and enables] access to high quality online resources on demand' (Asia eUniversity, 2016).

The expertise and experience of the ODL institutions allows them to maintain competitiveness on a sustainable basis in the market, while online learning has started to gain recognition by conventional face-to-face teaching universities. The conventional universities begin to offer more and more online programmes, including massive open online courses which have become increasingly popular. In other words, ODL institutions in Asia have notable contribution in introducing ODL and various kinds of online programmes in Asia. Not only are they taking a leading position in the development of ODL, but also the practice of online learning has been

[6] http://www.ignou.ac.in/ignou/aboutignou/profile/2

[7] http://www.ou.ac.lk/home/index.php/2013-12-19-09-04-42/introducing-ousl

increasingly adopted by conventional universities that conventionally mainly rely on face-to-face teaching.

Government Support

One characteristic of the selected Asian ODL institutions is that most of them (74%) are public institutions (see Table 6.4). This is in contrast to the overall situation in Asia where a majority of higher education institutions are private ones (UNESCO Institute for Statistics, 2014).[8] This indicates the critical role played by governments in ODL development through establishing ODL institutions and implementing relevant policies, as well as setting quality assurance standards (Darojat, Nilson, & Kaufman, 2015).

In the past, ODL institutions in Asia in general faced a problem of insufficient financial support from the government (Tsui, Zhang, Jegede, Ng, & Kwok, 1999; UNESCO, 2002). The situation has improved with various kinds of government support in place and the growing adoption of information and communication technologies (ICTs) for ODL delivery. For example, for countries such as China and India, a high percentage of recurrent funding provided to ODL institutions has come from the governments for implementing government policy on improving literacy and numeracy rates, as well as the emerging technical and vocational skills in the process of rapid economic restructuring. Also, the government of Bangladesh supports ODL through tax exemptions for ICT equipment (APCICT, 2014).

Taking China as an example, the government made technology and education the two main directions for sustainable development of agriculture in rural areas. Owing to the limitations of rural areas, such as the shortage of teachers, ODL is a suitable way for learners there to receive education with flexibility in terms of time and space (Li, 2009). The Open University of China was appointed to develop retainable and potential talents for rural areas through promoting a wide range of designated diploma programmes (Wu, 2004). The government provided support through various incentives to boost enrolments in rural areas. As such, ODL serves as an effective means for the government to provide learning opportunities for those who can hardly be accessible using conventional face-to-face learning modes.

[8] According to the UNESCO Institute for Statistics (2014), private institutions constitute on average 68% of higher education institutions among ten Asian countries, i.e. Cambodia, China, Indonesia, Korea, Lao PDR, Malaysia, the Philippines, Singapore, Thailand and Vietnam.

Inter-institutional Collaboration

There has been a close connection among ODL institutions in Asia. The AAOU serves as a regional collaborative network with member institutions working together to 'widen the educational opportunities available to all people in Asia and to improve the quality of the institutions in terms of their educational management, teaching and research' (AAOU, n.d.). By holding annual conferences and publishing the *AAOU Journal*, members' institutions can exchange experiences in ODL and explore collaborative opportunities with other institutions. Other than AAOU, there are also ODL networks at the international level such as the International Council for Open and Distance Education[9] and subregional ones such as the OU5[10]—a collaboration among five ODL institutions in Southeast Asia with a master's programme jointly offered by ODL institutions in the ASEAN region.

Individual institutions also form connections to others through various kinds of collaboration. For example, the Open University of Japan has made collaborative agreements with 11 universities worldwide for collaborative course material development, joint research, dual degree and exchange programmes (The Open University of Japan, 2016). Inter-institutional collaboration is therefore one of the effective means to facilitate long-term development of ODL providers in Asia.

Conclusion

The profiling of ODL institutions shows how this education mode is being put into practice to cope with the specific context of each country/region in this continent. The unique features of ODL allow learners who can hardly be accessed using face-to-face learning modes to obtain opportunities for education. Despite the growing popularity of online courses being offered by conventional education institutions, ODL remains irreplaceable as shown in the massive number of students enrolled in the ODL institutions across Asia in this study.

It is envisaged that ODL can flourish further by capitalising on its strengths and opportunities. In particular, (1) there will be many more potential students available as the online population continues to grow, especially in developing countries; (2) advances in educational technologies will allow learning and teaching to be conducted in more effective ways; (3) more quality open educational resources are available from the OER (open educational resources) movement; (4) government support is expected from cooperating with governmental bodies to implement their policies in education; and (5) collaboration among ODL institutions could be promoted to facilitate learner mobility and strengthen transnational qualifications.

[9] http://www.icde.org/

[10] http://www.stou.ac.th/ou5/

Those are ways emphasised by the Commonwealth of Learning (2015) for ODL to support a sustainable future.

Acknowledgement The work described in this paper was partially supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (UGC/IDS16/15).

References

AAOU. (n.d.). *About Asian Association of Open Universities*. Retrieved from http://aaou.ouhk.edu.hk/

APCICT. (2014). *Open and distance learning in Asia and the Pacific*. United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development. Retrieved from http://www.unapcict.org/ecohub/apcict-case-study-series-open-and-distance-learning-odl

Asia eUniversity. (2016). *Why AeU*. Retrieved from http://www.aeu.edu.my/future-students/why-aeu

Central Intelligence Agency. (n.d.). *The world Factbook*. Retrieved from https://www.cia.gov/library/publications/the-world-factbook/rankorder/2103rank.html

Commonwealth of Learning. (2015). *How online, open and flexible support learning will support a sustainable future – a call for action*. Retrieved from https://www.col.org/news/items/how-online-open-and-flexible-support-learning-will-support-sustainable-future-call-action

Darojat, O., Nilson, M., & Kaufman, D. (2015). Quality assurance in Asian open and distance learning: Policies and implementation. *Journal of Learning for Development*, *2*(2). Retrieved from http://www.jl4d.org/index.php/ejl4d/article/view/105/96

Gerland, P., Raftery, A. E., Ševčíková, H., Li, N., Gu, D., Spoorenberg, T., et al. (2014). World population stabilization unlikely this century. *Science, 346*, 234–237.

International Telecommunication Union. (2015). *ICT facts & figures*. Retrieved from http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2015.pdf

Li, Z. C. (2009). Developing higher education in rural villages, practicing the scheme of 'one village one college student'. *Chengren Jiaoyu, 2*, 64–65 (In Chinese).

The Open University of Japan. (2016). *International cooperation*. Retrieved from http://www.ouj.ac.jp/eng/cooperation/index.html

Tsui, C., Zhang, W.-Y., Jegede, O., Ng, F., & Kwok, L. (1999). Perception of administrative styles of open and distance learning institutions in Asia: A comparative study. In *Proceedings of the 13th Annual Conference of the Asian Association of Open Universities* (pp. 190–202). Beijing, China.

UNESCO. (2002). *Open and distance learning: Trends, policy and strategy considerations*. Retrieved from http://unesdoc.unesco.org/images/0012/001284/128463e.pdf

UNESCO Institute for Statistics. (2014). *Higher education in Asia: Expanding out, expanding up*. Retrieved from http://www.uis.unesco.org/Library/Documents/higher-education-asia-graduate-university-research-2014-en.pdf

United Nations. (2015). *World population prospects: The 2015 revision*. Retrieved from https://esa.un.org/unpd/wpp/Publications/Files/Key_Findings_WPP_2015.pdf

Wu, Q. D. (2004). Wu, Qi-di: To cultivate retainable and potential talents for rural areas. *China Education and Research Network*. Retrieved from http://www.edu.cn/20040220/3099390.shtml (In Chinese)

Chapter 7
Embedding MOOCs in Academic Programmes as a Part of Curriculum Transformation: A Pilot Case Study

Sarah Lambert and Irit Alony

Abstract The University of Wollongong's first locally developed and hosted massive open online course (MOOC) *The Reluctant Mathematician* was a highly scaffolded MOOC designed to support stressed and low-efficacy mathematics learners. It was developed to raise maths skills at our university and also in the community – where such skills continue to be a challenge and in some cases a source of stress. Internally, the MOOC provided an alternative online way to support students who struggle with mathematics at university level and as a complement to the existing face-to-face services. This paper describes a successful approach to using MOOCs not only for addressing skills shortage among university students but also to engage staff in the hybrid learning aspects of curriculum transformation. Based on a small-scale pilot, this paper describes the narrative of engagement of academics and highlights the main elements which were conducive to their involvement in selecting and using the MOOC as support for an assignment in their curriculum. A framework is proposed for educators who are interested in using MOOCs for a similar purpose.

Keywords MOOC · Mathematics · STEM · Staff development · Hybrid learning

Introduction

The 'maths skills crisis', which has been on the Australian education policy agenda for some time, has made an impact not only on students but also on tertiary education staff. This skills crisis is characterised by a lowering of maths skills in students and the community and the removal of the maths prerequisites for university entrance.

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_7

As seen in Professions Australia (2008), it is slowly having an effect on mathematics education through a vicious cycle, where fewer and fewer high-school students are willing and able to study advanced or intermediate mathematics, which leads to fewer students enrolling in mathematics classes at universities. This has the unfortunate consequence of reducing the number of mathematics teaching staff in universities and lowering the numbers of enthusiastic, mathematics-qualified teachers in schools (Professions Australia, 2008). The difficult reality for many Australian universities is an increase in the number of students without the requisite mathematics skills to succeed in their studies, not just in mathematics-related disciplines such as chemistry and physics but also in nursing, economics and finance, education, and even engineering courses. The ultimate consequence of this vicious cycle is an insufficient number of workers in a range of critical professions required of a modern economy, due to students' inability to negotiate the required tertiary mathematics courses that form a compulsory part of the training (Professions Australia, 2008).

Numerous staff have been engaged in projects to find solutions to the 'maths skills crisis' over many years at the University of Wollongong (UOW), and the current strategic push for curriculum transformation provides additional motivation and a mandate for change within the framework of a review of entire course curricula.

One of the four themes of the Curriculum Transformation Project is 'technology-enriched', and one of the related five transformational practices that will have a positive effect on the student experience is 'Hybrid learning@UOW'. These approaches align with an extensive body of research on what best delivers engaging student experiences and a relevant lasting impact (Huber & Hutchings, 2004; Kuh, 2008). The reuse of a MOOC as a self-paced resource and activity parallel to the classroom activities represents an early case of the hybrid learning and technology-enriched approaches being undertaken and evaluated.

This approach draws on student-centred online instructional scaffolding, inspired by MOOC video lessons and quizzes. It does not focus on merely delivering content online, but rather scaffolds the skills that students need to acquire and uses online tools to ensure this gradual acquisition. The results of this approach have demonstrated benefits not only to student performance, skills enhancement, self-efficacy, and anxiety issues but also to the engagement of teaching staff across disciplines. The original module was developed to address the shortage in generic mathematics skills, but staff are now seeking similar educational programmes to support discipline-specific mathematics applications as well as gaps in students' chemistry skills.

The paper is organised as follows. First, a description of the original MOOC and its design are provided, to understand the general context of the engagement. Then, the reuse of the MOOC and the main elements that promote the engagement of academics are summarised, based on interviews with them. The MOOC elements

conducive for reuse are summarised and discussed. Next, future directions for action are proposed. The paper concludes by suggesting a framework for educators who are interested in using MOOCs for a similar purpose.

Original MOOC: *The Reluctant Mathematician*

Massive online open courses (or MOOCs) have displayed explosive growth over the last few years, with increased numbers of students, courses, platforms (such as edX, Coursera, Udacity, FutureLearn, and OpenLearning), and staff involved (Pappano, 2012). Being offered by prestige universities, such as Stanford, MIT, and Berkeley, being accessible to anyone with an Internet connection, and being more affordable than many other higher education options make them an attractive way to learn about various topics (Delbanco, 2013). MOOCs have also been viewed by some as a threat to conventional higher education institutions and programmes (Campbell, 2013; Delbanco, 2013; N. L., 2013).

However, disruptive technologies also have the potential to spur innovation within existing members of the sector (Conole, 2007). It may be possible for universities to embrace the MOOC phenomenon to advance their own educational practices. The suggested benefits to universities resulting from offering MOOCs typically refer to an academic training ground for students (Campbell, 2013), the ability to convert free students to paying students (Campbell, 2013), and/or a source of revenue resulting from online students paying for accreditation (Valentin, Nafukho, Valentin Jr., Johnson, & LeCount, 2014).

This paper, however, identifies and describes another benefit from the uptake of MOOCs by conventional universities. Following the principles of open learning, which supports the reuse and repurposing of educational resources, this article presents an example of benefits to internal students, as well as to staff engagement, as a result of repurposing a MOOC designed for the general public. In the case described here, teaching staff became interested and inspired to reuse and repurpose an existing MOOC originally designed to address the shortage of mathematics skills and/or an aversion to learning and using them identified in on-campus students in their own disciplines. Such expressions of interest from teaching staff in accounting, engineering, and natural sciences suggest wider potential for the reuse of MOOCs within other curricula.

MOOC Design

Addressing the mathematics skills shortage identified in the local community, the University of Wollongong (UOW) developed and hosted a reusable massive open online course (MOOC) 'The Reluctant Mathematician', which was run in the last 4 weeks of the summer holiday, prior to the autumn session, in 2014.

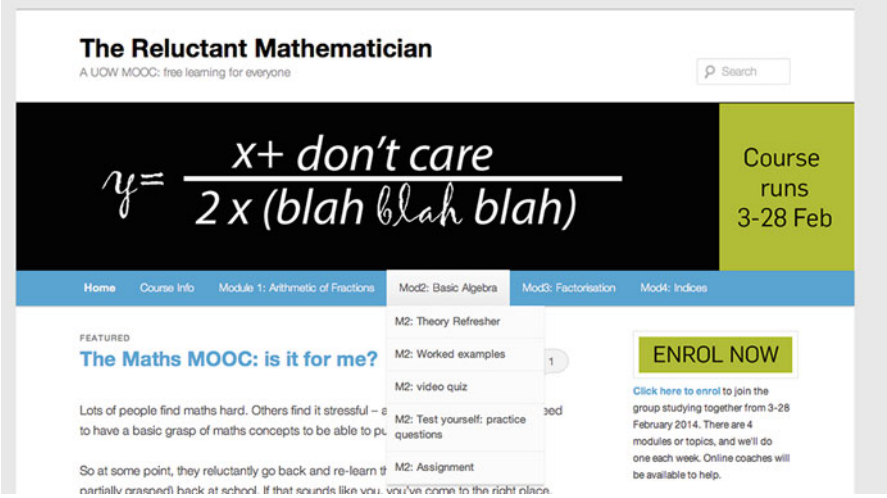

Fig. 7.1 A screenshot from the MOOC homepage showing the scaffolded learning sequence is accessed via a pull-down menu

Out of 11 mathematics topics included in a pre-existing preuniversity summer programme, 4 were selected by staff of the School of Mathematics and Applied Statistics as the ones most widely applicable to university and community use. The four topics selected were fractions, basic algebra, factorisation, and indices. Each topic had a pull-down menu which guides students through a scaffolded learning sequence, including a set of activities of increasing difficulty (see Fig. 7.1).

An existing openly licensed collection of video resources was reused, starting with a 'theory refresher' videos, including a recapping of key terms, and moving to short video lessons featuring a mathematician working out problems at a whiteboard. A new set of video resources was created, blending quiz technology with a video lesson, enabling us to provide a midway step between the passive video lectures and a difficult assignment: a set of 50 maths problems.

There was a final optional assignment task, asking the students to make their own video lesson, inspired by some recent advances in research in maths education (Hoban, Nielsen, & Carceller, 2010). The student learning outcomes from the first iteration of this project have been reported, and more detail on the design of the MOOC can be found there (Lambert, 2015).

The learning sequence shows scaffolding in action, with the first item being a teacher demonstrating mathematics and the last item a student practising mathematics, and there is a gradual reduction in support by the teacher of the course of the sequence, such that the students get used to doing aspects of the maths on their own until they can complete it all.

New Element: Video-Embedded Quiz

For effective outcomes, online learning experiences must engage the students (Greenagel, 2002). In order to do so, in activities based on their specific skills deficiencies, we developed a series of three or four video-embedded quizzes for each of the four topics. These quizzes allowed for a greater degree of scaffolding and formative feedback than a standard quiz, as follows: the videos demonstrated the worked solutions to various maths problems, but stopped at three or four places in the solution sequence, and asked the students to answer a quiz on the particular step in that problem. After the submission of a quiz question, the students received feedback as to whether their answers were correct, and then the video would continue and demonstrate the correct method of thinking and working out that step, before moving on to the next aspect of the solution item. Each video included around three or four quiz 'stop points'. In this way, the student could test their understanding by completing a quiz question before the video continued. The videos were rated highly by the students in the online form used to collect feedback on students' satisfaction with the MOOC resources.

Reusing the MOOC

After running the original MOOC successfully, as was evident in students' responses and performance (Lambert, 2015), the UOW staff were contacted by a university-wide email – entitled: 'Do your students need maths skills to succeed?' – 2 weeks prior to the start of the session. All the respondents were invited to a meeting to discuss the potential next steps in the evolution of the MOOC to meet stated shortfalls of skills within various classrooms of various different disciplines. Subsequent to interviewing the staff, one programme was selected within the Faculty of Engineering, with several subjects relying on the maths skills addressed by the MOOC. A single subject *Workplace Health and Safety* was selected for initial reuse within a new master's level subject. Based on multiple discussions with the academics involved, the following elements were highlighted as being conducive for this reuse, as follows.

- The learning experience was scaffolded. Rather than a teacher-led experience, the MOOC provided a student-paced environment for individual learning and practice.
- The MOOC's content was modular, allowing the teaching staff to select only relevant modules. This therefore did not burden students with irrelevant tasks.
- The content covered by students was flexible and self-determined. The modular structure of the MOOC enabled students to only engage in learning pathways relevant to them.

- The content was delivered outside of class time and so did not compromise the existing subject structure.
- The MOOC applied to a wide range of skill level. Thus, academic did not need to match students to resources, but rather the MOOC enabled students to improve the skill at the level relevant to them.
- The MOOC addressed learning-related stress and anxiety by providing a private self-paced experience. Students' practice and learning are conducted privately, with no risks of being judged, shamed, or mocked.
- The MOOC's delivery was customisable: a subject-related banner and introductory video addressing the specific subject-related cohort were offered to subject coordinators (see Fig. 7.2).

In addition to the uptake in the *Workplace Health and Safety* master's level programme, there were expressions of interest in customising this MOOC for chemistry students.

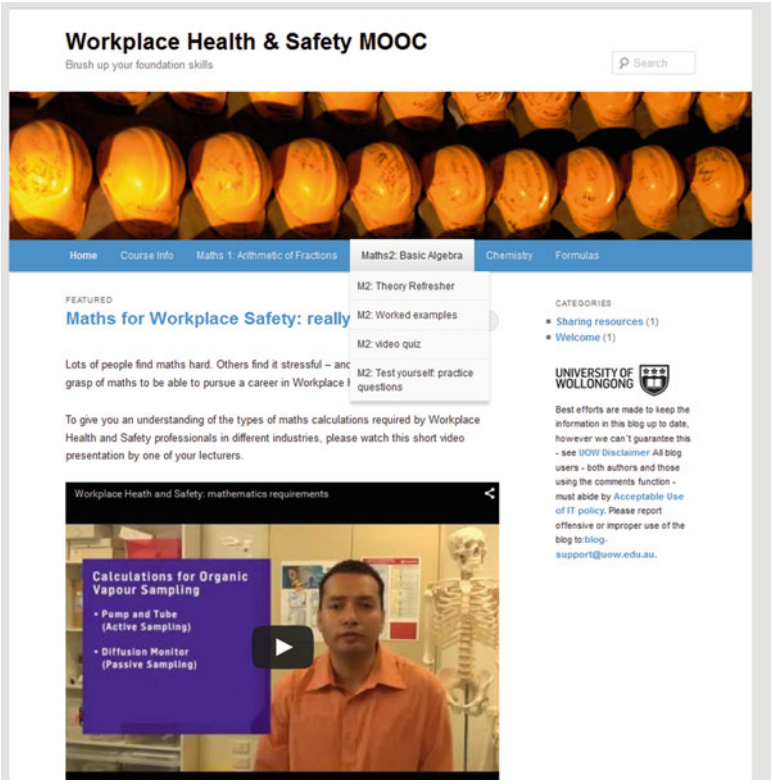

Fig. 7.2 Reused MOOC homepage showing pull-down menu navigation to the items in the learning sequence and a customised welcome video featuring the subject coordinator

Proposed Framework to Guide MOOC Reuse

We have summarised the themes that emerged in interviews with the academics involved in this project to develop a proposed framework to guide MOOC reuse in the curriculum, by focusing on key success elements of this reuse which are applicable to both teaching staff and students, as follows.

Teaching Staff

- *Addressing a pressing need*: The need to improve students' maths skills was identified in a consultation process with academics closely involved in existing attempts to address this need. The School of Mathematics and Applied Statistics has been focusing on this in many other ways over the years, and their familiarity with the needs was essential to the selection of the content.
- *Low time demands*: As most of the content was already prepared and relevant to the teaching staff's needs, they were not required to devote much time to the customisation or implementation of the components. Minimal customisation (a banner and a welcome video) was sufficient for the initial launch of the components, and future customisation of question forms to integrate subject-related content (e.g. calculating the levels of permitted gas levels as part of the fractions module) was possible, and staff from the Learning, Teaching, and Curriculum area were able to advise on digital resource development methods that were suitable for staff in the Faculty to do this on their own. While that involved the purchase of a licence for the software Camtasia and a graphics tablet (to allow handwritten inputs), the costs were under AU$500, and the time required to create their own workplace-safety-based maths calculation video samples was rated as achievable by the staff, to be done a few at a time over a period.

Students

- *User control*: The teaching staff were impressed by the degree of control and self-direction available to students. It was evident that the MOOC provides students with the option of selecting their own content areas and skill levels to be taught and demonstrated. Indeed, Web usage data show that these features were taken advantage of by most students (Lambert, forthcoming). Many students first attempted the concluding assignment, before undertaking the full learning sequence, and then selected the content relevant to them.

- *Scaffolded learning experience*: The teaching staff believed that a scaffolded approach would be effective for addressing students' skills deficiencies.
- *A safe and tailored learning environment:* The teachers believed that providing students with a private, as well as responsive, learning experience would address their specific skills deficiencies in a discrete, nonintimidating, and stress-reduced environment.

Future Research

Examining the effectiveness of the reused modules is the next step. We intend to undertake a pre–post study, evaluating the effect and benefits of these modules on the following:

- Attitudes and perceptions (anxiety and confidence, expectations of future usage, and expectations and prospects of future learning)
- Performance in mathematics (quiz marks), controlling for the following factors:
  - Online usage
  - Perceptions of usefulness

In addition, the university will be engaging more academics in this and other MOOCs, as a result of its current success. This will provide further confirmation and refinement of the proposed framework for reuse, as well as establishing the value of MOOCs as aspects of the hybrid learning and/or technology-enhanced learning approach to curriculum transformation.

Furthermore, there is interest in developing a similar MOOC for essay-writing skills, as this is another pressing need identified across many teaching disciplines in the university.

Conclusion

The quality and performance of MOOCs worldwide has set a high standard for modern distance education in general and online education in particular. The case study presented here shows how meeting these standards by academic institutions when they address the wider community can produce reusable resources for the benefit of enrolled students. The case described staff engagement with MOOCs for the purpose of solving particular local problems (mathematics skills) during a university-wide curriculum transformation process. Reusing MOOC elements

within an existing subject served as a useful and informative pilot for curriculum transformation, with regard to two major aspects: hybrid learning and technology-enriched learning.

In addition, the paper suggested a design framework which is conducive to reuse and highlights both teacher-related and student-related aspects in the design. The teacher-related aspects involve addressing a pressing need across a wide range of students, modular content, and customisable delivery presentation. The student-related aspects involve student control over content and pace, a scaffolded learning experience, and a learning experience which is at the same time both tailored to individual needs and safety, thus reducing anxiety and stress. Further examination of this framework, measuring pre- and post-MOOC usage levels of student performance, anxiety, and stress, will inform the framework's generalisability.

References

Campbell, A. (2013). *What threats and benefits do free online mathematics courses pose to traditional universities?* Paper presented at the proceedings of the 19th annual congress of the Association for Mathematics Education of South Africa. Cape Town.

Conole, G. (2007). An international comparison of the relationship between policy and practice in e-learning. In *Handbook of e-learning research* (pp. 286–310). London: Sage Publications.

Delbanco, A. (2013). *MOOCs of hazard: Will online education dampen the college experience? Yes: Will it be worth it? Well*. Retrieved from https://newrepublic.com/article/112731/moocs-will-online-education-ruin-university-experience05/05/2015

Greenagel, F. L. (2002). *The illusion of e-learning: Why we are missing out on the promise of technology. League White Papers*.

Hoban, G., Nielsen, W., & Carceller, C. (2010). Articulating constructionism: Learning science through designing and making 'Slowmations' (Student-generated animations). In C. H. Steel, M. J. Keppell, P. Gerbic, & S. Housego (Eds.), *Curriculum, technology & transformation for an unknown future* (pp. 433–443). Brisbane, Australia: University of Queensland.

Huber, M. T., & Hutchings, P. (2004). *Integrative learning: Mapping the terrain. The academy in transition*. Washington, DC: Association of American Colleges and Universities.

Kuh, G. D. (2008). *Excerpt from high-impact educational practices: What they are, who has access to them, and why they matter*. Washington, DC: Association of American Colleges and Universities.

Lambert, S. (2015). Reluctant mathematician: Skills-based MOOC scaffolds wide range of learners. *Journal of Interactive Media in Education, 1*, 1–11.

N. L. (2013). *The Economist explains: Will MOOCs kill university degrees?*. Retrieved from http://www.economist.com/blogs/economist-explains/2013/10/economist-explains

Pappano, L. (2012). *The year of the MOOC*. Retrieved from http://www.nytimes.com/2012/11/04/education/edlife/massive-open-online-courses-are-multiplying-at-a-rapid-pace.html?_r=0

Professions Australia. (2008). *Higher education policy: Delivering Australia's future professional workforce requirements*. Professions Australia.

Valentin, M. A., Nafukho, F., Valentin Jr, C., Johnson, D. D., & LeCount, J. (2014). *Return on investment: Contrary to popular belief, MOOC's are not free.* Paper presented at the 14th international conference on HRD theory and practice across Europe. Manchester, UK.

Part II
Mobile and Ubiquitous Learning

Chapter 8
Using Mobile and Flexible Technologies to Enhance Workplace Learning in Vocational Education and Training (VET)

Ricky Yuk Kwan Ng and Rechell Yee Shun Lam

Abstract This paper discusses the possibilities of using mobile and flexible technologies to enhance workplace learning in vocational education and training (VET). It also proposes a number of innovative pedagogical practices enabled by technologies to facilitate better learning and teaching experiences for VET students and mentors in workplaces. While mobile and flexible technologies emphasise self-paced online and virtual learning experiences, VET stresses the mastery of hands-on skills and practices in authentic workplaces. The findings of this study show that, despite the need for innovative pedagogical practices, an increase in the effectiveness of mobile and flexible technologies relies on the instructional design of the trade-specific learning and teaching materials, as well as the readiness of students, teachers and workplace mentors.

Keywords Mobile and flexible technologies · Workplace learning · Vocational education and training

Introduction

Half a century ago, McLuhan (1964) advocated that 'the medium is the message' and asserted that any new technological invention is an extension of ourselves and contributes to changes in human interaction. For McLuhan, changes are multidimensional, addressing technological, societal and cultural aspects. In this vein, the rapid advances in information communication technology and the popularity of mobile devices (e.g. smartphones, iPads and tablets) and flexible technologies (e.g. Wi-Fi, online and web-based networking) ease access to information. These advances have sparked a phenomenon of technology hype and massive information exchanges. Robertson (2007) contends that there is a 'convergence of technologies into the single units and a shift from fixed to wireless and mobile

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_8

systems' (p. 11). Rather than using station and laptop computers, there is an increasing preference for retrieving information by using mobile devices. Nowadays, mobility and flexibility are the priorities for technology consumers, especially the young generation. This development not only has an impact on technology and entertainment consumption but also implies that students may prefer using mobile and flexible technologies for learning. Therefore, it is not surprising that higher educational institutions have been experimenting with mobile and flexible technologies to enable students' self-paced online learning for academic subjects. Although promising results have been found in a number of studies (Jenkins, Klopfer, Squire, & Tan, 2003; Lee, Lam, & Liu, 2014; Tang, Pang, & Wong, 2014; Tsang, Yuen, & Cheung, 2014), while mobile and flexible technologies emphasise self-paced online and virtual learning experiences, vocational education and training (VET) stresses mastery of hands-on skills and practices in authentic workplaces. How could these two learning paradigms complement each other and benefit VET?

Current Issues in Vocational Education and Training (VET)

A Global Perspective

The global VET sector has undergone rapid changes in the past decade. The findings from the report *Global Trends in Vocational Education and Training* (Dandolopartners, 2011) showed that an increasing number of people are enrolling in vocational education at an earlier age or after years of work. This report found that, in the United Kingdom, the total number of vocational qualifications awarded increased by 11% from 2006 to 2009, mostly acquired by students who took vocational subjects at school (BBC News, 2009). The number of school students aged 15–19 who participated in Australian vocational education and training also increased by nearly 30% from 167,100 in 2006 to 216,700 in 2009 (NCVER, 2011). In Asia, Singapore, for instance, quadrupled its annual capacity in continuing education and training from 22,000 workers in 2007 to 80,000 in 2010 (Ministry of Manpower, Singapore Government, 2010). Also, to enhance the work readiness of its young people, China has introduced a 'dual certification' system that provides students with an academic diploma and a vocational work permit upon graduation from secondary vocational education schools (Australian Education International, 2010). VET aims to develop skills that help to engage people in useful endeavours and, at the same time, address the operational needs of society. VET also recognises that people have different talents – some geared more towards academic study and others towards hands-on dexterities – and offers them an education that suits their attributes. The above examples signify a growing anticipation of the possible contribution of VET to a number of societal and economic issues – such as the higher unemployment rate of youth, the large number of conventional school failures every year who are frustrated about where to go in employment or education and the shortage of suitably skilled human resources in various service and industry sectors

of society. To cater better for the increasing demand and diversification of trade-specific subjects in VET, governments and VET institutions in various countries have started to make significant efforts to enhance VET's positioning, curriculum design and delivery and learning and teaching strategies, as well as industrial and community collaboration.

The Hong Kong Experience

VET has received more attention in Hong Kong in recent years, due to a few significant factors. Firstly, VET is considered to be an alternative study pathway which benefits students who have achieved less academically. Secondly, there is a growing demand for skilled labour in some industries, especially for those manufacturing and production lines which have returned from mainland China. Thirdly, the Hong Kong SAR Government aims to produce graduates with knowledge and skills which match the labour qualities demanded by various industries. There are signs that the Government has started to step up the emphasis on VET. To enhance the image and quality of vocational education, the Government had set up a Task Force on Vocational Education to devise strategies for promoting it in the community. The year 2014 was particularly important for VET in Hong Kong, as a substantial portion of the 2014 Chief Executive's Policy Address was devoted to VET, in which the Chief Executive stated that 'mainstream education is not a straightjacket that fits all young people as everyone has his or her own interests and abilities. The Government should re-establish the positioning of vocational education in our education system and guide the younger generation in choosing their career' (Hong Kong SAR Policy Address, 2014, p. 102). He went on to announce a series of measures to strengthen VET and support its development alongside academic education. In particular, a pilot training and support scheme – 'The New Earn and Learn Pilot Scheme' achieved by 'integrating structured apprenticeship training programmes with clear career progression pathways' – was proposed to attract and retain talent for industries with a keen demand for labour (Hong Kong SAR Policy Address, 2014, p. 106). The 'New Earn and Learn Pilot Scheme' is an initiative that combines vocational education and on-the-job training with promising progression pathways to attract learners for a range of trade-specific industries. An allowance and a guaranteed salary will be given to the learners by the Government and participating industries to guarantee the learners a steady income while equipping themselves with knowledge and skills to pursue prosperous careers. Learners will study in the VET training programmes and be engaged in on-the-job training at the companies which employ them. Because of the academic qualification and recognition, graduates of the schemes are also eligible for further studies to obtain higher academic qualifications for pursuing their career development. This new Scheme was subsequently endorsed by the Legislative Council. During their study in the Scheme, students receive theoretical knowledge and practice in simulated work environments in school, while the learning and practices

of 'authentic' trade-specific and generic competences – such as communication, teamwork, problem-solving, transferability and work ethics – take place in real-life workplaces (Deissinger, 1997; Tremblay & Le Bot, 2003; van Merriënboer, 2001). For the above reasons, VET in Hong Kong has developed a heavy emphasis of workshop learning and industrial attachment. The salient issue is then the development of appropriate pedagogical approaches that enable the workplaces, in the settings of Hong Kong, to be used as authentic learning environments.

Workplace Learning and Situated Learning

Rauner and Maclean (2008) assert that 'vocational education and training is characterised by the crucial importance of learning in the work process as a dimension of intentional and informal competence development' (p. 15). Workplace learning is an important characteristic of VET as it provides 'a fertile opportunity for learners to appropriate knowledge that connects theory to practice in a realistic and efficient way' (cited in Smith, 2003, p. 53). Workplace learning is a manifestation of Lave and Wenger's (1991) view of learning as 'situated activity' (p. 29). In these authors' view, learning is a social process in which learners participate in the lived-in world and understand the world as they experience it. During workplace learning, students experience the real, factual consequences of their actions and the ultimate aim is 'learning transfer': students internalise the theories and skills and then export them to the field of enterprises and connect their learning experiences so that an earlier learning process can enhance a later one in a positive way (Bank, 2013). Research has shown that most VET learners prefer to learn in groups and from mentors in workplaces rather than learning on their own. A collegial context for learning is the essence of workplace learning where learners learn in social environments assisted by peers and instructors (Sangster, Maclaran, & Marshall, 2000; Smith, 2006). It is asserted that applying theories into practices through a competency-based training (CBT) approach in authentic work environment is exceptionally important in VET. However, given that many of the workplace mentors are trade specialists and do not have formal academic training, students' learning of subject theories in the workplace may not be provided. Instead of training, very often students spend most of their time doing practical and production work without a solid knowledge and theoretical background, and so the learning outcomes may not be achieved and students may not benefit as much as is desired from their workplace learning (Evans, 2001; Smith, 2003, 2006; Stehlik, 2003). Furthermore, as there are increasing changes in VET's programmes and delivery modes in Hong Kong and the scope of the new VET disciplines is being increased, it is necessary to review and propose innovative pedagogical strategies for VET in order to cope with the needs of students, mentors, institutions and industries in the workplaces.

Applying Mobile and Flexible Technologies to Enhance VET Workplace Learning

In addition to learning management platforms (e.g. Moodle, Blackboard), technology-enhanced learning (TEL) – such as MOOC, flipped classroom and lecture capture, particularly enabled by mobile and flexible technologies – has become the common means to facilitate learning and teaching in education. These kinds of technologies provide 'just-in-time contemporary learning and can be accessed from any site' (Choy, 2006, p. 2). Other than supplementary activities, TEL, when combined with flexible delivery and situated workplace learning, promotes students' cognitive and transferable skills, including problem-solving, analysis, reflection and learning to learn. Studies have found that mobile and flexible learning best connects theories and practices to enrich workplace learning experiences in VET (Liu, Han, & Li, 2010; Smith, 2003, 2006; Stehlik, 2003). As early as 2000, Mitchell observed the emerging of a network-based model of workplace training and realised that there is an increasing use of flexible learning methods involving technology-mediated forms of delivery. Liu et al. (2010) point out that 'mobile learning is increasingly used in workplaces, museums, schools, enabling a wide spectrum of possibilities' (p. 210). For instance, if students are to spend much of their time in the workplace, having a certain number of learning sessions that do not require them to go back to school, allowing them to be in different workplaces to co-learn together at the same time slot becomes desirable. Billett (cited in Smith, 2003) suggested the development of learning strategies based on students' everyday practice and human interactions in connection with mentoring, direct instruction, observation and listening, other workers and the work environment, subsequently found that 'everyday practice and engagement with authentic activities were consistently viewed as more effective than print-based instructional materials' (p. 53). Effective pedagogies that take advantage of mobile and flexible technologies need to be introduced to facilitate better quality workplace learning.

Taking this opportunity to promote better learning in different trade disciplines (i.e. nursing, catering, language) in diverse workplaces, a number of studies have been carried out on the effectiveness of using mobile technologies (Tsang et al., 2014), social media and instant messaging (Ng & Leung, 2014), and real-time augmented reality (Lee et al., 2014; Tang et al., 2014). These studies have been conducted by Hong Kong academics to enhance students' motivation, learning interest and collaborative learning, as well as their cognitive, psychomotor and communication skills, with promising results. Such kinds of flexible, mobile, web-based and blended learning tools would allow VET students to review recorded lectures or participate in live-broadcasting learning sessions (i.e. lectures and seminars in schools or conferences) and share their views collaboratively in their own workplaces. It is believed that an appropriate technology-enhanced pedagogical approach utilising mobile and flexible technologies would promote learning and teaching in workplaces and generate mutual benefits for workplace mentors and

students. Interestingly, Liu et al. (2010) found that, although students are enthusiastic about using mobile devices, flexible technologies and all sorts of online activities, they regarded themselves as technology users and consumers rather than learners. Similarly, Robertson (2007) found that students prefer using mobile devices and flexible technologies for entertainment, acquiring information and communicating with others, but they seldom use them for educational purposes. Given that mobile and flexible learning provides learners with a large degree of learning autonomy, it requires learners to have a higher degree of self-directness, self-management, persistence and independence. Teachers have also expressed the view that they are more likely to use technologies in teaching practices if they are user-friendly and compatible with their existing practices and teaching needs (Errington, 2001, 2004; John, 2002, 2005; Robertson, 2005a, 2005b, cited in Robertson, 2007). Also, while mobile and flexible technologies are well adapted for higher educational institutions' academic subjects and theory classes, their applicability for VET's trade-specific subjects is still in question because generally teachers and mentors consider that there is no substitution for practical and hands-on lessons, such as mechanical engineering and printing. Therefore, the consideration of what should be taught in schools and workplaces, and what should be covered by mobile and flexible technologies, is crucial. It is assumed that mixed modes or blended learning delivery with appropriate instructional design enabled by mobile and flexible technologies could be the solution. In sum, the application of TEL in VET is a dichotomy with a number of problematic issues yet to be resolved.

Proposed Strategies for Technology-Enhanced Learning

TEL in different forms is being adopted as supplementary and complementary learning activities to better support VET students with records of performance and timely feedback. Learning and teaching resources in the forms of video, augmented reality/virtual reality (AR/VR) and instant messaging have been developed for students and teachers' ease of access. The major direction in developing the learning and teaching resources is on the resources' mobility and flexibility.

Video Capture System, MOOC and Wearable Technology

To cope with VET's increasingly flexible delivery mode, a video capture system provides opportunities for students to review lectures in workplaces or after work at their own pace. Employing the concept of 'Bring Your Own Device' (BYOD), it is recommended that students bring in their own mobile and hand-held devices such as smartphones and iPads to access the learning materials. An example to illustrate mobile learning in the workplace would be that, as there are hundreds of recipes in culinary studies, students may have difficulty in memorising the exact ingredients

for particular dishes. In such a case, with the use of mobile devices, they can retrieve recipes or short video clips of demonstrations for immediate reference without flipping through cookbooks or print-based materials that are not convenient to carry around in the kitchen. The merits of mobile learning in workplaces are subject to having a well-planned curriculum, with instructional design, together with teachers' and mentors' facilitation skills. For instance, students who engage in learning in workplaces which are not normally equipped with computer facilities – such as kitchens and flight cabins – can use their own mobile devices to retrieve recorded lectures or watch live broadcasting of prescheduled lectures and seminars simultaneously in different work locations without the restriction of viewing them in classroom settings. Together with the group chat and instant messaging functions, students can conduct real-time questions and answers with their teachers and peers. Taking advantage of these mobile technologies and apps, teachers can further generate discussions on particular issues raised from the lectures, followed by group or individual tutorials.

Similar learning and teaching activities can be applied on MOOC to promote workplace learning. The key issues for MOOC rest on the contents, instructional design and online assessment. Despite well-developed learning and teaching resources, the readiness of VET students is another matter because VET stresses trade-specific skills, and currently most MOOC topics are related to theories and humanities. In addition, the attention span and self-learning skills of VET students are usually shorter than those of students studying academic subjects. Therefore, mini-MOOCs with short videos were developed and pilot-tested to cater for VET students' learning preferences and acceptance by the teachers and mentors. The results showed that mini-MOOCs are best aligned with the concept of a 'flipped classroom' to enable pre-class theory study. Similarly, wearable technology, such as Google Glass and GoPro camera, allows workplace mentors to record or conduct live broadcasting of their demonstrations of specific trade skills for students' instant viewing or playback. For example, with strapped-on wearable recording devices, mentors in hair salons can videorecord the procedures, processes and skills during washing, cutting or perming on hair models or even real clients from the hairdresser's viewing angle. Despite the different locations of students, they can watch the mentors' demonstration projected on a screen together or on their mobile devices. It is also helpful for the students to review the demonstrations step by step from the recorded videos for a better understanding of the procedures at an available time. The demonstrations from real-life work tasks also apply to other trade-specific disciplines (e.g. mechanical engineering, printing, hospitality and servicing industries).

Augmented Reality/Virtual Reality (AR/VR)

Augmented reality and virtual reality (AR/VR) learning would arouse students' interest, according to their learning preferences. AR integrates digital information

in the existing environment and allows animation to tie in with the real world. AR provides learning experiences in immersive environments for a live direct or indirect view to generate physical, real-world experiences augmented by sound, videos, graphics or animation. VR uses virtual or simulated environments produced by computer to enable students' presence in the virtual environments. In VR environments, students can feel the sensory experiences that may involve taste, sight, smell, sound and touch, as well as use equipment to practise tasks. It is much easier to change the virtual environments than having different physical venues and scenarios; and it gives the student a faster knowledge transfer because AR/VR allows repeated practices for a large number of students simultaneously in a virtual environment before practice in real-life locations. An example of using AR/VR in the VET context is the AR/VR retail laboratory on one of the VTC campuses. The retail laboratory is equipped with a changeable non-immersive VR environment (projected on one side of the wall) to cater for different contexts and scenarios for students' practice on the operation of a supermarket or a retail store. AR technology is also applied to the real goods and commodities on display on the shelves; and, using mobile devices, students can learn about the origins, history, characteristics, ingredients and details of the goods and commodities in the form of three-dimensional (3D) animation and graphics. Another AR/VR) training facility for practical training in electrical and mechanical services provides students with immersive simulated VR environments (projected on the whole room from wall to wall and floor to ceiling) that simulate real-life locations. This facility is now equipped with a simulated 3D engine plant room with the scenario of safety enhancement as the context tailored for training on safety procedures. Based on the experience of the pilot tests, a series of learning resources on arboriculture, aircraft and lift maintenance and engineering and automotive engineering will be developed to enrich students' learning experiences. AR/VR suits the purpose for learning and practising trade-specific methodical skills in safe simulated virtual workplace environments.

In a nutshell, content development for mobile and flexible learning requires three types of specialists: a programmer, an instructional designer and a trade-specific expert. In addition, to effectively implement mobile blended learning or AR/VR learning in workplaces, collaboration between lecturers and workplace mentors is also essential. There is a need for them to negotiate the distribution of teaching and mentoring workloads and plan thoroughly on who, when, how and what to do to facilitate lessons in workplaces.

Implications and Conclusion

Learning and teaching with new technologies raise a number of issues and implications that need to be examined. The first issue concerns investment. The investment in hardware and software is high, with most of the expenses being spent on the upgrading and maintenance of equipment and newer versions of software. The first-generation iPad is now regarded as a dinosaur when compared to the latest iPad mini

or iPad Air, and smartphones are constantly upgraded with advanced technologies. Secondly, with the rapid changes in trade skills, the contents of VET learning resources have to be renewed to meet industry standards. Thirdly, there is a shortage of professionals for content development (e.g. programmers, instructional designers and animators), as well as teachers and mentors in specific subjects and trades. Fourthly, the acceptance, willingness, readiness and mindset change of teachers, workplace mentors and students are hurdles to using mobile and flexible technologies for learning. Teachers and workplace mentors may find the new technologies inapplicable to VET because of its heavy emphasis on hands-on skills. For example, a teacher once asked the authors how students could practise a simple task like tightening and loosening nuts and bolts on a simulator. In real life, you need to use a certain degree of strength to tighten and loosen nuts and bolts, but, with today's technology, you may not be able to achieve it unless you invest a fortune to develop the hardware and software. Another teacher said that people only live once – you will not hurt in simulated environments if you make mistakes but will surely be injured in real life. In addition, to implement mobile and flexible learning, teachers and mentors need a closer work relationship and better instructional design; but, in reality, the collaboration between them is very limited. Very often, workplace mentors learned from doing their jobs and are not likely to have received formal training in mentoring skills, learning and teaching pedagogies and the principles of assessment. A noteworthy point, derived from the students' perspective, suggested that, although students are followers of technologies, they may prefer not to use their mobile devices for learning as most of them are technology users and consumers rather than learners. Moreover, as indicated by earlier studies, VET students prefer working in groups rather than self-learning and so need a lot of guidance and supervision from workplace mentors. Therefore, the distribution of blended learning activities between schools and workplaces is another issue to be examined. The authors of this paper suggest that the application of mobile and flexible learning in workplaces should not be a substitution for real-life practices. On the contrary, it should be regarded as a supplementary or complementary activity. Last but not least, effective mobile and flexible learning depends largely on the instructional design of the learning materials and the support from workplace mentors to raise students' motivation and sustain their engagement so as to enrich their learning experiences.

This paper has provided views for further study on the effectiveness of using mobile and flexible technologies to enhance learning in VET. Future studies may focus on the motivation, acceptance and readiness of the key players: teachers, workplace mentors and students. The strategies proposed for the development of innovative pedagogies to facilitate mobile and flexible learning in workplaces are yet to be explored and refined. Given the variety of trade-specific modules, it is suggested that the learning resources for core and foundation modules should be developed for the most popular trades – for example, engineering disciplines, culinary and catering services and the hospitality and retailing industries – which can then be easily adapted for enrichment. To conclude, this paper has addressed the increasing need for mobile and flexible learning technologies to be applied in the fast-changing VET sector. The article also discussed the importance of applying new

technologies to enhance students' learning experiences in workplaces. With examples of innovative learning and teaching pedagogies, the paper proposes using mobile and flexible technologies to complement and supplement learning and teaching strategies to enable self-paced learning and practice in hands-on skills in authentic workplaces.

References

Australian Education International. (2010). *Outline of China's national plan for medium and long-term education reform and development (2010–2020).* Beijing.

Bank, V. (2013). *On the essentials of the 'dual system' of vocational and professional education*. Unpublished.

BBC News. (2009). *Vocational exams on the increase*. Retrieved from http://news.bbc.co.uk/2/hi/uk_news/education/8115674.stm

Choy, S. (2006). *Benefits of e-leaning benchmarks: Australian case studies*. Technical report, Australian flexible learning framework, DEST.

Dandolopartners. (2011). *Global trends in vocational education and training*. National Conference of the Australian TAFE Directors Association.

Deissinger, T. (1997). The German dual system – A model for Europe. *Education and Training, 39*(8), 297–302.

Errington, E. (2001). The influence of teacher beliefs on flexible learning innovation in traditional university setting. In F. Lockwood & A. Gooley (Eds.), *Innovation in open and distance learning. Successful development of online and web-based learning* (pp. 27–37). London: Kogan Page Limited.

Errington, E. (2004). The impact of teacher beliefs on flexible learning innovation: Some practices and possibilities for academic developers. *Innovations in Education and Teaching International, 41*(1), 39–47.

Evans, T. D. (2001). Two approaches to workplace flexible delivery and assessment in rural community. *Australian and New Zealand Journal of Vocational Education Research, 9*(2), 1–22.

Hong Kong Special Administration Region. (2014). *The 2014 policy address – Support the needy, let youth flourish, unleash Hong Kong's potential*.

Jenkins, H., Klopfer, E., Squire, K., & Tan, P. (2003). Entering the education arcade. *Computers in Entertainment (CIE), 1*(1), 8.

John, P. (2002). *Teaching and learning with ICT: New technology, new pedagogy? Paper presented at the BERA conference*. University of Exeter, UK.

John, P. (2005). The sacred and the profane: Subject sub-culture, 'pedagogical practice and teachers' perceptions of the classroom uses of ICT. *Educational Review, 57*(4), 469–488.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York: Cambridge University Press.

Lee, C., Lam, S., & Liu, A. (2014). Enhancement of psychomotor skills through flexible learning in nursing education: A quasi-experimental study on respirator donning. In K. S. Yuen & K. C. Li (Eds.), *Emerging modes and approaches in open and flexible education*. Hong Kong: Open University of Hong Kong Press.

Liu, Y., Han, S., & Li, H. (2010). Understanding the factors driving m-learning adoption: A literature review. *Campus-Wide Information System, 27*(4), 210–226.

McLuhan, M. (1964). *Understanding media: The extensions of man*. New York: McGraw Hill.

Ministry of Manpower, Singapore Government. (2010). *Continuing education and training.*

NCVER. (2011). *Australian vocational education and training statistics: Young people in education and training 2010.* Adelaide: NCVER.

Ng, R., & Leung, C. (2014). An empirical study on using web-based social media to build a learning community. In K. S. Yuen & K. C. Li (Eds.), *Emerging modes and approaches in open and flexible education*. Hong Kong, Hong Kong: Open University of Hong Kong Press.

Rauner, F., & Maclean, R. (Eds.). (2008). *Handbook of technical and vocational education and training research*. New York: Springer.

Robertson, I. (2007). Technology-based learning: problematising VET students' preferences and readiness. In *Refereed paper presented at 2007 AVETRA conference* (pp. 11–13). Melbourne, Australia: Victoria University Footscray Park.

Sangster, A., Maclaran, P., & Marshall, S. (2000). Translating theory into practice: Facilitating work-based learning through IT. *Innovations in Education and Training International, 37*, 50–57.

Smith, P. J. (2003). Workplace learning and flexible delivery. *Review of Educational Research, 73* (1), 53–88.

Smith, P. J. (2006). Flexible delivery and apprentice training: Preferences, problems and challenges. *Journal of Vocational Education and Training, 52*(3), 483–503.

Stehlik, T. (2003). Professional development in online learning and flexible delivery in the VET sector–issues for assessment and evaluation. In *ATN evaluations and assessment conference,* Adelaide, South Australia.

Tang, J., Pang, W., & Wong, P. (2014). Enabling a flexible university education through an augmented reality interactive interface. In K. S. Yuen & K. C. Li (Eds.), *Emerging modes and approaches in open and flexible education*. Hong Kong, Hong Kong: Open University of Hong Kong Press.

Tremblay, D. G., & Le Bot, I. (2003). *The German dual apprenticeship system. Analysis of its evolution and present challenges*. Research Note no. 2003-4A. Chaire de Recherche du Canada sur les Enjeux Socio-organisationnels de L'economie du Savior.

Tsang, E., Yuen, K., & Cheung, P. (2014). Effective instructional design for mobile learning. In K. S. Yuen & K. C. Li (Eds.), *Emerging modes and approaches in open and flexible education*. Hong Kong, Hong Kong: Open University of Hong Kong Press.

van Merriënboer, J. J. (2001). ID for competency-based learning: New directions for design, delivery and diagnosis. *Interactive Educational Multimedia, 3*, 12–26.

Chapter 9
Preference and Readiness of Nursing Students for Mobile Learning

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Abstract Nursing education stresses the importance of theoretical and practical integration. Teaching and learning activities occur both in classroom and clinical venue. Owing to these characteristics, nursing education has to be delivered in a flexible way and mobile learning appears to be a desirable means. In order to achieve effective learning outcome from mobile learning, one of the essential issues is to deliver mobile learning that meet the preferences and readiness of nursing students. This paper presents a survey which aimed to investigate the preference of nursing students for engaging in mobile learning and their readiness to adopt this learning mode. A convenience sample of 158 full-time undergraduate nursing students at The Open University of Hong Kong was recruited. Data were collected by a questionnaire. The survey results revealed that nursing students would like to access their learning materials anytime and anywhere. The nursing students considered 'ease of reading' and 'ease of note-taking and highlighting' as the most important factors that determined their use of electronic learning materials. They further considered 'level of comfort in reading', 'portability' and 'input and output capabilities' as the three most important factors in using a mobile device for learning. Among the different study topics, they highly preferred to have body systems and diseases as well as medical terminology to be provided in multimedia materials in the mobile device. Based on these findings, the challenges and opportunities of mobile learning in nursing education are discussed. Unique features of mobile learning for nursing education are suggested.

Keywords Mobile learning · Nursing education · M-learning readiness

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_9

Introduction

Mobile learning has been regarded as one of the promising means of education delivery. It allows learning to take place across different settings beyond geographical barriers and time constraints. As a young but rapidly growing field playing an increasingly important role in education (UNESCO, 2012), it is regarded that mobile learning may benefit learners in multiple ways. For example, it allows learners to vary the location of their study and to learn 'on the move' (Evans, 2008). Learners may learn within a specific context, which provides authentic cultural and environmental cues for understanding the utilisation of information and thus enhances the retention, retrieval and transfer of the information for practical use (Koole, 2009). In addition to individual learning, mobile learning also facilitates social interaction among learners and teachers, through applications such as text messaging or voice communication (Uzunboylu & Ozdamli, 2011).

With the growing popularity of mobile devices, the development of mobile learning has been gaining momentum. Nursing education emphasises acquisition of both conceptual knowledge and practical skills in classrooms and clinical venues. The different learning environments of nursing education provide a suitable platform for mobile technology to take effect. The use of mobile devices enables provision of up-to-date and accurate content and supports situated, experiential and contextualised learning in the context of nursing education (Kukulska-Hulme & Traxler, 2005).

Success in provision of mobile learning requires purposeful and thoughtful planning. Baker, Dede and Evans (2014) summarise a wide range of areas that have to be taken into account in the planning of mobile learning, such as the learning goals to be accomplished, prior knowledge and skills of learners and teachers, instructional and curricular materials to be developed and their ways of delivery via mobile devices. Prior to implementation, studies are thus needed for an institution to assess how well its students and staff are ready for mobile learning.

This paper presents a survey on the preferences of nursing students for mobile learning and their readiness to adopt this learning mode. The findings show the relevant support required, which facilitate course designers and teachers to plan and deliver mobile learning in a way addressing students' specific needs. This study also reveals how mobile learning may be integrated into a conventional classroom setting so as to achieve a high level of learning and teaching effectiveness.

Mobile Learning for Nursing Students

This study focused on the practice of mobile learning in nursing education at The Open University of Hong Kong (OUHK). OUHK has been leveraging mobile technologies for clinical education support as far back as 2004. Mobile and wireless technologies were applied to remove the physical barriers associated with classroom

learning (Lee & Tsang, 2006). The nursing programmes at OUHK have in recent years been making use of iPod touch in their clinical practicum, in order to facilitate teaching and support learning. Equipped with the mobile devices, nursing students can access the learning materials anywhere and anytime and feasibly complete their clinical assessment.

Based on this successful experience, the university is planning to extend the provision of mobile learning to the classroom setting of nursing courses. An iPad mini will be given to each nursing student for learning purposes in the 5-year curriculum. Specific features are planned to be built into the mobile learning environment of the nursing courses, such as electronic database of nursing information, assessment/performance record, video clips, classroom attendance, ePortfolio, real-time quizzes, news announcements and reminders. These features are designed to enhance students' learning and interaction and to relieve teaching staff of their administrative burden.

A survey was conducted to collect nursing students' preferences and their readiness for mobile learning, so as to understand the mobile contents and ways of delivery suitable for them. It assessed the extent to which the nursing students are ready for adopting mobile learning, their preferences of mobile contents and their preferred ways of mobile learning. Such understandings are crucial to the planning, development and implementation of mobile learning in nursing education.

Related Studies

There are a broad range of dimensions suggested in the literature regarding students' readiness for mobile learning. For example, Parasuraman (2000) raised the notion of technology readiness, defined as 'people's propensity to embrace and use new technologies for accomplishing goals in home life and at work' (p. 308). Cheon, Sangno, Crooks and Song (2012) explained students' intention to adopt mobile learning based on the theory of planned behaviour (Ajzen, 1991), with constructs of perceived behavioural control, attitude and subjective norm. Kenny, Van Neste-Kenny, Burton, Park and Qayyum (2012) used mobile self-efficacy as an indicator to measure students' readiness to engage in mobile learning. They observed a tendency to mobile learning engagement that would emerge as a result of one using more frequently mobile devices, i.e. the more one uses the devices, the more self-efficacy one would be, and in turn more usage of the devices is encouraged.

Hussin, Manap, Amir and Krish (2012) categorised mobile learning readiness into five types, namely, basic readiness, skills readiness, psychological readiness, budget readiness and institutional readiness.

Basic readiness is related to students' ownership of devices, as well as features of the devices such as storage capacity and networking functions. It also includes device capability of running mobile apps for tasks such as reading PDF or PowerPoint files. Kenny et al. (2009) also noted that 'access to and usability of

mobile learning devices is critical to supporting the context of learning and learning interactions' (p. 94).

Skills readiness refers to familiarity of students to perform various tasks using the mobile devices, such as sending and receiving e-mails or files, accessing social networking sites and reading online news. Hamat, Embi, and Hassan (2012) found that skills readiness is positively correlated with students' prospect of engaging in mobile learning. So (2008) also reported that acceptance of mobile phones for teaching and learning has a direct relationship with students' daily uses of mobile phones.

Psychological readiness examines students' understanding and perception of mobile learning. In this dimension, Cheon et al. (2012) commented that inclusion of contents or materials mostly desired by students might be helpful to achieve a high level of perceived usefulness of mobile learning. For example, they found students regarded course information (e.g. schedulers and exam results) as the most desired function. Abas, Chng, and Mansor (2009) found that students of the Open University Malaysia preferred to have reminders of important events and study tips, as well as learning materials such as online tutorials and quizzes.

Institutional readiness concerns students' perceptions of whether the university and teachers are ready to offer mobile learning. Hamat et al. (2012) identified three most important factors for successful implementation of mobile learning, including integration of mobile contents with the existing e-learning platform of the university, complementary role to conventional teaching and well-designed interface of mobile devices for convenient access of materials.

Budget readiness regards willingness of students to bear extra cost for mobile learning. Hussin et al. (2012) showed that students are mindful of additional financial costs that might have incurred in the practice of mobile learning. Abas et al. (2009) revealed that students are cost-aware and not willing to spend extra money on mobile learning. Kenny et al. (2012) also noted that a major barrier to implement mobile learning is the party responsible for the associated cost of purchasing mobile devices and connecting to mobile network.

These dimensions suggest the wide range of areas to be taken into account in the planning and development stages, which are addressed in this survey studying the preferences and readiness of nursing students for mobile learning.

Research Method

This study aimed to investigate the preference and readiness of nursing students for mobile learning. Using a convenience sampling, the students who participated in the study were year 2 undergraduate nursing students from a course entitled Health Assessment, who did not practice mobile learning yet. Two focus group interviews had been carried out in advance to collect 20 students' views and experience on their study of nursing courses and mobile learning. The focus group findings were used to develop a questionnaire for the survey.

The survey was conducted in December 2014. A total of 158 responses were collected, with 80.4% of female respondents and 19.6% of males. Upon obtaining their consent to participate in the study, the students were asked to indicate their preference for a wide number of areas related to mobile learning, such as mobile device, electronic material and means of communication.

Findings

The findings of the survey are presented with reference to the dimensions of mobile learning readiness from Hussin et al. (2012) relevant to our context, i.e. skills readiness and psychological readiness.

Skills Readiness

Table 9.1 shows the familiarity of students with mobile devices using iOS, i.e. the operation system of mobile device to be given to students (using a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree)). Despite the fact that they may own different types of mobile devices, the students generally indicated a moderate familiarity with devices running iOS. The students are expected to possess the skills for tasks such as using e-mail services, accessing Wi-Fi network, uploading and downloading files and reading online materials.

The results show that the students are in general more familiar with iPad/iPad mini than iPod touch and iPhone. As the students will be given iPad mini for mobile learning, this implies that they would not have great difficulty in adapting the device for learning purposes.

Table 9.2 reports the version of textbook owned by the students which is used in the nursing course. Most of the students (61.2% in total) owned either the electronic version or both electronic and printed versions. According to Hamat et al. (2012), students' familiarity with electronic materials would result in a favourable attitude to mobile learning.

Tables 9.3 and 9.4 show the students' preference in means of communication with teachers and classmates on academic matters, respectively. A ranking scale is used from 1 (most preferred) to 9 (least preferred). The results show that most students favour face-to-face interaction with both teachers and fellow classmates. Other than this, the students appear to have little barrier to use mobile devices for communication, especially instant messaging which ranks the second or third for both student-to-teacher and student-to-student interaction. It is worth noting that, among e-mail, telephone call and social networking site (e.g. Facebook), the students prefer to use e-mails for communication with the teachers, while they prefer telephone calls and Facebook when communicating with classmates. However, the discussion board on the online learning environment, the web-based learning

Table 9.1 Familiarity of mobile devices using iOS

I am familiar with the following mobile devices using iOS	Mean	SD
iPad/iPad mini	5.070	1.820
iPod touch	4.665	1.891
iPhone	4.898	1.812

Table 9.2 Ownership of textbook version

Which version of textbook do you have?	Frequency	Percentage
Printed (i.e. paper) version	32	20.6
Electronic version	63	40.6
Both of the above	32	20.6
None of the above	28	18.1

Table 9.3 Pattern of communication – preferred means to communicate with teachers

	Rank (frequency of students)									Median
Means of communication	1	2	3	4	5	6	7	8	9	Rank
Face-to-face interaction	85	10	11	3	2	0	0	2	5	1
Mobile instant messaging (e.g. WhatsApp, line)	13	30	25	10	16	6	12	2	3	3
E-mail – using computer	8	16	27	17	23	10	8	5	4	4
E-mail – using mobile device	4	15	19	37	12	15	8	6	2	4
Telephone call	2	31	16	10	13	3	14	5	22	4.5
Facebook – using mobile device	2	5	5	14	14	24	15	24	15	6
Facebook – using computer	0	3	9	11	15	16	22	21	20	7
Discussion board on online learning environment – using mobile device	3	3	2	7	10	29	16	33	15	7
Discussion board on online learning environment – using computer	1	5	4	8	14	14	23	18	30	7

Valid responses = 118

management system currently in use for the nursing courses, ranks the lowest for communication with both teachers and classmates.

Psychological Readiness

Figure 9.1 shows the students' preference of mobile device for study. A majority of the students (65%) indicated their preference for iPad mini over iPod touch and other mobile devices (e.g. android devices and notebook computers). This suggests a favourable response to mobile learning using iPad mini.

Table 9.5 reports the students' rating of learning materials to access anytime and anywhere (using a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly

Table 9.4 Pattern of communication – preferred means to communicate with classmates on academic matters

	Rank (frequency of students)									Median
Means of communication	1	2	3	4	5	6	7	8	9	Rank
Face-to-face interaction	81	17	5	6	4	1	0	0	1	1
Mobile instant messaging (e.g. WhatsApp, line)	27	46	31	1	2	1	4	2	3	2
Telephone call	3	32	35	4	18	5	7	1	10	3
Facebook – using mobile device	3	7	20	37	15	9	8	14	4	4
Facebook – using computer	1	4	9	31	32	11	10	7	12	5
E-mail – using mobile device	0	2	4	19	14	41	25	9	3	6
E-mail – using computer	0	2	5	9	18	28	44	5	6	6
Discussion board on online learning environment – using mobile device	0	2	4	2	11	13	9	55	21	8
Discussion board on online learning environment – using computer	0	3	4	8	3	8	11	24	56	8

Valid responses = 117

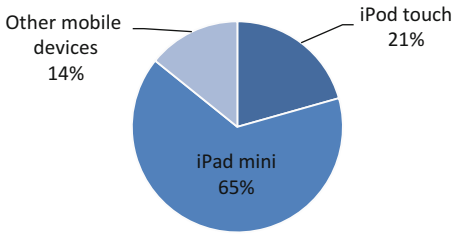

Fig. 9.1 Preference of mobile device for study

Table 9.5 Learning materials students would like to access anytime and anywhere

Learning materials	Mean	SD
Lecture PowerPoint slides	5.766	1.095
Lecture handouts	5.763	1.187
Textbook	5.101	1.442
Videos from external sources (e.g. YouTube)	4.950	1.281
Supplementary learning materials (e.g. online articles)	4.918	1.321
Nursing videos from OUHK	4.911	1.299

agree)). Lecture PowerPoint slides and handouts are the two most preferred materials to be accessed in a mobile environment, followed by the textbook. This suggests that the students wish to study the lecture contents in mobile environments other than the classroom.

Table 9.6 presents the students' preferences of functions/materials to be provided in the mobile device (using a ranking scale from 1 (most preferred) to 7 (least preferred)). The students tend to favour the nursing learning materials. It is notable that communication function for class interaction ranks the lowest. The students may

Table 9.6 Students' preferences of functions/materials to be provided in the mobile device

	Rank (frequency of students)							Median
Functions/materials	1	2	3	4	5	6	7	Rank
Multimedia materials of body systems and diseases	37	24	21	18	14	4	5	3
Medical terminology	24	31	16	11	19	15	7	3
Audio examples of auscultation (e.g. heart sounds and breath sounds)	15	19	23	30	24	10	2	4
Procedures of health assessment	28	12	19	18	14	31	1	4
Image examples of ECG patterns	11	20	22	30	32	7	1	4
Audio version of reference articles	8	12	22	12	15	40	14	5
Communication function for class interaction (e.g. discussion board)	0	4	1	5	7	15	89	7

Valid responses = 123

not have a strong need for online class interaction or such need has been largely satisfied by mobile apps in use.

Table 9.7 presents the students' preferred locations to access electronic materials. Most students prefer to use electronic materials at home (54.8%) or places with Wi-Fi network (50.3%). Some of them also wish to access the materials in classrooms (43.3%) or libraries (34.4%). This result supports the need of the students for mobile learning to access learning materials in different environments.

Table 9.8 shows the students' perceived importance of factors determining their use of electronic materials (using a ranking scale from 1 (most preferred) to 9 (least preferred)). Ease of reading and ease of note-taking and highlighting are the two most important factors, followed by ease of searching information, portability, ease of storage and look and feel. It is noted that 'look and feel' has extreme ranks, in which a high proportion of the students perceived it as an important factor while another substantial proportion regarded it as unimportant. Multimedia content, cost and ease of sharing were deemed less important for the use of electronic materials.

Table 9.9 shows the students' perceived importance of factors determining their use of mobile devices for learning (using a ranking scale from 1 (most important) to 6 (least important)). Level of comfort in reading is the most important factor, followed by portability and input and output capabilities. The students paid less attention for the processor speed and 3G/4G networking function of the devices. For the factors that may be contradictory, such as level of comfort in reading (which may refer to a device with a larger screen size) and portability (which implies smaller size and weight of the device), the students prefer the device to be more suitable for reading.

Table 9.7 Students' preferred location to use electronic learning materials

Locations	Frequency	Percentage
Home	86	54.8%
Other places with Wi-Fi network (e.g. restaurant)	79	50.3%
Lecture halls/classrooms	68	43.3%
University's libraries	54	34.4%
Other (self-study room, computer room, street, vehicle)	13	8.3%

Note: Students may choose more than one option

Table 9.8 Students' perceived importance of factors determining their use of electronic learning materials

	Rank (frequency of students)									Median
Factors	1	2	3	4	5	6	7	8	9	Rank
Ease of reading	33	30	26	13	10	4	2	1	0	2
Ease of note-taking and highlighting	34	31	18	19	7	4	2	4	0	2
Ease of searching information	5	12	21	14	18	21	16	8	4	5
Portability	10	11	8	19	18	18	14	18	3	5
Ease of storage	2	10	17	18	20	21	13	10	8	5
Look and feel	23	11	7	14	9	7	4	17	26	5
Multimedia content	0	9	8	9	15	13	19	26	20	7
Cost	8	6	8	6	9	12	17	10	41	7
Ease of sharing	2	2	3	7	15	19	30	24	16	7

Table 9.9 Students' perceived importance of factors determining the use of mobile devices for learning

	Rank (frequency of students)						Median
Factors	1	2	3	4	5	6	Rank
Level of comfort in reading (e.g. screen size)	59	18	19	7	6	11	2
Portability (e.g. size and weight)	32	33	18	17	11	12	3
Input and output capabilities (e.g. efficiency of typing)	16	26	24	18	26	11	3.5
Storage capacity (e.g. memory)	5	18	26	39	16	18	4
Processor speed	4	13	22	19	46	17	5
3G/4G networking	6	12	12	22	17	52	5

Discussion

This survey has shown the preferences of nursing students in mobile learning. It has also revealed how the students are ready to engage in mobile learning.

The students generally possess the knowledge and skills required for mobile learning. They are familiar with the mobile devices and electronic materials of the nursing courses. This implies that most of them can adapt to mobile learning without much effort, when the contents and ways of delivery suit their needs.

For the mobile learning materials, the students indicated their preference to have those summarising the major contents of the nursing courses, i.e. lecture handouts and PowerPoint slides. They also preferred supplementary materials such as multimedia materials of body systems and diseases and medical terminology. On the other hand, the students expressed a diverse range of preferred locations to access the materials, e.g. home, libraries and other places with Wi-Fi network. This suggests their need of mobile learning in terms of accessing the materials anytime and anywhere to facilitate their study of the nursing courses.

The students appear to view mobile means of communication as a less-preferred alternative. Most of them would choose to have face-to-face interaction, if applicable, both for communication with teachers and classmates on academic matters. This is also reflected in their preference of functions/materials to be provided in mobile device – communication function for class interaction is ranked the lowest. This result deviates from the hypothesis of some mobile learning theories. For example, in Koole's (2009) FRAME model, social interaction is one of the core aspects in mobile learning. Further investigation is needed for finding out the reasons of such students' preference.

In general, the choice of iPad mini to be used for mobile learning in nursing education will suit the students' preference, both in terms of their familiarity with the device and their need to have a high level of comfort in reading. Among the different features of the mobile device, mobile networking (3G/4G) was ranked the lowest. This suggests that the students may not have a strong need to access the Internet anytime, or they deemed it acceptable to access the Internet only in locations with Wi-Fi network.

Conclusion

This study contributes to uncover the preferences and readiness of nursing students for mobile learning. The students expressed their desired ways of studying the nursing courses which can be largely satisfied by the features of mobile device and mobile learning materials planned to be provided.

For implementing mobile learning in the nursing courses, the present findings show that the students may only value the learning materials provided and the opportunity to access the materials anywhere. While they did not indicate a strong preference of mobile communication with teachers and classmates, further support may be necessary if part of learning activities are planned to deliver through mobile interaction. This may involve provision of training and technical support for the communication functions of the mobile device or having the learning activities as a compulsory part of the courses. As mentioned in Kenny et al. (2012), increasing students' familiarity and experience in using mobile devices would facilitate their engagement in mobile learning. It is expected that their self-efficacy will be increased if more exposure is provided to the students, which would contribute to raise their attitude to mobile learning.

Looking ahead, students' preference may change after mobile learning has been implemented. Further adjustment in mobile learning provision may be required. We

are also waiting to see the extent of effectiveness when mobile learning has been planned in a way taking into account the students' preference that this study has shown.

Acknowledgements The work described in this paper was substantially supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (UGC/FDS16/H10/14).

References

Abas, Z. W., Chng, L. P., & Mansor, N. (2009). A study on learner readiness for mobile learning at Open University Malaysia. In *Proceedings of IADIS international conference mobile learning 2009* (pp. 151–157). Barcelona, Spain.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211.

Baker, A., Dede, C., & Evans, J. (2014). *The 8 essentials for mobile learning success in education*. Qualcomm. Retrieved from https://www.qualcomm.com/media/documents/files/the-8-essentials-for-mobile-learning-success-in-education.pdf

Cheon, J., Sangno, L., Crooks, S. M., & Song, J. (2012). An investigation of mobile learning readiness in higher education based on the theory of planned behavior. *Computers & Education, 59*, 1054–1064.

Evans, C. (2008). The effectiveness of m-learning in the form of podcast revision lectures in higher education. *Computers & Education, 50*(2), 491–498.

Hamat, A., Embi, M. A., & Hassan, H. A. (2012). Mobile learning readiness among UKM lecturers. *Procedia-Social and Behavioral Sciences, 59*, 406–410.

Hussin, S., Manap, M. R., Amir, Z., & Krish, P. (2012). Mobile learning readiness among Malaysian students at higher learning institutes. *Asian Social Science, 8*(12), 276–283.

Kenny, R. F., Park, C., Van Neste-Kenny, J. M., Burton, P. A., & Meiers, J. (2009). Using mobile learning to enhance the quality of nursing practice education. In M. Ally (Ed.), *Mobile learning: Transforming the delivery of education and training* (pp. 75–98). Athabasca, AB: Athabasca University Press.

Kenny, R. F., Van Neste-Kenny, J. M., Burton, P. A., Park, C. L., & Qayyum, A. (2012). Using self-efficacy to assess the readiness of nursing educators and students for mobile learning. *The International Review of Research in Open and Distributed Learning, 13*(3), 277–296.

Koole, M. L. (2009). A model for framing mobile learning. *Mobile Learning: Transforming the Delivery of Education and Training, 1*, 25–47.

Kukulska-Hulme, A., & Traxler, J. (2005). Mobile teaching and learning. In *Mobile learning – A handbook for educators and trainers* (pp. 25–44). London: Routledge.

Lee, J. K. L., & Tsang, E. Y. M. (2006). Mobile learning support in patient care and clinical nursing education. In *Proceedings of the international conference on ICT in teaching and learning (ICT 2006)*. Hong Kong, China.

Parasuraman, A. (2000). Technology readiness index (TRI): A multiple-item scale to measure readiness to embrace new technologies. *Journal of Service Research, 2*(4), 307–320.

So, W. W. S. (2008). A study on the acceptance of mobile phones for teaching and learning with pre-service teachers in Hong Kong. *Journal of Educational Technology Development and Exchange, 1*(1), 81–92.

UNESCO. (2012). *Mobile learning and policies: Key issues to consider*. Paris: Author.

Uzunboylu, H., & Ozdamli, F. (2011). Teacher perception for m-learning: Scale development and teachers' perceptions. *Journal of Computer Assisted Learning, 27*(6), 544–556.

Chapter 10
Mobile Learning Support to Distance Learners: Using WhatsApp Messenger

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Abstract This paper examines the Open University Malaysia's (OUM) forays into using WhatsApp Messenger as a tool for supporting learning. The pilot project was implemented on the new group of about 3000 first-semester learners. The mobile learning messages were in the form of images, audios and videos, in addition to the text format. A preliminary survey was conducted using the Google Drive survey instrument, and it was communicated to the learners via WhatsApp. This paper outlines the OUM's efforts and processes in implementing WhatsApp as a tool for mobile learning support and distance learners' experience and usage pattern for the mobile learning messages.

Keywords Mobile learning · WhatsApp Messenger · Instant messaging

Introduction

As more and more institutions are offering distance learning, there is an increasing need for learning support. Information and communication technologies, as well as new media technologies, are capitalised on for this purpose. Appropriate use of technology can take the distance out of the learning (Watts, Lewis, & Green, 2003). The emergence of mobile learning offers opportunities to make new inroads into open and distance learning (ODL), especially since it provides mobility and the means to individualise learning (Kim, Mims, & Holmes, 2006).

One popular mobile learning tool is WhatsApp Messenger, a cross-platform mobile messaging app which sends real-time messages to individuals and groups, with no extra cost other than that incurred by the Internet connection. WhatsApp is used widely by mobile phone users to communicate and share information in the form of text, images, audios and videos and also location information. According to

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_10

Statista (2015), WhatsApp was the most popular global mobile messenger app in March 2015, with 700 million active users per month. In the fourth quarter of 2014, South Africa ranked first with 78% mobile Internet users' usage penetration, followed by Malaysia with 75%.

Instant messaging technologies have had a positive impact on youth preference over voice calls (Lenhart & Ling, 2010). Learners in Malaysia reported their preference to integrate mobile learning into their studies (Harvinder, 2012; Veeramuthu, Hui, Siew, & Sharmala, 2014).

Given that Malaysia has such a high adoption rate and little is known about the impact of WhatsApp on learning, it is important to find out how WhatsApp can be used as a tool for revolutionising learning. This study seeks to highlight the distance learners' experience and usage pattern with mobile learning messages received.

Methodology

In this section, the processes involved for broadcasting the mobile learning support messages via WhatsApp Messenger and the data collection methods are described.

Research Site

The study was conducted at Open University Malaysia (OUM), the pioneer and leading ODL institution in Malaysia. OUM practises a blended learning approach which comprises face-to-face tutorials and online learning via the university's learning management system called *myVLE*.

Sample

Mobile learning support was given to 2934 first-semester learners taking OUM's undergraduate programmes. A total of 12 groups of learners were formed, with each group comprising a maximum of 250 learners. These learners were registered across the country in 34 learning centres. However, only 150 participants responded to the online survey questionnaire via their mobile phones. As shown in Table 10.1, the majority of the respondents (61.3%) were female. About 50% of the respondents were ranging in the age group 21–29 years, followed by 29.3% in the age group 30–39. Most of the respondents (84.7%) had an Internet data plan on their mobile phones.

Table 10.1 Demographics details of the respondents

Demographics		Number	Percent (%)
Gender	Male	58	38.7
	Female	92	61.3
Age	Below 21 years	8	5.3
	21–29 years	75	50
	30–39 years	44	29.3
	40–49 years	20	13.3
	Above 50 years	3	2
Internet data plan	Yes	127	84.7
	No	23	15.3
Total		150	

Types of Messages

There were four areas of mobile learning support, namely, (1) important announcements, (2) learning tips, (3) a guide on myVLE (OUM's learning management system) and (4) information on helpdesk support available in OUM. The messages were in various formats, such as text, graphics, audio and video, and were designed accordingly to fit for the purpose. A total of 23 messages were delivered to the learners. Table 10.2 shows the number of messages by category and format. The messages that contained images and videos were accompanied by text.

Table 10.3 shows some examples of the mobile learning messages. The text messages included meaningful emoji from the list of available emoticons in WhatsApp Messenger. Messages filled with emoji is intended to help learners to process the messages more effectively as images are more representative than words. Messages with emoji are like pictographic script that helps to convey emotion and expression and lighten the communication, thus leading to an enrichment of the messages.

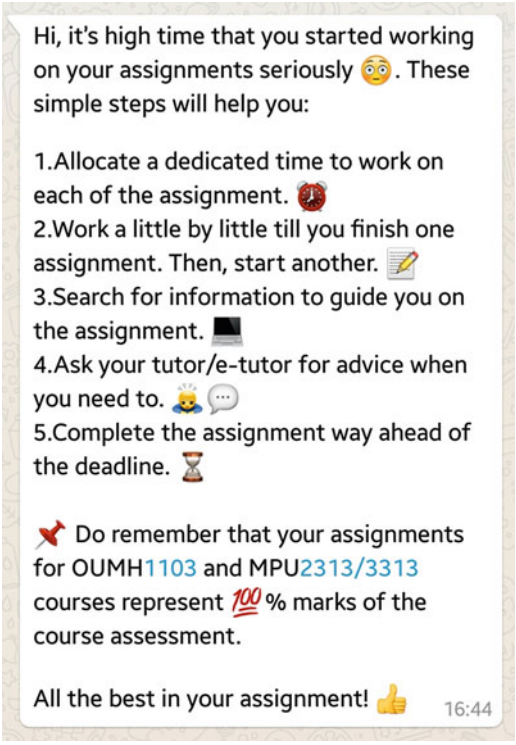
Software and Hardware Tools

At the start, a BlueStacks App Player was downloaded to host the WhatsApp Messenger on the laptop. This software enables the broadcasting of WhatsApp messages to an unlimited number of groups with a maximum of 250 recipients per group, instead of being limited to only 100 recipients per group using a mobile phone device. At present, a web-based WhatsApp application is being used to replace the BlueStacks App. A local pre-paid phone SIM card number was keyed into the system which then allowed the laptop to function as a phone device. The

Table 10.2 Number of messages by category and by format

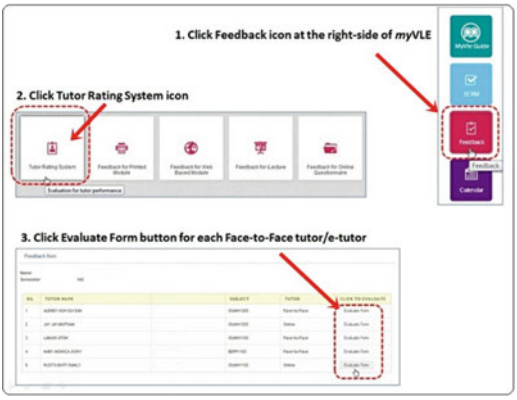
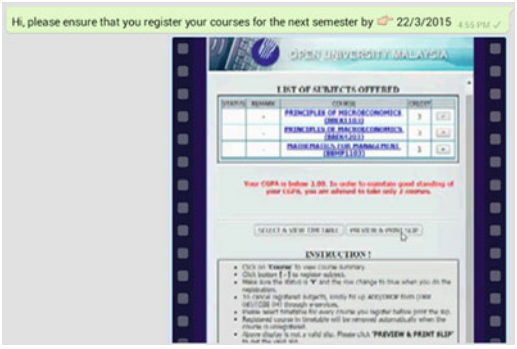
Category	Format				
	Text	Text + image	Audio	Text + video	Total
Important announcements	5	1	1	1	10
Learning tips	4	2		4	9
Guide on myVLE				3	4
Information on helpdesk support	1	1			2
Total	10	4	1	8	23

Table 10.3 Sample screenshots of WhatsApp messages by category

Category	Examples
Text	
Image	[4/2, 4:58 PM] OUM Mobile Learning: Dear learners, As part of OUM's commitment to provide quality tutoring, we value your feedback on tutors. Please respond to the short survey 'learner evaluation on tutors'. It will only take 2 min or less. The tutor rating system link can be found by clicking the feedback icon at the right side of myVLE. Then, continue by clicking the tutor rating system icon. Kindly view the steps in the image to access the survey form. Thank you for your contribution in evaluating OUM tutors.

(continued)

Table 10.3 (continued)

Category	Examples
	
	
Audio	
Video	

audio and video recordings of the messages were done using the smart mobile phone and Snagit 12 Editor software. Some of the video messages were sourced from YouTube. In addition, the images in the messages were captured and edited using PhotoScape software.

Procedure

The methods and procedures for the study involved the following phases:

Phase 1: Development of mobile learning messages

- Identifying the learning support required by first-semester undergraduate learners
- Formulating the mobile learning messages using pedagogically sound strategies

Phase 2: Implementation

- Creating a database of learners' mobile phone contact numbers
- Promoting learners to join OUM WhatsApp Mobile Learning Support Group
- Scheduling the mobile learning messages appropriately into the semester calendar
- Delivering/broadcasting the mobile learning messages to the learners

As the mobile learning support was delivered to a large number of learners, it was impractical to allow two-way communication between the teacher and the learners. The learners were discouraged from replying to the messages to avoid the overwhelming number of messages that would be likely to occur in the group if this option was enabled.

Phase 3: Evaluation

- Collecting feedback about learners' experience through an online survey
- Analysing the responses

Data Collection Instrument

An online survey instrument was created using Google Drive for collecting data. The online survey link was sent to the learners through a WhatsApp message. The questionnaire had 6 items under the demographics section and 26 items on the mobile learning experience. This would address area usage pattern and preferred message type.

Table 10.4 Purpose of using WhatsApp Messenger

Purpose	Number	Percent (%)
Chatting with friends	66	44.0
Job-related	34	22.7
Family matters	16	10.7
Study	13	8.7
All the above purposes	21	14.0
Total	150	100

Findings

This section analyses the responses collected from the learners via the Google Drive online survey instrument. The analyses and interpretation of the findings are presented as follows.

The Purpose of Using WhatsApp Messenger

Table 10.4 confirms that WhatsApp Messenger was used mostly for chatting with friends (44%), followed by discussion on job-related matters (22.7%). Interestingly, only 8.7% indicated that WhatsApp was mostly used for learning purposes. A total of 14% reported that they do all the activities. This suggests that the WhatsApp Messenger tool is used as a communication tool among OUM learners, allowing them to connect with each other on a variety of matters. Although, learning is not on their priority for WhatsApp messaging but WhatsApp brings learners together socially by allowing chats and discussions. The obvious implication seems to be that it helps learners by 'taking the lonely out of distance learning' (Gilding, Helm, & McClements, 1996).

Time Spent on WhatsApp Messenger

Figure 10.1 shows that 28% of the respondents reported that they spent an estimated 1–2 h per day on WhatsApp Messenger. Next came those who spent less than 1 h per day (24%); and in third place were those who spent more than 6 h a day (21.3%). This suggests that there is no generalised pattern in terms of the time spent on WhatsApp Messenger per day by the respondents, possibly because most distance learners are working adults, juggling family and work commitments, and so it is natural for them to use the WhatsApp according to their individual preferences and available time.

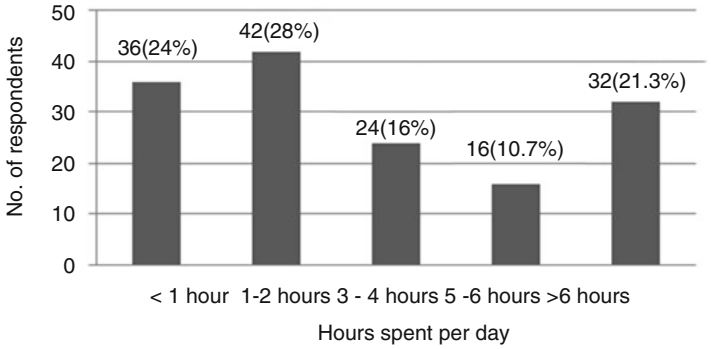


Fig. 10.1 Estimated time spent on WhatsApp Messenger per day

Table 10.5 Reaction to the mobile learning support messages

Whenever I receive a WhatsApp message from OUM Mobile Learning, I usually will	Number of respondents	Percent (%)
Read/view it immediately	104	69.3
Read/view it when I am free	44	29.3
Delete it immediately	0	0
Not read/view it at all	2	1.3
Total	150	

Table 10.6 Frequency of reading the mobile learning support messages

For each OUM Mobile Learning WhatsApp message received, I normally read/view	Number of respondents	Percent (%)
Once only	37	24.7
Twice only	55	36.7
More than twice	58	38.7
Total	150	

Reaction to Mobile Learning Support

The respondents were keen to read or view the mobile learning messages sent to them via WhatsApp Messenger as shown in Table 10.5. A total of 69.3% read or viewed the message immediately, followed by 29.3% who read or viewed them when they were able to do so. Only two (1.3%) of the respondents never read or viewed the messages sent to them, and none deleted the message.

Table 10.6 also shows that 75.3% of the learners read or viewed the mobile learning messages twice or more. These findings suggest that most learners considered that the messages were deserving of their time. This is congruent with the findings of another paper related to this study, which reported that 72.7% of the

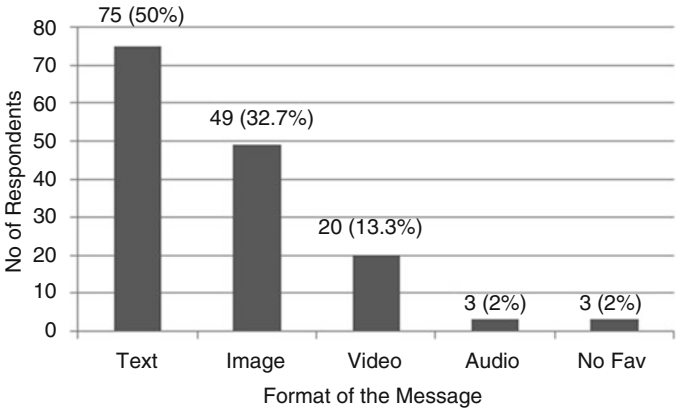


Fig. 10.2 Preferred message type

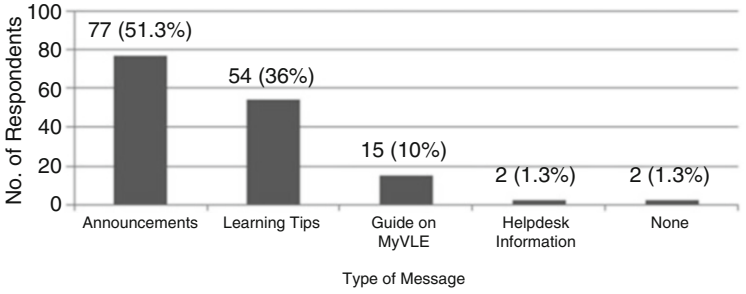


Fig. 10.3 Preferred message type

respondents perceived the messages to be useful for their learning; and, in addition, 74% indicated that they liked to receive and read the messages (Harvinder, Lim, & Mohd, 2015).

As shown in Fig. 10.2, a large number of respondents (50%) preferred text type WhatsApp messages, followed by image type (32.7%) and video type (13.3%).

Figure 10.3 shows that more than half of the respondents (51.3%) preferred to receive announcement/reminder type of messages, followed by those who preferred learning tips (36%) and the guide on myVLE (10%).

This indicates that the respondents tended to prefer text messages than messages in rich video format because the text format is the most straightforward reminders to ensure easy and quick reading by the recipients. Heavy video and/or audio files can be very slow and need time for downloading and may risk varied interpretation, but text messages can be received instantly and easily convey the required information. Even though many of the videos were no longer than 1 min in duration, some learners found it difficult to access them due to slow downloading.

Overall, the mean satisfaction rating given by the respondents was 4.37 (from 1 being 'least satisfied' to 7 being 'most satisfied'). The rating is above average as many of the respondents felt that the mobile learning messages were beneficial and useful to them, as indicated in their comments below:

- 'The daily reminder was interesting and helped to motivate the learner' (Learner ID5).
- 'Quick, fast, and easy understanding' (Learner ID20).
- 'Easily understood . . . I don't access myVLE often as I've work responsibility. I depend on WhatsApp to remind me' (Learner ID21).
- 'It helps me a lot when I do my assignments' (Learner ID32).
- 'I give a rating of 4 because I have gained a lot from the messages received, especially tips on doing assignments and reminder for the assignments deadline' (Learner ID83).

However, 26.7% of the respondents rated their satisfaction with the mobile learning support messages at 3 and below. Some of the reasons for this poor satisfaction rating were reported as follows:

- Lack of sufficient information:
  - 'The information given is too general and at times does not provide any great impact' (Learner ID43).
  - 'Give more information on myVLE at the appropriate moment. More about assignment and library information' (Learner ID110).
  - 'Still lacking in latest information as in myVLE. . ., for example, information on registration' (Learner ID129).
- Lack of understanding of the messages:
  - 'Sometimes the messages are not in dual languages and therefore [I] need to refer to other learners for understanding it' (Learner ID53).
  - 'Lack of understanding' (Learner ID86).
  - 'Because I'm new to learning, I don't understand much about it' (Learner ID111).
- Uninteresting content:
  - 'Content is less interesting' (Learner ID36).
  - 'Bored with texts' (Learner ID38).
- Downloading time:
  - 'Sometimes it is difficult to access due to slow downloading' (Learner ID76).

Conclusion

WhatsApp Messenger is primarily used for chatting with friends and accepted as a medium for social networking. However, it has great potential for use as a tool for facilitating learning or providing support for it. The mobile learning support messages were intended to enhance awareness of the university's learning environment for new undergraduate learners and also to reduce the feeling of isolation among distance learners. Broadcasting one to three messages per week regularly in the semester helped to create a connection between the learners and the university. The findings of this study revealed that the mobile learning support via WhatsApp Messenger helped the majority of the learners. They considered the messages to be useful and worthy of their time and attention. The ubiquitous nature of WhatsApp with appropriate mobile learning instructional strategies can help to further advance the support for course-specific content.

Acknowledgements The authors gratefully acknowledge the staff of the Institute for Teaching and Learning Advancement in OUM for their contributions to this project.

References

Gilding, B., Helm, P., & McClements, R. (1996). Taking the lonely out of distance learning. UK: *Times Higher Education*. Retrieved from https://www.timeshighereducation.com/features/taking-the-lonely-out-of-distance-learning/94133.article

Harvinder, K. D. S. (2012). *Developing and validating a mobile learning pedagogical model for distance learners*. Unpublished doctoral dissertation, International Christian University, Japan.

Harvinder, K. D. S., Lim, T. M., & Mohd, R. Z. (2015). Mobile learning support via WhatsApp Messenger. *Proceedings from the 29th annual conference of the Asian Association of Open Universities*. Kuala Lumpur, Malaysia. Retrieved from http://s170.oum.edu.my/aaou2015/sites/default/files/AAOU_Proceedings.pdf

Kim, S. H., Mims, C., & Holmes, K. P. (2006). An introduction to current trends and benefits of mobile wireless technology use in higher education. *AACE Journal, 14*(1), 77–100.

Lenhart, A., & Ling, R. (2010). *Teens and mobile phones*. Pew Research Center's Internet & American Life Project. Retrieved from http://www.pewinternet.org/2010/04/20/teens-and-mobile-phones/

Statista. (2015). *Number of monthly active WhatsApp Users worldwide from April 2013 to 2015*. Retrieved from http://www.statista.com/statistics/260819/number-of-monthly-active-whatsapp-users/

Veeramuthu, V., Hui, S. W., Siew, P. W., & Shamala, P. (2014). Mobile assisted teaching and learning in an institute of higher education. *International Review of Social Sciences and Humanities, 8*(1), 68–79.

Watts, T., Lewis, L., & Green, B. (2003). *Distance education at degree-granting postsecondary institutions: 2000–2001*. Washington, DC: US. Department of Education, National Center for Educational Statistics. Retrieved from http://nces.ed.gov/pubs2003/2003017.pdf

Chapter 11
Designing Smart Apps to Enhance Learners' Engagement in Online Learning

Xiangyang Zhang, Shu-Chiu Hung, and Linda Zhang

Abstract In China nowadays, the majority of online learning students are digital natives, and there also exist many digital migrants, including middle-aged and retired professionals and senior citizens. This paper addresses the concept and context of current online learning in Ming Chuan University (MU); and, after a survey of learners' needs, it discusses the design of the apps for smart learning to enhance students' engagement with online learning. It also discusses MU's smart apps and the potential benefits of adopting this new alternative route to the learning platform, with an expectation of more engagement with learning activities, learners' satisfaction and versatility.

Keywords Smart apps · Online learning · Moodle · Mobile learning

Introduction

With the quick expansion and penetration of the Internet, people, old and young, in the mainland prefer to log in and browse websites for accessing the information they need. Of course, needless to say, they not only access texts on the Web – videos and entertainment websites are often frequented by them. Computer-mediated education with the Internet is appealing for investment by Internet corporates and some training organisations. Online education is the buzzword in China.

In recent years, using social media apps has become a trendy movement in every walk of life, with the market for large-screen smartphones being dynamic and vibrant. According to an informal survey, people tend to use mobile phones or

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_11

tablets to communicate with their friends by keying in words, use apps to browse the Internet for news and blogs and conduct learning activities on some specific websites. According to the fiscal reports of the three telecommunication network giants in China, mobile phones with larger screens sell well. Moreover, the 4G network has joined the wireless service throughout the nation. Therefore, it is high time for online learning universities to integrate mobile learning into the conventional online learning based on desktop/laptop computers with the Internet. Working adult learners can access the Internet through their wireless devices anytime and anywhere without any constraints.

This paper first addresses the concept of ubiquitous and mobile learning and then considers the context of current online learning in Ming Chuan University (MU). Next, after a survey of learners' needs, it discusses the design of the apps for smart learning to enhance the students' engagement with online learning. Finally, the article discusses the smart apps in MU and then looks at the potential benefits of adopting this new alternative route to the learning platform, with the expectation that it will result in more engagement with learning activities, learner satisfaction and versatility.

Ubiquitous and Mobile Learning in the Digital Age

The Internet has penetrated the daily life of our society in diverse ways – it has changed the ways we live, work and communicate in the world. In this digital age, information communication technologies provide abundant opportunities for people to gain access to knowledge and information: learning is no longer confined within the walls of classrooms in which students gather. The rapid developments in technologies have brought changes in societies and the economy (Alley, 2009; Tsinakos & Alley, 2013). Modern technologies have created ubiquitous learning and blurred the divide between formal and informal learning in education (Kinshuk & Huang, 2015; Sampson, Isaias, Ifenthaler, & Spector, 2013). In facing the challenges of high technology, conventional educational institutions should be aware of the following changes in this digital age:

1. People open up and express themselves with rich media, such as texts, videos and photos, for entertainment.
2. With the Internet, people in developed, developing or underdeveloped countries can access and share information with each other, thus in a certain sense reducing the digital gap in information.
3. People can take control of their lives by such a small thing as holding a remote control to switch on/off a channel.
4. People feel worried about not knowing the true causes of issues or events which are happening.

5. In the Internet, people are in a state of confusion and apprehension and tend to seek soulmates via the Internet.
6. In the Internet community, people tend to exchange, disseminate or share information.
7. Those born in the prosperous and peaceful years of the 1980s or 1990s make up the bulk of Internet users, who are called 'digital natives'.

Mobile learning, or sometimes ubiquitous learning, refers mainly to the provision of education services with handheld devices. With the integration of handheld devices into education, learning can happen anytime and anywhere with wireless and Internet technologies. Mobile technologies not only bring mobility, and ubiquity but also have an impact on the pedagogies of conventional educational institutions (Pachler, Bachmair, & Cook, 2010; Unhelkar, 2009). As regards smart education with smart mobile devices, there are six dramatic changes which will have an impact on education: mobile devices can be viewed as an extension of human organs and are more viable for real personalised learning; learning moves from being closed to opening up; learning is not confined to a physical classroom; learning time, location, courses, knowledge and activities can be fragmented, not necessarily prefabricated; texts, sound, videos, rich media, AR and holograms can connect the classroom to the outside world; and the individual can use the Internet to connect and establish diverse communities and access knowledge, no longer relying only on instructors because of the explosion of information in the Internet age.

Learners' Engagement

In the digital age, the conventional educational context has changed radically – it is not an evolution, but a revolution, in learning. Teaching in higher education in China has become more demanding for academics. With knowledge accessed from the Internet, students dislike the slow and boring lecture-based classroom instruction. The demand for multilayered delivery of high-tech media has become stronger than ever before. But online courses are still text-based, dotted with prefabricated video lectures and audio learning materials. Therefore, engaging learners in doing 'meaningful learning is a profound and ongoing challenge' (Barkley, 2010, p. xii) to online course providers and designers.

There exists a prevailing misunderstanding that engaging students in learning involves entertaining them in their studies; but they are not young learners in school – they are adult learners who have come to learn something pragmatic for use in their professions. They have prior learning experience and work experience and bring their experiences, ideas, insights and attitudes to their learning.

The problems which remain for course providers to solve are how to motivate the learners, facilitate their learning desires and reshape their expectations for successful achievement of learning outcomes.

Smart apps might be the solution to fulfilling these goals by enhancing the learners' engagement in online learning with ubiquitous use of smartphones and connecting students in a social community. In the learning community they set up, the learners will foster a sense of belonging (Brown & Mbati, 2015; Herrington, Herrington, Mantei, Olney, & Ferry, 2009). They will also feel comfortable in communicating with their peers by raising questions and seeking answers and feedback from them, exchanging or sharing some comments from the tutors and confirming some important information or issues about learning activities (Wakefield, McNally, Bowler, & Mayne, 2007). With smart apps, the learning community will remove the sense of isolation or alienation which distance learners often feel in conventional distance learning.

The Context for Using the Internet and Mobile Technologies in China

China is a large country for manufacturing smartphones and is the biggest market for them. Growth in the use of mobile phones in China has been quite rapid and has been accompanied by the availability of relatively inexpensive smartphones. According to the 34th S*tatistical Report on the Internet Network Development in China* issued by the China Internet Network Information Center (2014), by the middle of 2014, netizens in mainland China reached 632 million, of whom 46.9% accessed the Internet (Fig. 11.1).

Access to the Internet and wireless networks has brought a boom in using mobile phones for logging into the Internet. By the middle of 2014, the population of mobile netizens reached 527 million (83.4% of them accessed the Internet via mobile phones), which shows that mobile netizens outnumbered computer netizens for the first time. The chief reason for this quick expansion is that, since 2009, there has been an increase of more than 100 million mobile users each year, and the market for smart apps has a bright future, with newly designed smartphones attracting more buyers, young and old. Above all, the wireless technologies are very helpful for people on the move, including rural residents and temporary workers in the cities and towns. In China, smartphones cost much less than desktop computers and have the advantage of easier access to the Internet and apps. Also, as noted earlier, the fiscal reports by the three biggest telecommunication networks in China show that mobile phones with larger screen sell well; and since 2014, the 4G network has joined the wireless service throughout the country (Fig. 11.2).

The rapid development of the Internet and mobile technologies has a potential impact on education. Various shifts for education have occurred in the discourse of

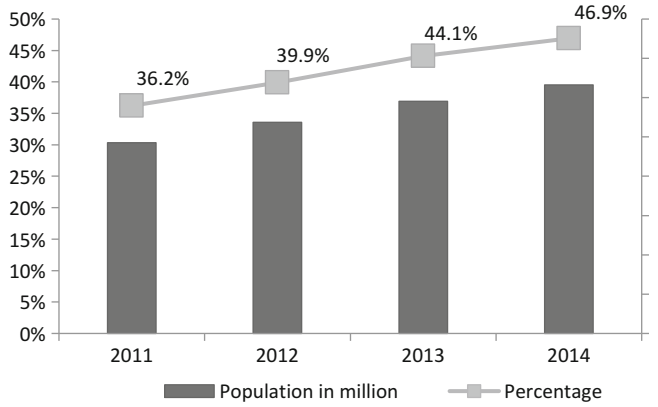

Fig. 11.1 Internet users in China (2011–2014)

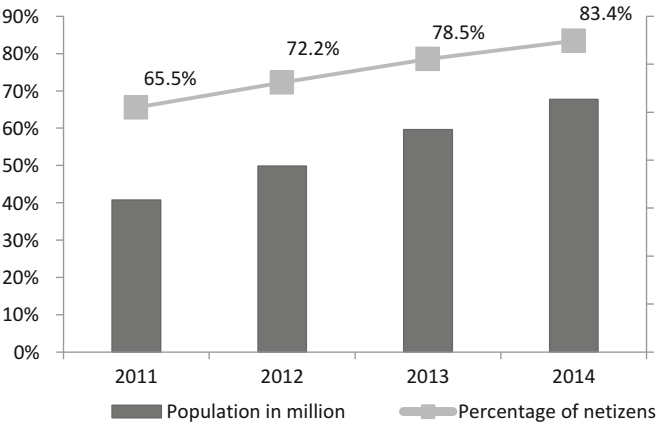

Fig. 11.2 Mobile netizens in China (2011–2014)

mobile technologies in the digital age, viz. shifts in instructional development, technical integration, the user interface and learners' experience.

Online Learning Mode of MU

MU is a conventional education institution with campus-based education as the mainstream activity. In the university, the Moodle learning system is used mainly to support technology-assisted teaching and learning, viz. to supplement courses

Fig. 11.3 The Moodle system in the university (Hung & Zhang, 2014, p. 96)

offered at the university and facilitate students' learning in and after class. Figure 11.3 shows the front page of the Moodle system used in the university.

In the autumn semester of the 2013 academic year, the university offered 3228 courses. Among them, 2779 courses used the Moodle system to support teaching and learning in and outside classroom instruction. The Moodle system is used mainly to upload and download files related to the courses, and 2548 courses have set up such files, with 2398 having used it to provide learning resources, 1463 for homework, 338 for testing and 34 to do student learning surveys. At present, the online presentation of learning materials is just a supplement to individual learning or face-to-face classroom tutorials with the BBS forum. The current practice in MU has received positive and complimentary responses and feedback from the faculty and students.

In the presentation of some courses, QR codes are used to support the mobile learning. For instance, by scanning some QR codes, students can watch video lectures by downloading them into their big screen smartphones, though this is not a common practice. At present, according to a survey conducted by www.medu.org.cn, 80% of students have smartphones, which suggests that there will be a growing and prosperous market for mobile leaning in the near future. With the cost of wireless communication reducing, it is the right time to plan a mobile learning system with smart apps to assist seamless learning (Aberdour, 2013).

A Survey on the Learners' Needs for Ubiquitous and Mobile Learning

According to Bates (2015), 'our educational institutions were built largely for another age, based around an industrial rather than a digital era' (p. 3). The conventional distance education institutions are faced with a massive change in their students. How can the online course providers ensure that the contents are delivered to the learners in the way that best suits these digital natives? This is the key issue that education institutions should be taking into consideration in designing online programmes.

The ubiquity of the Internet creates the potential for providing learning to new cohort of learners, to 'ease capacity constraints, and to capitalise on emerging market opportunities' (Rinear, 2003, p. 3). The online computer-mediated platform, as Bielawski and Metcalf (2003) point out, should integrate the wireless devices into the existing scenarios, mapping out site plans to ensure that, in a typical learning environment, wireless will cover 'device selection, possible support for multi-devices, and device management issues, such as synchronization, connectivity, and scalability' (p. 332).

An informal survey was conducted before planning the mobile learning system design to find out the needs of the younger students in the university. The questionnaire was issued in a special website which the students could log into and respond to the items. The website summarises the responses and does the statistics automatically. Around 1384 students responded to the questionnaire online.

Here is a summary of the survey results (Tables 11.1, 11.2, 11.3, 11.4, 11.5 and 11.6).

According to the above summary of the questionnaire statistics, the students have already got some sense of what mobile learning involves. Smartphones, especially big screen smartphones, are rather popular among the students. In the new learning platform, the social media apps will be integrated with the virtual class. The students can access the learning communities by desktop/laptop computers or simply by their smartphones. The prerequisites for the smart learning apps are there – what is waiting to be done is the decision-making.

The Design for Adult Learners on the Move

In collaboration with the Department of Learning Technologies at the Open University of Jiangsu, which is now a fully online teaching institution, a team has been set up to work with some high-technology firms to develop and upgrade the mobile learning system with smart apps which makes a composite of mobile learning with the online learning. The mobile learning system encompasses course learning,

Table 11.1 Main factors affecting online learning

1	Contents of the courses are rather boring	76%
2	Online learning and mobile learning have advantages over other formats of learning. Multi-platforms and seamless learning apps are what the students cherish	70%

Table 11.2 Factors affecting the desire for mobile learning

1	Students do not want to learn.	24%
2	Lack of mobile learning awareness	37.17%
3	Not easy to use and less functions needed	62.83%
4	Dry content, not appealing to students	61.06%
5	Slow linking speed	46.90%
6	Less promotion	38.94%
7	Others	15.04%

Table 11.3 Problems encountered by the mobile learners

1	No strong desire	44.25%
2	Complicated operation of apps	24.78%
3	Lack of genuine developers of apps	35.40%
4	Lack of funding	18.58%
5	Lack of initiatives	1.77%

Table 11.4 The future of online and mobile learning

1	Mobility and ubiquity	77.88%
2	Big data	64.60%
3	Intelligence	53.10%
4	Socialising	46.90%
5	Seamless learning	37.17%
6	High efficiency	37.17%
7	Gamification	52.21%
8	Hybrid learning	46.90%
9	Take the place of conventional education partially	53.98%
10	Replace conventional education	3.54%

Table 11.5 Attitudes towards mobile and conventional online learning

1	Both have their own advantages	71%
2	Mobility will surpass the online learning	16%
3	Mobility will not surpass the online learning	9%
4	No connection between the two formats	4%

Table 11.6 The weaknesses of mobile leaning (open questions)

1	Not so convenient for keying in text on the mobile device screens
2	Most of the screens are not big enough
3	Limitation of the width of the broadband

educational training, educational management, educational information collection, outdoor learning support, mobile Q and As, education blogs and educational game modules. The mobile learning system is a multi-platform compatible with android and IOS.

The following functions of the mobile learning platform have been considered:

- Small, delicate, specific, low-cost learning mode
- Free, flexible learning mode; easy to fragment the learning process
- Break the limits of time and places; easy to learn anytime and anywhere for any purposes
- Integrate pictures, texts, sound and videos to enhance the efficiency of learning
- Revolutionise the mode of assessments; conduct statistics smartly; and improve the management of learning
- Embedded with social media apps, such as Line/WeChat or Facebook/QQ to set up learning communities
- Synchronous live webcast/recording, VOD, synchronous directing of the webcast; automatic tracing of learning activities for the learners
- A special sign-up system for the learners to make them adopt better learning habits

With this mobile learning system, the users are expected to post and upload information, notices etc., make the trees of knowledge in detail but in branches of categories, contact the instructors/tutors, watch the short video clips, browse the data needed and use learning management and learning support.

The Plan for Implementing a Ubiquitous Learning System

To date, the core designs of the mobile learning system at the Open University of Jiangsu have been completed and the smart apps for course learning and assessment have been developed and tested among the civil engineering students, who will be the first cohort to enjoy the benefits of the ubiquitous and mobile learning system. The reason for this is quite obvious: they are scattered around the country in diverse worksites, away from the reach of the Internet for months. Learning fragmented knowledge in fragmented time will surely facilitate their engagement in learning.

The action plan has been initiated and submitted to the University Senate for its approval for implementation. The action plan will be executed in three phases: a pilot phase, trying out the smart apps in the civil engineering programmes; a modification phase, modifying or redesigning some apps to be applied in three other programmes in the humanity disciplines; and, finally, the overall implementation of the smart apps in all the programmes of the baccalaureate and associate degrees. All the phases will be completed in 1 year, and the evaluation report on the implementation will be published after that.

This point should be emphasised again: the smart apps are not designed for one course or one programme – they will bridge the online learning Moodle platform and the mobile learning system to create a seamless learning system. The potential

benefits of adopting this new alternative route to the learning platform are greater engagement with learning activities, learners' satisfaction and versatility.

Conclusion

At the time the authors prepared this paper for publication, the Ministry of Education proposed an initiative to promote online learning, which depicts a bright future for education institutions getting involved in open and distance learning. In China, big screen smartphones sell well, and this suggests that ubiquitous and mobile learning will have a very major expansion in education and there will be a massive market for it. Smartphones with smart apps will benefit learning whether formal, non-formal or informal in the future of education.

References

Aberdour, M. (2013). *Moodle for mobile learning*. Birminham, UK: Packt Publishing Ltd.

Alley, M. (Ed.). (2009). *Mobile learning: Transforming the delivery of education and training*. Edmonton, AB: AU Press/Athabasca University.

Barkley, E. F. (2010). *Student engagement techniques: A handbook for college faculty*. San Francisco: Jossey-Bass.

Bates, A. W. (2015). *Teaching in a digital age*. Retrieved from http://opentextbc.ca/teachinginadigitalage/

Bielawski, L., & Metcalf, D. (2003). *Blended eLearning: Integrating knowledge, performance, support, and online learning*. Amherst, MA: HRD Press.

Brown, T. H., & Mbati, L. S. (2015). Mobile learning: Moving past the myths and embracing the opportunities. *International Review of Research in Open and Distributed Learning, 16*(2). Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/2071

China Internet Network Information Centre. (2014). *The 34th statistical report on the Internet network development in China*. Retrieved from http://www.cnnic.cn/hlwfzyj/hlwxzbg/index_1.htm

Herrington, J., Herrington, A., Mantei, J., Olney, I. W., & Ferry, B. (Eds.). (2009). *New technologies, new pedagogies: Mobile learning in higher education*. Retrieved from http://ro.uow.edu.au/edupapers/91

Hung, S., & Zhang, X. (2014). Moodle e-learning in higher education: A case study of its applications and impact in a university in Taiwan. In *Proceedings of ICOFE 2014* (pp. 93–99), Hong Kong, China.

Kinshuk, & Huang, R. (Eds.). (2015). *Ubiquitous learning environments and technologies*. New York: Springer.

Pachler, N., Bachmair, B., & Cook, J. (2010). *Mobile learning: Structures, agency, practices*. New York: Springer.

Rinear, K. (2003). How to deliver integrated support to your students. *Distance Education Report, 7*(21), 3–4.

Sampson, G. D., Isaias, P., Ifenthaler, D., & Spector, J. M. (Eds.). (2013). *Ubiquitous and mobile learning in the digital age*. New York: Springer.

Tsinakos, A., & Alley, M. (Eds.). (2013). *Global mobile learning implementations and trends*. Beijing, China: China Central Radio and TV University Press.

Unhelkar, B. (2009). *Handbook of research in mobile business: Technical, methodological, and social perspectives*. Hershey, PA: Idea Group References.

Wakefield, T., McNally, D., Bowler, D., & Mayne, A. (2007). *Introduction to mobile communications: Technology, services, markets*. New York: Auerbach Publications.

Chapter 12
The Impact of Mobile Technology on the Learning of Management Science and the Development of Problem-Solving Skills

Sheila Cheng and Heng Loke Siow

Abstract Learning is the construction of knowledge; and e-learning is the application of information and communication technology (ICT) to make education accessible to learners who are not physically on-site. E-learning is ubiquitous, enabling learners to study whenever they wish and wherever they are. In learning problem-solving skills in management science (MS), mobile technology plays an important role in enhancing students' understanding. This paper presents part of the research findings on a sample of 15 undergraduate students and 4 facilitators for a class in MS. The study found that the respondents had mixed opinions on whether mobile learning enhances or inhibits their learning of MS. Various implications of the study are suggested.

Keywords Mobile technology · Problem-solving skills · Management science

Introduction

The advent of the new generation of smartphones has changed people's lifestyles dramatically. The third generation of mobile networks, or 3G – which was introduced in the USA in 2003 – had a minimum consistent Internet speed of 144Kbps and was equipped with 'mobile broadband'. But 3G has now been greatly improved to an Internet speed of more than 400Kbps, with more network capacity for more data per use and better voice quality. The emergence of 4G phones in 2015 is a major advance for users who like to surf the Web and, especially, stream video. If a laptop is connected to a mobile link, 4G makes a huge difference to transferring large amounts of data (Cassavoy, 2015; Segan, 2014). Mobile technology, 3G or 4G, has

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_12

radically changed the methods of learning, communication and information access among students via e-books, e-learning, Facebook, YouTube, mobile blogging, MySpace, PLS, Moodle and other digital tools. The mobile generation stays connected with their peers via SMS, WhatsApp, chat rooms and email messages and expects teachers or institutions to be connected in the same manner. This new wave of communication has created the need for educators to be more knowledgeable and understanding about the use of mobile technology such as virtual classroom learning experiences.

The discipline of management science (MS) came into existence due to the need to solve problems in the area. Problem-solving is regarded by many educators as the most meaningful and important way of learning and thinking and also as one of the educational objectives in the international education system (OECD, 2004). Most MS problems are real-world problems, but they are complex in nature. Various studies have reported that MS methods are being used increasingly for tactical, operational and organisational decision-making in Malaysia and many other Asian countries (Chang & Hsieh, 2008; Cheng & Siow, 2015; Munisamy, 2012). However, in Malaysia, other studies (HRDF, 2011; Mahavera, 2014; PISA, 2012) have periodically reported that fresh graduates generally lack problem-solving skills when they start in their careers. Problem-solving is one of the critical skills most sought after by employers.

In learning problem-solving skills in management science, it is envisaged that mobile technology could play an important role in enhancing students' understanding as it enables them to learn anywhere and at any time (Attewell, 2004; Ching, 2009; Watson & White, 2006; Wentzel, Lammeren, Molendijk, Bruin, & Wagtendonk, 2005). Siraj and Nair (2008) reported that students from the digital generation prefer self-accessed information, which allows self-paced learning and the discovery of interesting learning topics. Over 10 years ago, Prensky (2005) argued that there was a need for education systems to take heed of the pervasiveness of mobile technology and embrace it in their pedagogical practices.

In Malaysia, many higher education institutions, whether public or private, have invested in e-learning to enhance student's performance by incorporating mobile technology (Manimekalai, 2014). While several projects (Adkins, 2011; Ragus, 2006; Rosli, Ismail, Idrus, & Ziden, 2010) have shown that mobile learning offers convenience to students because of easy access to information, Abas, Chang and Mansor (2009) found that 44.09% of students in the Open University Malaysia were less willing to subscribe to mobile learning. The purpose of this research is to explore the behavioural intentions of MS students towards adopting mobile learning. The technology adoption model (Davis, Bagozzi, & Warshaw, 1989; Hassan, 2009) is used as the basis of the research.

Methodology

The main objective of this study is to investigate the extent to which MS students have adopted mobile learning for solving problems. In order to probe the 'real-world' issues in the adoption of mobile learning in this subject, a phenomenographic approach was adopted to gather detailed and rich qualitative data. This allowed the researcher to examine the students' learning experiences in their natural situation while solving MS problems.

This case study was conducted on 15 MS students in a private education institution in Malaysia. It was considered important that the students who participated in this study were matured enough to make informed judgements about the adoption of mobile learning. Furthermore, these students were chosen because they were in the second and third years of their bachelor's degree and were supposed to be familiar with mobile learning approaches. Before the interviews, the students were asked to fill in a questionnaire to seek their perceptions of mobile learning. Individual face-to-face interviews were subsequently conducted, and the interview questions were guided by the questionnaire responses, thus providing rich data on the topic.

Results and Discussions

In this study of 15 MS students, the majority (80.0%) were female. They were in the age group 20–22, and due to the attendance requirement of the programme, they attended the face-to-face lectures.

Perceptions of Mobile Learning

Table 12.1 presents the participants' perceptions of m-learning gathered through the questionnaire, which indicated that they agreed to its 'relevance' for solving MS problems but were less positive about its 'helpfulness'. Also, they disagreed that m-learning was able to act as a substitute for the instructor and accelerate their problem-solving skills in MS. In addition, they considered that m-learning was time-consuming and they therefore resorted to not making use of it.

Based on their perceptions, they were then interviewed to hear their views on adapting and adopting m-learning to solve MS problems.

Table 12.1 Perceptions of participants on m-learning for solving MS problems

Rank	Details of items	Mean	Standard deviation
1	Relevance	3.57	0.54
2	Helpful	3.43	0.79
3	Substitution	2.57	0.79
4	Slowness	2.14	1.06
5	Time-consuming	1.29	0.49
6	Frequency of use of m-learning	1.14	0.38

The Voice of the Participants on M-Learning for Solving MS Problems

Individual interviews were conducted with participants to examine more deeply their reasons for using/not using the m-learning approach. The responses below were typical answers to specific questions.

- Do you understand what is meant by 'mobile technology'?

  A bit – not so much – for accessing notes directly. I still prefer paper notes (P1, female).
  Yes, such as the learning system online (P2, male).

  It could be inferred that most of the participants had a 'rough' notion of the meaning of mobile technology, but were not aware of its depth and importance.
- Do you find it useful in helping your learning (of MS)?

  It helps you learn. It is easier to find information, quicker and more efficient if only to search for one piece of info (P5, male).
  There is no need to open the computer, [as] it is very distracting (P15, female).
  A bit, [but] not so much, for accessing notes directly. I still prefer paper notes (P13, male).

  The results seem to suggest mixed feelings about the efficacy of m-learning in helping the participants in their learning. Their responses also indicated that m-learning is time-consuming.
- Do you find m-technology changes your learning style?

  Yes, I go to the library less often. Even if I go to the library, I will borrow fewer books (P13, female).
  No, I still like to read hard copy. Reading on the screen has a lot of radiation and makes my eyes very tired; I can't read for long, [and] still prefer print outs (P11, female).

  While the participants acknowledged that m-learning reduced their visits to the library, they did not accept reading the on-screen notes and preferred hard copy materials.

- Do you find e-learning useful in your learning?

  Yes, I go to the library less often. However, I still like conventional printed materials. I prefer going to the class (P10, male).

  It depends on the subject. For MS, I can study by myself – it's not necessary to attend class. I prefer to learn it at my own pace. I focus on areas which are different from the lectures. I cannot focus in the class. Usually I will chat with my friends in the class (P8, female).

  Being exposed to other subjects, the participants preferred to study on their own, reinforced by their friends and printed materials.
- Is the e-learning enough to replace the face-to-face classes?

  I still need a table, chair and printed books. E-learning is just a supplement (P2, male).

  There is no substitute. I can learn better in the classroom environment (P8, female).

  Practically all the participants preferred to attend the 'conventional' classroom environment for learning the MS subjects.

These interviews provided in-depth knowledge on why the participants adopted or were reluctant to adopt m-learning in solving MS problems.

Based on the survey and interviews, it can be concluded that, while m-learning is an innovative change in learning, the participants in this study were not prepared for the changes involved. They preferred conventional face-to-face teaching and interaction in delivering the lessons. Similar findings have also been reported by Zainab (2003) and Manimekalai (2014) who argue that new technologies for learning and teaching need time to be accepted by the users.

Conclusion

The findings presented in this paper illustrate the 'voices' of the participants studying the MS programme. These results could help educators to recognise the need to educate the learners and instructors on the effectiveness of m-learning in the modern classroom. The students' reactions to m-learning described here need to be addressed for their sake; and m-learning should be implemented in MS subjects, as well as across the undergraduate curriculum. After all, as mentioned earlier, problem-solving is seen as the most meaningful and important way of learning and thinking – and the ability to apply cognitive skills appropriately in problem-solving is considered to be a fundamental and crucial aspect of human life.

It is hoped that these findings will stimulate improvements in the implementation of m-learning for problem-solving skills among Malaysian students, especially in MS.

References

Abas, Z. W., Chang, L. P., & Mansor, N. (2009). A study on learner readiness for mobile learning at Open University Malaysia. *IADIS international conference mobile learning* (pp. 151–157), Malaysia. Retrieved from http://library.oum.edu.my/repository/569/1/a_study_on_learner_readiness_for_mobile_learning_at_OUM.pdf

Adkins, S. (2011). *We put research into practice*. Online Research paper.

Attewell, J. (2004). Mobile technologies and learning. *A technology update and m-learning project summary*, 25. Retrieved from http://www.hostdrome.com/technical/The%20m-learning%20project%20-%20technology%20update%20and%20project%20summary.pdf

Cassavoy, L. (2015). *Today's 4G phones*. Retrieved from http://cellphones.about.com/od/cellphonereviews/tp/4G-phones.htm

Chang, P., & Hsieh, P. (2008). Bibliometric overview of operations research/management science research in Asia. *Asia Pacific Journal of Operational Research, 25*(2), 217–241.

Cheng, S., & Siow, H. L. (2015). Enhancing problem solving skills in operational research: The well-structured problem case study. In *World Journal of Management*. Sydney, Australia: World Business Institute.

Ching, Y. H. (2009). *The effects of computer-based video strategy training for problem representation and self-explanation on undergraduate students representing and solving ill-structured problems*. Unpublished doctoral dissertation, Pennsylvania State University, PA, USA.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982–1003.

Hassan, A. (2009). *Determinants of mobile learning acceptance: An empirical investigation in higher education*. Unpublished doctoral dissertation, Oklahoma State University, Stillwater, OK.

Human Resources Development Fund (HRDF). (2011). *Malaysia training programme*. Putrajaya, Malaysia: Ministry of Human Resources.

Mahavera, S. (2014). *Low quality Malaysian education more alarming than household debt, says World Bank economist*. Retrieved from http://www.etawau.com/edu/Department/EducationSystem.htm

Manimekalai, J. (2014). *Determinants that influence adoption of mobile technology in learning environment*. Unpublished Ph. D. thesis, Asia e University, Kuala Lumpur, Malaysia.

Munisamy, S. (2012). Corporate operations research practice: Evidence from Malaysia. *Interdisciplinary Journal of Contemporary Research in Business, 4*(3), 342–352.

OECD (Organisation for Economic Co-operation and Development). (2004). Retrieved from http://www.oecd.org/

PISA. (2012). *Technical report*. OECD. Retrieved from https://www.oecd.org/pisa/pisaproducts/PISA-2012-technical-report-final.pdf

Prensky, M. (2005). *Adopt and adapt school technology in the 21st century*. Retrieved from http://www.edutopia.org/adopt-and-adapt-shaping-tech-for-classroom

Ragus, M. (2006). M-learning: A future of learning. *Knowledge Tree eJournal, Edition, 9*.

Rosli, M., Ismail, I., Idrus, R. M., & Ziden, A. A. (2010). Adoption of mobile learning among distance education students in Universiti Sains Malaysia. *International Journal of Interactive Mobile Technologies, 4*(2), 24–28.

Segan, S. (2014). *Which carrier is the best for fast mobile data where you live? Fastest mobile networks 2014*. Retrieved from http://www.pcmag.com/article2/0,2817,2459185,00.asp

Siraj, S., & Nair, V. K. (2008). *Mlearning modules design for futuristic secondary curriculum implementation Malaysia*. Konvensyen Teknologi Pendidikan (Educational Technology Convention), 654.

Watson, H., & White, G. K. (2006). mLearning in education: A summary.

Wentzel, P., Lammeren, R., Molendijk, M., Bruin, S., & Wagtendonk, A. (2005). *Using mobile technology to enhance student's educational experiences*. Case study from the EDUCAUSE Centre for Applied Research. Retrieved from http://www.educause.edu/ir/library/pdf/ers0502/cs/ecs0502.pdf

Zainab, H. (2003). *Factors affecting distance learning student's use of the Internet as a student support system*. Unpublished Ph.D. thesis, University of Malaya, Kuala Lumpur, Malaysia.

Part III
Digitised Media and Open Educational Resources

Chapter 13
An Explorative Study on the Pedagogical Potential of Gamification

Anna Wing Bo Tso and Janet Man Ying Lau

Abstract Recent studies indicate that learners who participate in digital game-based learning do exhibit a deeper understanding of the learned subject, better problem-solving skills, and a higher level of academic achievement. However, to what extent can educational games be adapted to the local context, culture, and curriculum is yet to be examined. With a view to finding out how useful digital gamification is to young learners, this chapter recounts a small-scale study on the pedagogical possibility of electronic gaming in the Hong Kong mathematics curriculum and then progresses to a discussion of how digital game-based learning can increase learners' motivation, develop learners' autonomy, and improve their academic performance.

Keywords Digital game-based learning (DGBL) · Gamification · Primary school mathematics education · Self-directed learning

The Learning Landscape in the Digital Age

According to Bloom's taxonomy of learning domains (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956), educational objectives can be classified into hierarchical categories, each progressing into the next. The successive levels of knowledge structure are ordered from less to more complex in the following sequence: knowledge, comprehension, application, analysis, synthesis, and evaluation. Similarly, in Anderson and Krathwohl's modified taxonomy of the cognitive domain (2001), there are six successive levels: remembering, understanding, applying, analysing, evaluating, and creating. When educators compare the conventional classroom teaching with the taxonomy of learning domains, it is found that because of the

This research is part of the 'Digital Culture, the Humanities and New Possibilities for Teaching and Research' project, currently being undertaken at the Research Institute for Digital Culture and Humanities (RIDCH), a research institute supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (UGC/IDS16/14).

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_13

numerous constraints in the class size, time limitation, and assessment standardisation, learning in classrooms can hardly go beyond the knowledge stage of rote memorisation and defining.

The issue of classroom teaching and learning is getting more and more problematic as technologies proliferate in recent years. For the twenty-first-century digital era, educators and researchers have come up with new taxonomies of what learners should obtain in education, which includes digital literacy, team-working, problem-solving, self-directed learning, and readiness for lifelong learning (Jerald, 2009; Voogt & Roblin, 2012). The conventional teaching mode in classrooms falls short in facilitating most of the new skills mentioned in the new taxonomies of learning domains, and it is imperative that educators promote digital gamification, or digital game-based learning, which not only trains up learners' digital literacy but also 'recruit[s] learning and mastery as a form of pleasure' (Gee, 2008, p. 36), helping learners 'to develop situated understandings, to learn through failure, and to develop identities as expert problem solvers' (Squire, 2006, p. 26).

Purpose of the Study

While edutainment through digital games has opened up new possibilities in teaching (Buckingham, 2005; Gee, 2003; Prensky, 2002), some teachers and parents in Hong Kong are still hesitant to accept the game-based e-learning approach. One major concern is: gameplay can be an addictive time waster. If digital educational games are to be adapted to the formal curriculum, to what extent can they really enhance students' learning experience? With a view to exploring the effectiveness of incorporating electronic educational games in the formal curriculum, in May 2015, we conducted a contrastive study of the conventional lecture method and the gamification teaching method in primary mathematics education in Hong Kong.

Research Questions

In our preliminary study, we have two research questions:

1. Can digital gamification increase learners' motivation and autonomy when young learners (aged 8–11) learn serious mathematics items such as compass skills, map reading, and distance measurement?
2. Can the use of digital games improve the young learners' math performance?

By comparing the learners' performance and learning motivation in both pedagogical approaches, we will first report on the key findings of the case study in Hong Kong. Based on the data and results, we will discuss the pedagogical potential of digital gamification.

The E-Learning Game Package

This digital game package was one of the free resource kits created and developed for the Hong Kong Education City, established by the HKSAR Government (www.hkedcity.net) as an open e-learning platform under the Education Bureau. The target users of the digital game package are primary school teachers and students in Hong Kong. Learning materials, games, and quizzes in different subjects can be found in the website, which range from languages to science.

The digital game package, 'Concepts and Measurement of Directions', is a web-based e-learning package for the Mathematics iWorld of the Hong Kong Education City. It includes three digital games, namely, (A) 'Simulated Scene Design', (B) 'Quiz', and (C) 'Treasure Hunt'. Each game is designed with a specific learning aim to enhance the players' knowledge on the concepts and measurement of directions. The digital game package is intended to provide students' learning motives to explore the games themselves. As children love playing games, using games as the learning tool is appropriate. The design of the game flow and interface has employed a user-friendly navigation strategy. Active engagement, interactivity, and visually attractiveness in the game design are meant to suit the needs of children at the age of 7–11 (i.e. Primary 2 to Primary 5), who are also the primary target group.

In consideration of user-friendly navigation, all instructions were written in simple expressions and the texts are easy to scan in an online environment. As shown in Figs. 13.1 and 13.2, the clear button design assists players of different education levels. Players can choose the language of instruction (Chinese or English) and the game type as they see fit. The games also allow players to opt in and opt out anytime with multiple points of navigation and entry on every page. It is designed particularly to aid the classroom teaching environment that is not necessarily bound by time or sequence. It provides freedom for players to change pathways. The games can be played individually or in pairs.

To achieve self-directed learning, children players have to actively engage in the gameplay. In other words, interactivity and visually attractiveness are essential elements in children games. Additionally, the story setting in the game is another important component that can enhance interactions among the players in the gameplay. Although linear storytelling in game design is a common approach, this game package is not quite the same. It does not have a strong narrative or a linear storytelling to follow through from one point to another. Instead, the game structure offers various settings allowing users to create their own individual 'mini-story'. For example, as Fig. 13.3 has shown, in game (A) 'Simulated Scene Design', the player is given ten scenes, including a jungle, a park, a town, a business centre, etc. After a scene is selected, 15 relevant objects/locations are provided and five objects in maximum can be selected (see Fig. 13.4). The player can drag these items onto the selected scene (see Fig. 13.5). The idea of this digital game is like giving a choice of several objects for players to create their own scene. After the objects are dragged onto the virtual map of the selected scene, players will need to answer the questions

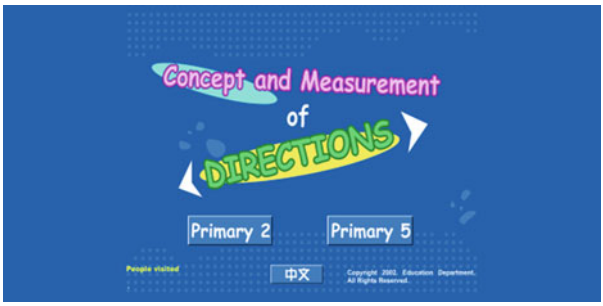

Fig. 13.1 Homepage where game players can choose the language and the educational level

Fig. 13.2 Page where game players can choose from the three different digital games (they can play the digital games in any order as they wish)

Fig. 13.3 Page where game player can choose the scenes

Fig. 13.4 Page where game players can drag the selected items onto the virtual map of the selected scene

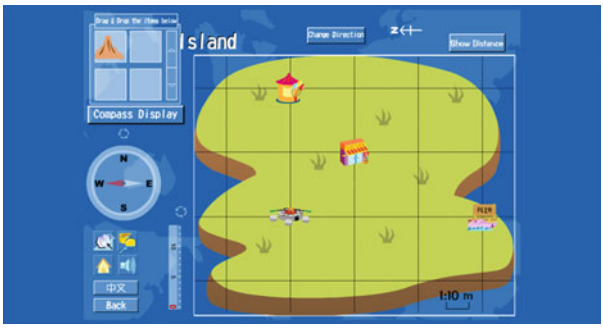

Fig. 13.5 Page where game players can play the selected items in any location they prefer within the virtual map of the selected scene

in relation to the direction of the chosen object with the use of compass point and the extensible ruler provided in the game. It encourages the players to participate in and work creatively through learning. Players are expected to get actively involved in designing their own individual 'mini-story' and enjoy learning through playing.

To further enhance the players' learning experience, the other two games, (B) 'Quiz' (Direction Game) and (C) 'Treasure Hunt', are designed for players to apply their knowledge and skills in map-reading, compass bearing, and distance measurement. The former includes a set of interactive exercises as revision for student players (see Fig. 13.6), while the latter allows player(s) to apply the mathematics skills acquired from the first two games and hunt for treasure. The latter game, as shown in Fig. 13.7, is designed in a chessboard-like format, and the player(s) need to enter the direction and steps in order to move the designated cartoon character(s). Each move is given a controlled time. Player(s) need to obtain as many treasures as possible and escape from the barriers to win the game. The 'Treasure Hunt' game provides a competitive environment which keeps the player(s) more engaged in the game.

Methodology

In order to gain a better understanding of how electronic games may influence the learning and teaching of primary mathematics education, we conducted a small-scale case study by setting a control group and an experimental group. Both groups consisted of a class of 20 local Hong Kong primary school students aged 8–11. Ninety-five percent of the control group participants revealed that they had learnt to identify the eight compass points from the math lessons in school. On the other hand, only 40% of the experimental group participants had learnt about compass directions. Nonetheless, in the study, a 20-min conventional-based, face-to-face lecture on map-reading, compass bearing, and distance measurement was given to the control group. Likewise, the experimental group was given a similar 15-min lecture. The only difference was that on top of the lecture, each participant of the experimental group was also given 5 min to play the electronic game package. Finally, all

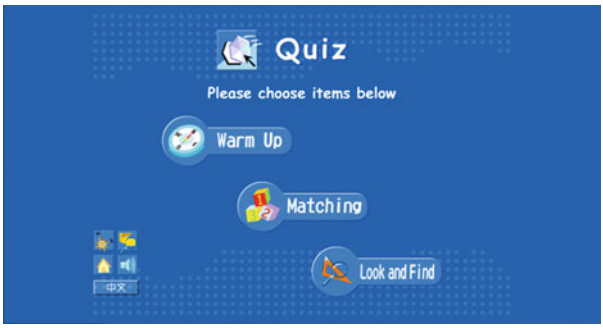

Fig. 13.6 Three types of interactive exercises to be chosen

Fig. 13.7 A two-player chessboard game

participants were given a test on compass bearing and distance measurement. After the test, all participants were asked to fill in a questionnaire and write down their feedback about the learning session too.

Findings and Discussion

The survey data show that up to 95% of the game players in the experimental group acknowledged the effectiveness of electronic games in mathematics education, among which 55% stated that electronic educational games were helpful in strengthening their understanding of compass directions and distance measurement; 40% agreed that the electronic game package was, to some extent, useful.

Learners' Motivation and Autonomy in the Control Group and the Experimental Group

Noticeably, as can be seen in Table 13.1, 80% of the game players reflected that learning became exciting and engaging when they were allowed to try the new

Table 13.1 The views towards the electronic games of the experimental group participants

	Yes	Yes, to an extent	No
1. Do you think electronic games can enhance your understanding of compass directions and distance measurement?	55%	40%	5%
	(11)	(8)	(1)
2. Do you think that the learning session with electronic games was enjoyable and engaging?	60%	20%	20%
	(12)	(4)	(4)

electronic games in the learning session. As we instructed the game players to stop playing the game and move on to the math test, many participants asked if they could be allowed more time to continue with the game. Many participants who had completed the written test also came back and requested if they could play the electronic games again. From the written feedback, it is found that young learners from the experimental group used positive adjectives such as 'fun', 'happy', 'useful', and 'interesting' to describe their learning process.

However, the survey data collected from the control group do not appear to be as positive as that of the experimental group. Although 19 out of 20 participants agreed that the lecture on compass directions and distance measurement was useful to them, only fewer than half of the participants replied that they found the conventional-based learning session enjoyable; 11 rated the session as 'passable' only, whereas one-fourth of the learners proposed that the session could be improved if games are used (see Table 13.2).

Apparently, game-based learning is desirable for all. The control group suggested that games should be used in their learning, while the experimental group reflected that the digital game package did make learning enjoyable for them. Through the small-scale case study, we can see that electronic games, when incorporated in mathematics education, can definitely increase learners' motivation and autonomy.

Math Performances in the Control Group and the Experimental Group

Comparing the test performances of the control group and experimental group, we can observe that there may be a positive correlation between learners' performances and the use of electronic educational games. Most noticeably, as can be seen from Figs. 13.8 and 13.9, our data show that only 25% of the control group participants managed to complete all test questions, and the average score seems unexpectedly low: only 57 out of 100. Moreover, while most control group participants gained score through rote memorisation in *Part A: Labelling the compass points*, they performed fairly poorly in *Part B: Distance measurement on the map*.

By contrast, the performance of the experimental group was better in all aspects: as shown in Figs. 13.1 and 13.2, 85% of the participants completed all test questions. The average score obtained was 72 out of 100, and most experimental group

Table 13.2 Feedback from control group participants on being asked 'How do you think the learning can be improved?'

1	Game. Game is fun
2	Play games; go out of the classroom
3	Through the games
4	Through the games
5	Give harder questions; explain more

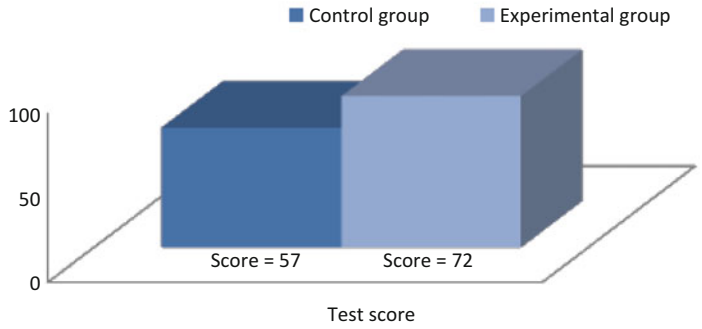

Fig. 13.8 A comparison of the test score of the control and experimental groups

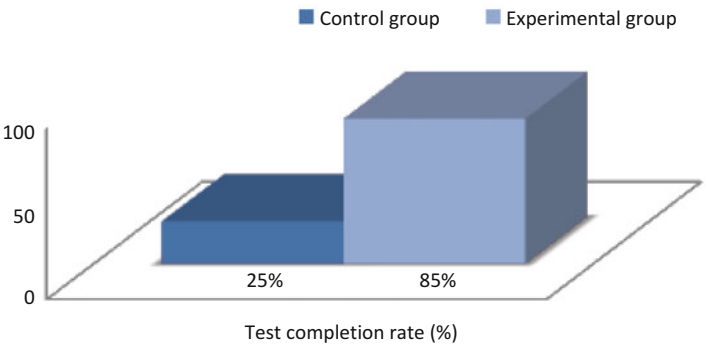

Fig. 13.9 A comparison of the test completion rate of the control and experimental groups

participants gained relatively good scores from both *Parts A* and *B* of the test. This shows that most learners of the experimental group not only had good rote-memorisation skills but also better map-reading, compass, and distance measurement skills.

The results suggest that electronic educational games can indeed create a positive chain reaction in learning: first, they enhance young learners' motivation, turning them in self-directed learners. Once motivated, learners tend to be more willing to

spend time in learning and make an effort in completing challenging tasks. As a result, it comes as no surprise that the highly motivated, hard-working self-learners achieve better learning results and a higher level of satisfaction.

Conclusion

Through the survey statistics, participants' feedback, and the test results collected from this small-scale case study, we can conclude that the use of electronic games for learning and teaching in primary mathematics education is successful. It is not only useful in eliciting learners' motivation, enhancing learner's self-directed learning skills, but also significant in improving learners' academic performance. As digital experience has come to play a central role in modern life, educators should reflect upon what they can do to help students train up their digital literacy, problem-solving, self-directed learning, and readiness for lifelong learning, so as to become competitive and well-equipped for their future. The conventional teacher-centred method must change. Incorporating game-based e-learning in classrooms is going to be a global trend.

References

Anderson, L. W., & Keathwohl, D. R. (Eds.). (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. New York: Longman.

Bloom, B., Englehart, M., Furst, E., Hill, W., & Krathwohl, D. (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain*. New York/ Toronto, Canada: Longmans, Green.

Buckingham, D. (2005). *The media literacy of children and young people: A review of the research literature*. London: Ofcom.

Gee, J. P. (2003). *What video games have to teach us about learning and literacy*. New York: Palgrave Macmillan.

Gee, J. P. (2008). Learning and games. In K. Salen (Ed.), *The ecology of games: Connecting youth, games, and learning* (pp. 21–40). Cambridge, MA: MIT Press.

Jerald, C. D. (2009). *Defining a 21st century education.* The Center for Public Education. Available at. http://www.centerforpubliceducation.org/Learn-About/21st-Century/Defining-a-21st-Century-Education-Full-Report-PDF.pdf

Prensky, M. (2002). *The motivation of game play: The real twenty-first century learning revolution*. On the Horizon, 10(1). Retrieved from http://www.marcprensky.com/writing/Prensky%20-%20The%20Motivation%20of%20Gameplay-OTH%2010-1.pdf

Squire, K. (2006). From content to context: Video games as designed experiences. *Educational Researcher, 35*(8), 19–29.

Voogt, J., & Roblin, N. (2012). A comparative analysis of international frameworks for 21st century competences: Implications for national curriculum policies. *Journal of Curriculum Studies, 44* (3), 299–321.

Chapter 14
A Comparative Study of the Teaching Effect of 'Flipped' MOOC Class and Conventional Class

Xiaolu Chen and Helan Wu

Abstract MOOC and flipped classes are models of instruction which have sprung up in the last few years, in educational circles all over the world. In the School of Physics and Engineering at Tongji University, we have integrated a flipped class into a MOOC teaching method, which is called a 'flipped' MOOC class. The aim of this paper is to assess whether this improves the quality of instruction in university physics classes and enhances student performance. Two second-year physics classes were randomly chosen as the research subjects, with one class being taught in the conventional way and the other with the flipped MOOC method. In order to guarantee a reliable foundation for comparing students' learning effectiveness in these two approaches, we analysed the rationality of the teaching process and the evaluation method. After a correlation analysis of the students' records for both classes, we concluded that the flipped MOOC class showed an enhanced teaching effect and better student grades than the conventional class. In the process, we encountered some unexpected problems. So, we figured out why they were happening and reflected on how we could handle these difficulties if we wanted to promote quality instruction and improve students' ability by this flipped MOOC approach.

Keywords Massive open online courses · MOOC · Flipped class · Teaching effect

Background

Flipped classrooms and MOOCs are both new teaching models which arose in the USA and then rapidly became popular in international higher education and educational theory. They were selected by the NMC Horizon Reports in 2013 and 2014 as important educational technologies which would have a major effect on education in the near future. In China, a National Plan for educational reform advocated 'using national advanced educational concepts and educational experience to promote reform and development of our education, and elevate the level, influence and the

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_14

competitiveness of the educational system on the national stage' (National Plan for Medium and Long-term Education Reform and Development, 2010). It also points out that we should try new pedagogical approaches and be more motivated to carry on educational informationisation.

Literature Review

The flipped classrooms began in Forest Park High School, Colorado, in the USA, and the videos of Salman Khan and his Khan Academy in 2011 became a milestone in the flipped classroom development process. In 2012, in Education Week, Katie Ash said that a rapidly increasing number of scholars are replacing lectures with on-demand videos; and, according to Yang, Yang and Chen (2012), this new way of teaching in the classroom very soon attracted worldwide attention. Gardner (2012) points out that the studies on flipped classrooms in foreign countries are centred on how they work in educational practice; Strayer (2012) compares such classrooms with the conventional teaching mode; and Cannod, Burge, and Helmick (2008) point out the educational effect when we connect the flipped classroom with other educational methods and technologies. These researchers concentrate on the application of flipped classrooms as an important issue and take an extensive period of time to test this new teaching model; and with accumulating experience of the process, they argue that it is a proven improved practice in classroom teaching. However, there are many differences between the educational concepts and teaching forms of China and America, so we cannot just transplant their experience into our courses. We need to examine closely the benefits and limitations of this new teaching model in the Chinese context.

MOOC originated from the development of open education resources (OER). Following the launch of the major OER platforms (e.g. Coursera, edX and FutureLearn) in about 2012, MOOC has become fashionable worldwide. Many universities in China are starting to organise their own MOOC courses, such as molecular biology at Wuhan University, flipped classroom instruction at Beijing University, preventive medicine at Fudan University and college physics at Tongji University. For supporting progress in this development, online education platforms have been set up. For example, Shanghai Jiao Tong University developed the platform 'Good University Online', and Tsinghua University took the initiative to find 'online courses'. Both the Ministry of Education and Ministry of Finance are together supporting funding for i-course platforms; and some platforms are designed by commercial companies.

According to Zhang (2012), the practice of flipped classrooms in China is just at the beginning and is still at an introductory stage. His paper about flipped classrooms is mainly concerned with theoretical analysis, discussing this new teaching model, implementation strategy and teaching design, though there is much more theoretical than practice and more about description of educational belief than providing empirical research findings. Wang and Zhang (2013) indicate in their research that

there are ongoing discussions about this new pedagogical approach in primary and middle schools but little about its application in colleges. Also, there is little comparative study of the teaching effectiveness of flipped classrooms and conventional classes.

We combine the flipped classroom with a MOOC platform because of the expanding functions of MOOC platforms, which promotes the educational process in a more open and free educational environment. Meanwhile, the discussion segment in the flipped classroom could offset the disadvantages of MOOC in comparison with the conventional face-to-face didactic teaching in the classroom.

The Research Study

This section outlines our research subjects, the educational processes involved in the 'flipped' MOOC classroom compared with conventional education and the reasons for evaluating the two educational models. Then it presents a contrastive analysis of what was achieved.

Research Subjects

Second-year students in two physics classes at Tongji University were chosen as the research subjects. We divided the students into classes randomly according to their entrance scores, so we can assume that the classes had no essential differences.

Contrasts in the Teaching Process

Table 14.1 gives details of the different educational processes in the 'flipped' MOOC model and conventional classes at various stages.

Some pedagogical stages are essential in the flipped MOOC class: pre-learning content class → discussing in the class →teacher's guidance and problem-solving →summarising. This is different from the teaching process in the conventional class: prepare lessons before the class →teacher's explanation in class →exercises after the class.

As seen in Table 14.1, we use the 'flipped classroom' process in the 'flipped' MOOC class, but almost two-thirds of the process taking place in the MOOC platform is different. Before class, the teacher uploads the necessary resources into the platform, and the students just learn from those resources provided by the teacher and complete the test. In class, the teacher's major tasks are organising student discussion, to be supplemented by explaining misunderstanding of the questions and missing knowledge, and assigning homework – while students discuss the pretest

Table 14.1 The contrast in the teaching process between the 'flipped' MOOC class and a conventional class

Phase	Time	'Flipped' MOOC class		Conventional class	
		Activity of the teacher	Activity of the student	Activity of the teacher	Activity of the student
Pre-class	A week before class	Upload the necessary resources	Understand the teaching videos and teaching materials, the basic teaching tasks and teaching requirements	Prepare the teaching content and teaching materials	Preview the basic knowledge in the educational content
In-class	The first class	Introduce the teaching contents – Their emphasis and difficulty	Complete the teaching videos, the online test and assessment	Complete the first part of the content	Complete the study mission and homework after the class
	The second class	According to the students' feedback in the process of the online class, organise students to discuss the problems	Participate in group discussion; reflect the problems in the online course to the teacher and solve them; actively help group members to solve problems	Study the second part of the content, and solve the problems about the lesson in the class	Reflect the problems in the first lesson to the teacher; complete the learning tasks in this course
	The third class	Give supplementary explanation, unriddling and homework	Correct the mistakes in the discussion and, before class, submit the network operation	Complete the course, sum up the knowledge, and arrange homework	Finish homework
After-class	A week after class	Provide online support	Communicate with peers online about homework questions after class	Nil	Consolidate knowledge
Platform		A network teaching platform will be required for the release of study guides, learning resources and teaching videos, online testing and test results of the real-time statistics and feedback		Nil	

questions cooperatively with their teammates and modify misunderstandings with the help of the teacher. After class, the teacher can discuss any problems with the students online, and they can also interact with each other on the platform. In the conventional classes, the teachers give a lecture, and students just listen to it.

Table 14.2 Standards of evaluation

Standards of evaluation						
	Procedure			Online		Exam (%)
	Homework (%)	Attendance (%)	Course (discussion) (%)	Participation (%)	Online test (%)	
'Flipped' MOOC class	10	5	15	15	15	40
Conventional class	10	10	10	Nil		70

Standards of Evaluation

The standards of evaluation are shown in Table 14.2. As the standards of evaluation are the basis of effectiveness of learning and teaching, it is important to ensure that the contrast in teaching results between the 'flipped' MOOC class and the conventional class is reliable and reasonable.

As shown in Table 14.2, in a 'flipped' MOOC class, the final score = the procedure score * 30% + the online score * 30% + the exam score * 40%. The procedure score includes homework, class attendance and participation in discussion; and the online test comprises an online score. In the conventional class, the final score = the procedure score * 30% + the exam score * 70%; and the procedure score also includes homework, class attendance and discussion. The conventional class has no online component, so the exam score takes up 70% of the final score. As seen in Table 14.2, in the procedure score, the proportion of the total score for the 'flipped' MOOC class is the same as in the conventional class, but there is some difference between them in classroom learning, as about one-third of the attendance time is used for online learning – and so the disparity between the two classes is reasonable. There is more discussion – a more educational part – in the 'flipped' MOOC class than in the conventional class; and it can also be seen that the proportion for the online test and exam score in the 'flipped' MOOC class is equal to the proportion for the exam score in the conventional class because the online course takes one-third of the total time and every single section has a test. The data for tests were collected for a process evaluation and a supplement to the exam.

Contrastive Analysis of the Teaching Effectiveness

The examination papers used in the two classes were the same, and no students knew the details in the papers before the exam, so it is reliable. The procedure scores, online scores, exam scores and final scores in the two classes were analysed by SPSS and Excel.

Table 14.3 The score table for the 'flipped' MOOC class

'Flipped' MOOC class						
	Highest score	Lowest score	Average score	Population variance	Sample variance	Standard deviation
Exam scores	94	35	71.75	191.53	193.66	13.91
Final scores	94	29.8	79.59	139.29	140.83	11.86
Online scores	100	33	79.4	353.04	357.01	19.01
Procedure scores	97	9	86.7	142	143.4	14.9

Table 14.4 The score table for the conventional class

Conventional class						
	Highest score	Lowest score	Average score	Population variance	Sample variance	Standard deviation
Exam scores	97	0	67.73	351.73	354.02	18.75
Final scores	96.1	9.3	73.8	244.23	245.81	15.62
Procedure scores	100	23	88	208.3	209.7	14.43

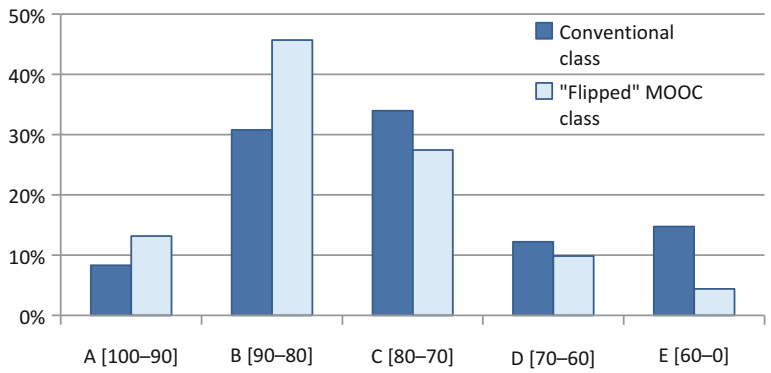

Fig. 14.1 The grade distribution statistics

The scores for the 'flipped' MOOC class are shown in Table 14.3 and for the conventional class in Table 14.4. The difference between the two classes in different items was analysed, and Fig. 14.1 presents the grade distribution statistics. The *t*-test correlation analysis is presented in Table 14.5.

The highest score, lowest score, mean score and variance of the exam scores and final scores were analysed, and the results for the two classes were compared. As Tables 14.3 and 14.4 show, although the highest exam score and final score in the 'flipped' MOOC class were slightly lower than those in the conventional class (i.e. 3

Table 14.5 *T*-test correlation analysis

	T double tail critical	*P* ($T <= T$) double tail	F single tail critical	*P* ($F <= F$) single tail
Exam scores	1.97	0.046	1.816	0.0011
Procedure scores	1.97	0.575	0.991	0.474
Final scores	1.97	0.001	1.734	0.002

and 2.1 scores, respectively), the lowest exam score and final score were much higher in the 'flipped' MOOC class than those in the control group, i.e. the conventional class where they were 0 and 9.3. The mean exam score in the 'flipped' MOOC class was 71.75, which was 4.02 higher than the mean exam score of 67.73 in the conventional class; and the average final score in the 'flipped' MOOC class was 79.59, which is 5.79 higher than the average final score of 73.8 in the conventional class. Finally, the variance in the conventional class was higher than that in the 'flipped' MOOC class – that is, the grades in the conventional class were much more scattered.

The students' scores were divided into five groups: A [100–90], B [90–80], C [80–70], D [70–60] and E [60–0]. Figure 14.1 shows that the percentages in the five groups in the 'flipped' MOOC class, respectively, were 13.18%, 45.76%, 27.47%, 9.89% and 4.39%; while in the conventional class, the respective figures were 8.33%, 30.76%, 33.97%, 12.18% and 14.74%. In Groups A and B, the percentages for the 'flipped' MOOC class were 4.85% and 15% higher, respectively, than in the conventional class; and, in Groups C, D and E, they were 6.5%, 2.29% and 10.35% lower than in the conventional class. Therefore, it can be said that at the higher levels, the learning outcomes in the 'flipped' MOOC class were much better than those in the conventional class.

A correlation analysis was then carried out for the exam scores, procedure scores and final scores. For the exam scores, using analysis of variance methods to do a significance test of the homogeneity of variance in the two classes, the results were $F = 1.816$, $p = 0.0011$ – thus indicating homogeneity. A bilateral *t*-test ($t = 1.97$, $p = 0.046 < 0.05$) showed that the difference was significant. As the average exam scores for the 'flipped' MOOC class and conventional class were 71.75 and 67.73, respectively, the average exam score for the former class was therefore much better than for the latter. For the procedure scores, using the same method, $F = 0.991$, $p = 0.474$, showing homogeneity. The bilateral *t*-test result – $t = 1.97$, $p = 0.575 > 0.05$ – indicated that the difference was not significant. The average procedure scores in the 'flipped' MOOC and conventional classes were 86.7 and 88, respectively, so the average procedure score for the former class was a little better than for the latter. Lastly, again using the same approach for the final scores in the two classes, the result ($F = 1.734$, $p = 0.002$) showed homogeneity. The result of the bilateral *t*-test ($t = 1.97$, $p = 0.001 < 0.05$) indicated that the difference was significant. As the average final scores in the 'flipped' MOOC class and

conventional class were 79.59 and 73.80, respectively, one can see that the average final scores for the former were much higher than for the latter.

Conclusion

In conclusion, the average exam score in the 'flipped' MOOC class was better than the average exam score in the conventional class, and the *t*-test showed that the difference between them was significant; and the same applied to the average final scores. However, there was not a significant difference in procedure scores. So, compared with the conventional class, the learning outcomes in the 'flipped' MOOC class were better. It is suggested that this outcome was due to student interest and learning involvement and that the online course may have extended the learning time.

There were 106 students in the 'flipped' MOOC class, excluding 91 students who did not register for the online course (i.e. 85% of the total). There were 163 students at the beginning. However, some students dropped out in the process, leaving only 156 students in the conventional class attending throughout the course, i.e. 93% of the total. Compared with the conventional class, more students in the 'flipped' MOOC class did not register for attendance. There are several possible reasons for this. First, some students resist the new teaching methods and did not want to sign up for the online course. Second, the way in which the 'flipped' MOOC was introduced was not clear so that some students misunderstood what was involved in the process. Also, technology problems in the MOOC platform, if any, may result in deregistering.

The 'flipped' MOOC class did not just enhance students' knowledge. The students also learned cooperative, self-management, communicative and organisational skills, and so the 'flipped' MOOC class has good prospects.

References

Ash, K. (2012). Educators evaluate 'flipped classrooms. *Education Week, 10*, 6–8.

Cannod, G. C., Burge, J. E., & Helmick, M. T. (2008). Using the inverted classroom to teach software engineering. *Proceedings from the ACM/IEEE 30th international conference on software engineering* (pp. 777–786). Leipzig, Germany.

Gardner, J. G (2012). The inverted agricultural economics classroom: A new way to teach? *Presented at the Agricultural & Applied Economics Association AAEA annual meeting*. Seattle, WA.

Strayer, J. F. (2012). How learning in an inverted classroom influences cooperation, innovation and task orientation. *Learning Environment Research, 15*, 171–193.

The State Council. (2010). *The national plan for medium- and long-term education reform and development (2010–2020)*. Beijing, China. Retrieved from http://www.gov.cn/jrzg/2010-07/29/content_1667143.htm (in Chinese).

Wang, X. D., & Zhang, C. J. Z. (2013). The application of research on flipped classroom in university teaching. *Modern Educational Technology, 8*, 11–16.

Yang, G., Yang, W. Z., & Chen, L. (2012). Ten cases of 'flipped classroom'. *Educational Technology of Middle and Primary School, 8*, 11–13.

Zhang, Y. J. (2012). The change of flipped classroom. *China Information Technology Education, 10*, 118–121.

Chapter 15
Formative Evaluation of Hong Kong's First Open Textbooks

Kin Sun Yuen and Kam Cheong Li

Abstract Twelve open textbooks for the local school curriculum – the first set ever developed in Hong Kong – were completed in 2015. During the development process, formative feedback was gathered from primary and secondary school teachers and students who tried out some of the draft versions of the units in the textbooks developed for the project. The evaluation was carried out with the aim of improving the open textbooks being produced. This paper reports the results of the formative evaluation which involved two questionnaires, one for the teachers and the other for the students.

Keywords Open textbooks · Open licence · Textbook evaluation · Open educational resources

Introduction

In 2012, the Open University of Hong Kong (OUHK) obtained funding from a charity, through the support of the Government of the Hong Kong Special Administrative Region, to develop an open textbook system for Hong Kong. The deliverables of the project include open textbooks at tertiary, secondary and primary levels. This involved the development from scratch of 12 open textbooks covering the formal school curriculum for the English Language subject for all primary and secondary levels (Yuen & Li, 2012).

The project started in January 2013, and by mid-2015, 12 open textbooks for primary and secondary schools were completed. Feedback from teachers and students was gathered during September 2014 to April 2015 when the books were in their developmental stage (Li, Yuen, & Wong, 2015). Data were collected mainly through two surveys, one on teachers and the other on students. This paper reports the survey results for the formative evaluation.

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_15

The Open Textbook Project

One major motivation for carrying out the project was to alleviate the problem of high textbook prices, a perennial issue in Hong Kong (Consumer Council, 2001, 2012; Li, Yuen, Cheung, & Tsang, 2012). There is also a need to allow teachers to tailor textbooks for their individual learner groups. However, commercial textbooks already printed for the market offer no possibility for adaptation. Also, copyright licences for electronic versions of textbooks do not allow tailoring for repurposing contents.

Hong Kong's Education Bureau (EDB) recognises the role of e-learning resources in education (Education Bureau, 2009). Yet, even the learning materials in the Bureau's associated websites generally do not use open licences, such as Creative Commons. Teachers, therefore, do not have materials at hand which they can adapt to suit their students' needs. Even though the EDB launched the E-textbooks Market Development Scheme in 2012 (EMADS, see Education Bureau, 2012), teachers are not able to make changes to the e-textbooks under the scheme. To promote the wide practice of e-learning, the availability of free access e-learning resources which also allow free adaptation is essential.

In this context, a group of senior staff at the Open University of Hong Kong believe that open textbooks could solve the problem of escalating textbook prices, allow quick updates and tailoring of the learning resources and provide easily accessible electronic resources for e-learning.

Learning from the experience of open textbooks around the globe (Allen, 2010; Fischer, Hilton, Robinson, & Wiley, 2015; Petrides, Jimes, Middleton-Detzner, Walling, & Weiss, 2011), the project (entitled 'Open Textbooks for Hong Kong') offers many advantages. Those which are particularly relevant to schools in Hong Kong are as follows:

- The price of the printed textbooks is greatly reduced. With the use of the Creative Commons licence for the textbooks, teachers, parents and students only pay for basic printing costs for the printed copies, through our recommended on-demand printer or using their own means. We estimate that our open textbooks will cost less than 30% of an average textbook in the market.
- Where necessary, rapid revisions and timely updating of the textbook content can be made efficiently.
- Teachers are able to select and customise the open textbooks to cater for the specific needs of particular groups of students.
- The e-versions of the textbooks are free of charge. The multimedia elements of the content greatly enrich students' learning experience. Since they can be easily downloaded or are accessible online for active and flexible learning, such versions of the textbooks are conducive to effective e-learning.

The open textbooks have been designed to be closely aligned to the syllabi set by the EDB. The books will encourage active and flexible learning, and we are mindful of developing a textbook that can be customised to meet students' interests, needs

and expectations in varied contexts. The textbooks not only contain text-based contents – they also include interactive learning contents, and they are hyperlinked to useful online resources for students' further enrichment.

Methods

We began our formative evaluation of the open textbooks, while some of the early draft units were being tried out. After promotional work on the Open Textbooks project, 43 schools (19 primary and 24 secondary) joined the trialling of the textbooks in the 2014–2015 school year. Some schools used the textbooks in the first term (starting September 2014) and others in the second term (starting February 2015).

In the tryout of the textbooks, most teachers just adopted the printed copies. In some cases, the e-versions were also used for demonstration in the classroom. Many teachers used the open textbooks to replace existing textbooks, and others adopted them as supplementary materials. This practice is different from the results of our earlier survey on teachers' expectations of open textbooks, where the majority of teachers said they would just use the open textbooks as supplementary to their existing textbooks.

The teachers were all asked to join an evaluation study after they had used the textbooks. A questionnaire was devised to collect teachers' feedback on the textbooks, and another was produced separately for students. Both questionnaires were designed with reference to EDB's evaluation for assessing the quality of textbooks. The teachers' and students' questionnaires can be found at http://www.opentextbooks.org.hk/resources.

By the end of May 2015, teachers and students from 34 schools (14 primary and 20 secondary) provided us with their feedback on the open textbooks they had used. The return rates are given in Table 15.1.

Table 15.1 Number of teachers and students participating in the tryout scheme

	Questionnaires sent out (schools)	Number of responses	Response rate (%)
Questionnaires for primary students	1875 (14)	533	28
Questionnaires for secondary students	2889 (20)	1077	37
Questionnaires to primary teachers	79 (14)	34	43
Questionnaires for secondary teachers	113 (20)	72	64

Feedback from Students and Teachers

Students' Feedback on the Open Textbooks

There were nine questions in the students' questionnaire. Students were asked to indicate their level of agreement with the statements in a Likert scale: 'strongly agree', 'agree', 'no comment', 'disagree' and 'strongly disagree'.

Primary Students

The first seven questions were about students' views on the textbook. For six of the seven questions, close to one half of the students strongly agreed with the statements (see Table 15.2). The majority of the students ('strongly agree' + 'agree') liked the book (81.05%); found the pictures to be lovely (79.55%); and considered the reading in each lesson to be interesting (67.54%). Also, the textbook gave them a sense of satisfaction after they completed the main tasks (63.42%); the book was convenient to carry as it is printed in separate booklets (72.04%); and the book made them interested in studying English (72.23%). These results suggest that our open textbooks are viewed as quite satisfactory by the primary school students.

However, for the statement 'the listening task is very interesting', nearly half of the students' respondents (44.09%) indicated that they had no comment; and only 36.58% agreed with it. As we were rather concerned about this feedback, we examined the audio component of the electronic textbooks and did not find any major problem with it – the narration can be played with ease, and the sound is quite

Table 15.2 Feedback from primary school students

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I like the book	292	140	56	18	21
	54.78%	26.27%	10.51%	3.38%	3.94%
The diagrams in the book are lovely	285	139	55	26	26
	53.47%	26.08%	10.32%	4.88%	4.88%
The readings are interesting	234	126	80	33	29
	43.90%	23.64%	15.01%	6.19%	5.44%
The listening tasks are interesting	142	53	235	30	37
	26.64%	9.94%	44.09%	5.63%	6.94%
The main tasks give me satisfaction after I work on them	228	110	124	28	33
	42.78%	20.64%	23.26%	5.25%	6.19%
The booklet format is convenient for me to carry	276	108	69	22	46
	51.78%	20.26%	12.95%	4.13%	8.63%
The book makes me interested in studying the subject	284	101	61	31	37
	53.28%	18.95%	11.44%	5.82%	6.94%

audible. We contacted some teachers and asked them why so many students had no comments on this statement. To our surprise, we found that many teachers had not used the narration or the sound effects in the tryout – so the students did not use the narrations. We also examined the proportion of students who disagreed with the statement and found that the percentage was not particularly high. We therefore believe that there may not be a significant problem with our listening tasks.

Two questions were then asked about students' learning (Table 15.3). The feedback showed that 80.87% had learned vocabulary and 64.72% different text types.

Students were then asked to add any comments they wished to make. Some qualitative comments given by primary school students were very graphical and cute. Statements made in Chinese by students included: 'I like this book very much!', 'I like the book so much', 'I hope there are more such books', 'The diagrams are lovely', 'I think it is very interesting', 'Add more exercises!' and 'I love reading the book' (Fig. 15.1).

Table 15.3 New things that primary students have learned

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I have learned new vocabulary from the book	304	127	52	14	30
	57.04%	23.83%	9.76%	2.63%	5.63%
I have learned different text types from the book	246	99	134	16	25
	46.15%	18.57%	25.14%	3.00%	4.69%

Fig. 15.1 Primary students' scripts

Table 15.4 Feedback from secondary school students

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The content of each lesson is related to my everyday life	178	588	257	35	15
	16.53%	54.60%	23.86%	3.25%	1.39%
I am interested in reading the texts	117	511	355	61	30
	10.86%	47.45%	32.96%	5.66%	2.79%
The layout and design of the book are nice	139	365	444	84	41
	12.91%	33.89%	41.23%	7.80%	3.81%
The difficulty is pitched at the right level for my study	172	525	292	55	29
	15.97%	48.75%	27.11%	5.11%	2.69%
The font size is suitable for reading	267	512	248	33	12
	24.79%	47.54%	23.03%	3.06%	1.11%
The textbooks are printed in small booklets; this makes them easy to carry	294	457	270	32	19
	27.30%	42.43%	25.07%	2.97%	1.76%
The content of the book makes me interested in studying the subject	132	451	397	48	40
	12.26%	41.88%	36.86%	4.46%	3.71%

Secondary Students

The secondary school students also indicated their fondness for the textbook, but not as much as the primary school students did (see Table 15.4). For six of the seven questions, close to half of the students agreed with the statements. The majority of the students ('strongly agree' + 'agree') felt that the contents of the lessons were relevant to their daily lives (71.13%); they were interested in reading the texts of the lessons (58.31%); the difficulty level of the books suited them well (64.72%); and the letter font size was well chosen, so that the text was easy to read (72.33%). Also they indicated that the book was convenient to carry as it is printed in separate booklets (69.73%); and the book made them interested in studying English (54.14%). Again, this is a good indication that the secondary students consider our open textbooks to be quite satisfactory.

For the statement, 'the layout and design of the book are nice', close to half of the students (41.23%) had no comment, and 46.80% agreed or strongly agreed with it. This statement receives the least support from students, and the writing team will bear this in mind and try to improve the diagrams and layout of the book, hoping that the improved design will gain greater support from the students.

As regards the impact of the open textbooks on their learning, as shown in Table 15.5, secondary school students agreed that the textbooks increase their knowledge of text types (65.74%), English grammar (61.46%), vocabulary (72.70%), and ability to read (59.24%). Many of them were neutral about the effect of the textbook on their writing skills (42.53%), listening ability (45.59% agreed), ability to speak (46.98%), and knowledge about elective modules (45.87% agreed). When we asked the teachers why this was the case, they answered that their classes did the vocabulary and grammar tasks more than other task**s.**

Table 15.5 New things that secondary students have learned

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The book helps me learn different text types	130	578	297	43	19
	12.07%	53.67%	27.58%	3.99%	1.76%
The book increases my knowledge in grammar	120	542	337	50	21
	11.14%	50.32%	31.29%	4.64%	1.95%
The book helps me learn new vocabularies	203	580	249	27	12
	18.85%	53.85%	23.12%	2.51%	1.11%
The integrated task has increased my writing ability	96	433	458	59	13
	8.91%	40.20%	42.53%	5.48%	1.21%
The integrated task has increased my reading skills	126	512	355	40	10
	11.70%	47.54%	32.96%	3.71%	0.93%
The integrated task has increased my ability in listening	88	370	491	61	20
	8.17%	34.35%	45.59%	5.66%	1.86%
The integrated task has increased my ability in speaking	81	364	506	77	24
	7.52%	33.80%	46.98%	7.15%	2.23%
The 'elective' has increased my knowledge of the 'elective modules'	81	389	494	55	17
	7.52%	36.12%	45.87%	5.11%	1.58%

At the end of the questionnaire, secondary school students also gave qualitative comments on the textbooks. These comments included 'Very good'; 'The content is way too easy for Secondary 5 students'; 'I hope there are more such books in future – they can be cheaper too'; 'There is no need to print them on glossy paper – can you use ordinary paper to print them?'; 'This is a good textbook for learning English'; 'It is easy to take to users [*sic*]'; 'I know if the electronic version of the textbook is used in teaching, students will be more engaged (in learning)'; 'I hope we can use the tablets in the classroom in future'; and 'I think the book is good'. The topic is quite easy for the Form 5 students. It can provide more exercises for students to practise'. (See Fig. 15.2 on secondary students' scripts.)

Teachers' Feedback on the Open Textbooks

In the teachers' questionnaire, there were 20 statements about the open textbooks, and we asked them to indicate the extent to which they agreed with them. For all the questions, the majority of the teachers agreed with the statements about the tryout units (see Tables 15.6 and 15.7).

More secondary school teachers disagreed with the statements than did primary school teaches, but, in general, more than 70% of the teachers indicated that the open textbooks are of good quality.

Fig. 15.2 Secondary students' scripts

The teachers also made very useful and interesting qualitative comments on the perceived impact of the open textbooks in the evaluation questionnaire. Most of them complimented the quality of the textbooks, but some good suggestions were provided to enhance them. These are summarised in Tables 15.8 and 15.9.

Discussion

In general, students' feedback on the textbooks is very positive. We are now more confident about the quality of the books we have produced.

The majority of the primary school students gave a 'neutral' response to the 'listening tasks', but this could be because many teachers had not asked students to download the e-version for their own study. A large percentage (41.23%) of the secondary school students was 'neutral' on the statement 'the layout and design of the book are nice'. Also, nearly half of the secondary school students were neutral on the statements regarding whether the books helped them to improve their writing, listening or speaking abilities. These are the areas in which we need to seek improvement in future updates of the books.

The teachers were also quite positive about the content and presentation of the open textbooks.

The majority of the teachers indicated that there was not much difference in their teaching strategies when open textbooks are used, compared with commercial textbooks. In a way, this reflects their ease and comfort in using the open textbooks for the first time.

In our discussion with teachers, we found that many of them seemed to have 'owned' the textbooks. 'Post-it' tags were used to bookmark the books, which were themselves heavily annotated. They were aware that they can modify the books in the future if they wish. This sense of 'ownership' of the open textbooks is exactly what the project wishes to instil in teachers. It is only when they see themselves as

Table 15.6 Feedback from primary school teachers

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1.1	The content is interesting	2	27	5	0	0
		5.9%	79.4%	14.7%	0.0%	0.0%
1.2	The content is relevant to students' daily life	5	29	0	0	0
		14.7%	85.3%	0.0%	0.0%	0.0%
1.3	The content is effective to meet curriculum requirements	3	31	0	0	0
		8.8%	91.2%	0.0%	0.0%	0.0%
1.4	The level of difficulty is appropriate	2	31	1	0	0
		5.9%	91.2%	2.9%	0.0%	0.0%
2.1	The learning activities can help students to achieve learning targets	1	28	5	0	0
		2.9%	82.4%	14.7%	0.0%	0.0%
2.2	The units facilitate new knowledge integration and application	0	28	5	1	0
		0.0%	82.4%	14.7%	2.9%	0.0%
2.3	The tryout units motivate students to learn	2	26	6	0	0
		5.9%	76.5%	17.6%	0.0%	0.0%
2.4	The instructions in the tryout units are clear	2	27	1	4	0
		5.9%	79.4%	2.9%	11.8%	0.0%
3.1	The organisation of the content is logical	0	32	1	1	0
		0.0%	94.1%	2.9%	2.9%	0.0%
3.2	The use of table of content, headings and outlines is appropriate	0	31	3	0	0
		0.0%	91.2%	8.8%	0.0%	0.0%
3.3	The overviews and summaries can facilitate learning	0	24	10	0	0
		0.0%	70.6%	29.4%	0.0%	0.0%
4.1	The language used is of appropriate level of difficulty	1	29	2	0	0
		2.9%	85.3%	5.9%	0.0%	0.0%
4.2	Familiar and interesting language is used	0	25	3	4	0
		0.0%	73.5%	8.8%	11.8%	0.0%
4.3	The language used is accurate	1	28	3	0	0
		2.9%	82.4%	8.8%	0.0%	0.0%
5.1	The layout is logical and consistent	0	31	1	0	0
		0.0%	91.2%	2.9%	0.0%	0.0%
5.2	The use of space and margin facilitates easy reading	1	27	3	1	0
		2.9%	79.4%	8.8%	2.9%	0.0%
5.3	The illustrations facilitate students' learning	2	25	4	1	0
		5.9%	73.5%	11.8%	2.9%	0.0%
5.4	Appropriate print font size and style	5	19	2	6	0
		14.7%	55.9%	5.9%	17.6%	0.0%
5.5	The paper used for the textbooks is light-weight and durable	3	22	7	0	0
		8.8%	64.7%	20.6%	0.0%	0.0%
5.6	The tryout units used nonglossy paper for easy reading	11	17	4	0	0
		32.4%	50.0%	11.8%	0.0%	0.0%

Table 15.7 Feedback from secondary school teachers

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1.1	The content is interesting	7	55	7	2	0
		9.7%	76.4%	9.7%	2.8%	0.0%
1.2	The content is relevant to students' daily life	18	50	2	1	0
		25.0%	69.4%	2.8%	1.4%	0.0%
1.3	The content is effective to meet curriculum requirements	8	58	3	2	0
		11.1%	80.6%	4.2%	2.8%	0.0%
1.4	The level of difficulty of the tryout units is appropriate	5	49	4	13	0
		6.9%	68.1%	5.6%	18.1%	0.0%
2.1	The learning activities can help students to achieve learning targets	4	52	5	9	0
		5.6%	72.2%	6.9%	12.5%	0.0%
2.2	The tryout units facilitate new knowledge integration and application	6	41	13	10	0
		8.3%	56.9%	18.1%	13.9%	0.0%
2.3	The tryout units motivate students to learn	3	44	14	10	0
		4.2%	61.1%	19.4%	13.9%	0.0%
2.4	The instructions in the tryout units are clear	3	57	7	4	0
		4.2%	79.2%	9.7%	5.6%	0.0%
3.1	The organisation of the content is logical	2	59	4	4	2
		2.8%	81.9%	5.6%	5.6%	2.8%
3.2	The use of table of content, headings and outlines is appropriate	5	57	7	2	0
		6.9%	79.2%	9.7%	2.8%	0.0%
3.3	The overviews and summaries of the tryout units can facilitate students' learning	7	44	15	5	0
		9.7%	61.1%	20.8%	6.9%	0.0%
4.1	The language used in the tryout unit is of appropriate level of difficulty	6	51	4	10	0
		8.3%	70.8%	5.6%	13.9%	0.0%
4.2	Familiar and interesting language is used in the tryout units	6	45	14	6	0
		8.3%	62.5%	19.4%	8.3%	0.0%
4.3	The language used in the tryout units is accurate	4	62	2	3	0
		5.6%	86.1%	2.8%	4.2%	0.0%
5.1	The layout is logical and consistent	3	58	5	4	0
		4.2%	80.6%	6.9%	5.6%	0.0%
5.2	The use of space and margin facilitates easy reading.	7	44	6	13	0
		9.7%	61.1%	8.3%	18.1%	0.0%
5.3	The illustrations facilitate students' learning	9	48	7	7	0
		12.5%	66.7%	9.7%	9.7%	0.0%
5.4	Appropriate print font size and style	9	51	1	10	0
		12.5%	70.8%	1.4%	13.9%	0.0%
5.5	The paper used for printing of the textbooks is light-weight and durable	13	48	10	0	0
		18.1%	66.7%	13.9%	0.0%	0.0%
5.6	The tryout units used nonglossy paper for easy reading	19	46	6	0	0
		26.4%	63.9%	8.3%	0.0%	0.0%

Table 15.8 Qualitative comments of primary teachers

School 1	*For the above average class*:
	Probably because my students have been learning the basic English skills in using New Magic, when they approach the Open English, they have a high sense of satisfaction. Parents are also satisfied with the open textbooks possibly because they are produced by the Open U
	For the average class:
	Students are able to complete the exercises, and they have a good sense of satisfaction
	Students are very fond of the rhymes and the poems; they tend to read the poems aloud in the class
	Remedial class
	There are only two study units in one booklet; the learning load is light, and the learning objectives are clear
School 2	The books have a positive impact on students:
	The supplementary exercises help students approach different types of questions; they can find the answers much quicker when they see a question. Students can very quickly use the vocabulary they have learned; this increases students' confidence in using the language
School 3	Students show progress after using the textbooks
	They made very few mistakes in the exercises provided by the textbook; they show higher referring skills; this may probably be due to the fact that students can find the answers quite easily due to the layout of the book, but students' interest and confidence in learning English are much enhanced when they give correct answers often
School 4	Students show progress in learning English:
	They are quicker in learning vocabulary
	My students are SEN students, and their level of English varies. It will be good if I can revise the content myself to tailor for their needs

the owners of the open textbooks that they will start to get involved and collaborate in further enhancing them for the teaching community to share. We believe that, with more contributions from teacher users, the quality can be further improved.

Many teachers noted that students are happy to have the books because they are free – a strength of the open textbooks which we should not overlook. Free for use is an important merit (and motivation for adoption) of the open textbooks and this is confirmed by the initial feedback from both teachers and students.

While students were excited about the textbooks being free of charge, this does not necessarily mean that teachers were equally interested in using them. Teachers' choice of textbooks depends on a variety of factors other than cost, as revealed in our study. In an earlier study (Yuen & Li, 2014), we found that the most important factor in selecting textbooks was the quality of the content, followed by the effectiveness of their application in teaching and learning, their level of difficulty and the provision of support resources – with textbook prices being the least important factor. The provision of supplementary exercises is also necessary, though this may only be applicable to textbooks on languages. Training in the use of the hardware and software associated with the open textbooks is also needed to increase teachers' desire to use them.

Table 15.9 Comments of secondary teachers

School 1	I would like to suggest that:
	For writing: provided three different versions for three different levels of students: easy, average and challenging tasks
	For vocabulary: provide more language support about vocabulary
	For grammar; the exercises should be graded, so that students can progress from the simple drills to contextual exercises
School 2	According to my observation during lessons, the open textbooks are able to achieve the following:
	In composition, students often refer to the text of the lesson and make use of the keywords and sentence structures; although they may not always use these correctly, they are often able to do so in the theme-based exercises
	The context of the lesson is quite relevant to students' everyday life, so students are now more willing to write long texts and express their opinion in English
	Students' knowledge about the theme and the vocabulary is strengthened
School 3	I suggest that the vocabulary can be included in the texts of the lesson. Students can first learn the vocabulary or take a short paragraph from the whole text and use it as an example for skimming and scanning. Then it will be easier for students to learn the vocabulary in the text
	The formats of the exercises can include more variety. For example, multiple-choice questions and true/false questions can be added
	Questions should be graded, i.e. going from the easy to the more difficult
	I also suggest that more diagrams and pictures be used to illustrate the concepts in the text
	More internet contents and links should be included, for example, links to videos – it will be wonderful if English subtitles can be added if there are not any.

Conclusion

Feedback from users of Hong Kong's first open textbooks was positive. This is a strong indication that the quality of our textbooks is well received by the users (students and teachers), which is very encouraging to our project team.

It is also encouraging to note that most teachers who used the open textbooks have developed a sense of ownership of the books because of the possibility of customisation as part of the design of the open textbooks. Ownership is the first step for teachers' involvement in future modification of the open textbooks. Improvement in the quality of the open textbooks depends on many teachers participating in contributing to the project.

The findings of the present study are in line with those of open textbooks projects in other countries. For example, a study (Petrides et al., 2011) on the Community College Open Textbook Project (CCOTP) found that a major advantage of the project was the cost reduction that removed a significant obstacle to success in college education. We found similar results in our survey – students welcomed the 'free' textbooks they were provided with.

Also, online textbooks can lessen the students' burden of carrying heavy copies of the books to and from school (Petrides et al., 2011). In our case, this feature was also realised, as the printed textbooks are produced in separate modules, so each booklet is light in weight.

References

Allen, N. (2010). A *cover to cover solution: How open textbooks are the path to textbook affordability*. The Student Public Interest Research Groups. Retrieved from http://www.studentpirgs.org/sites/student/files/reports/A-Cover-To-Cover-Solution_4.pdf

Consumer Council. (2001). *Report on the supply and demand of textbooks in Hong Kong*. Retrieved from http://www.consumer.org.hk/website/ws_en/competition_issues/competition_studies/textbook2001/report.html

Consumer Council. (2012). *Considerable variation in textbook expenditure among schools* [Press release, 17 September 2012]. Retrieved from http://www.consumer.org.hk/website/ws_en/news/press_releases/p43104.html

Education Bureau. (2009). *Working group on textbooks and e-learning resources development main report*. Hong Kong: Education Bureau. Retrieved from http://www.edb.gov.hk/attachment/en/curriculum-development//textbook-info/wg%20final%20report.pdf

Education Bureau. (2012). *E-textbook market development scheme* (EMADS). Retrieved from http://www.edb.gov.hk/en/curriculum-development/resource-support/textbook-info//index.html

Fischer, L., Hilton, J., Robinson, T. J., & Wiley, D. A. (2015). A multi-institutional study of the impact of open textbook adoption on the learning outcomes of post-secondary students. *Journal of Computing in Higher Education, 27*(3), 159–172.

Li, K. C., Yuen, K. S., Cheung, S. K. S., & Tsang, E. Y. M. (2012). eVolution from conventional textbooks to open textbooks: A way out for Hong Kong. In K. C. Li, F. L. Wang, K. S. Yuen, S. K. S. Cheung, & R. Kwan (Eds.), *Engaging learners through emerging technology* (Vol. 302, pp. 211–225). New York: Springer CCIS.

Li, K. C., Yuen, K. S., & Wong, A. J. W. (2015). Open textbooks: Liberating the classroom. In G. Dhanarajan (Ed.), *Open educational resources: A study of six Asian cases* (A report of a study commissioned by the Asian Development Bank). Mandaluyong, Philippines: Asian Development Bank.

Petrides, L., Jimes, C., Middleton-Detzner, C., Walling, J., & Weiss, S. (2011). Open textbook adoption and use: Implications for teachers and learners. *Open Learning, 26*(1), 39–49. Retrieved from http://www.tandfonline.com/doi/abs/10.1080/02680513.2011.538563

Yuen, K. S., & Li, K. C. (2012). An open textbook system to tackle Hong Kong's textbook problems. *Proceedings of regional symposium on open educational resources: An Asian perspective on policy and practices*. Penang, Malaysia.

Yuen, K. S., & Li, K. C. (2014). How do teachers like to use open textbooks? Paper presented at *the second regional symposium on open educational resources: Beyond advocacy, research and policy*. Penang, Malaysia.

Chapter 16
How to Incorporate Open Educational Resources (OER) into the Infrastructure and Pedagogy for Promoting Ubiquitous Learning

Kamalika Banerjee

Abstract Ubiquitous learning can be promoted with the proper use of open educational resources (OER) which, with the help of audiovisual effects, can support learning anytime and anywhere. This paper lists the various ways in which OER can be incorporated into the infrastructure and pedagogy for promoting ubiquitous learning. Steps have to be taken so that the different boundaries of education are removed. To involve the teachers in this approach is a challenge which can be met by providing them with the required technical know-how and also training them professionally in the newer paradigms of instructional design and pedagogy which are required for ubiquitous learning. As a result of this change in instructional design, the learners shift from being knowledge receptors to knowledge actors. Research has to be carried out on learners with varied learner profiles and their proactive participation in using various media and teaching-learning tools. Also, the assessment tools have to be made in such a way that they provide useful and relevant formative and summative evaluative information to learners, their parents and educators. Also, social platforms have to be used to build collaborative knowledge cultures. To achieve all this, the requisite technical support has to be provided to the learners as well. The provision of Internet connectivity is another challenge that has to be dealt with. The digital divide has to be removed and OER provided for all. In a nutshell, it must be recognised that investment in OER is the key to improving the teaching-learning environment – so OER and u-learning are very important.

Keywords OER · Ubiquitous learning · Pedagogy · Instructional design

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_16

Introduction

The term ‘open educational resources’ (OER) emerged at the UNESCO Forum on Open Courseware for Higher Education in Developing Countries held in 2002. Then, after ongoing online discussion, OER was finally defined as ‘technology-enabled, open provision of educational resources for consultation, use and adaptation by a community of users for non-commercial purposes’. Of course, OER are free of charge and may be made available over the Web or the Internet, mainly for teachers and educational institutions to support course development – but they can also be used directly by students. The OER include materials for lectures, references and readings, simulations and practical laboratory-related manuals, which are often called ‘learning objects’; and even syllabi, curricula and guides for teachers may be OER (Wiley, 2006). We should not confuse OER with online learning or e-learning, as OER may also be printable.

Curriculum maps, course materials, textbooks, streaming videos, multimedia applications, podcasts and any other materials, which educators and students utilise in teaching and learning, may be OER. But they must be freely available as open sources, with no need to pay royalties or licence fees for using them for communicating curricula in education courses. In the case of resource-based learning, digitised OER can be shared through the Internet. An educational resource that has a licence that promotes use and potential adaptation, without first requesting permission from the copyright holder, may be called an OER.

The Creative Commons (CC) licensing framework (www.creativecommons.org) provides legal mechanisms to make it mandatory that authors of materials can, if they wish, retain acknowledgement for their work while allowing it to be shared, can restrict commercial activity and can try to prevent people from adapting it, if appropriate.

There is a great need to promote ubiquitous learning for which OER are indispensable. Lessons may be delivered in the form of text, multimedia, videos, applications, games or in other electronic formats – but they should support learning anytime and anywhere.

Recently, there has been a shift in education, with the availability, awareness and use of OER, which are essential for ubiquitous computing (ubicomp). Cheap and efficient technologies are needed for the development of OER and EFA (Dourish & Bell, 2011). There has been a mismatch between technology affordances and pedagogical opportunities in higher education from the early promises of microcomputers in the 1970s to the Internet in the late 1990s (Collis & Moonen, 2008). Higher learning institutes have not been able to fully utilise the pedagogical potential of the social Web. From the time computers became portable, the concept of ubiquitous computing (ubicomp) has arisen, with no fixed locations for learning and teaching. Cloud-based, mobile learning and teaching, virtual WIL (work-integrated learning) as well as physical WIL placements are all important for ubiquitous learning.

As educators, we have a responsibility to design programmes in such a way as to engage students and staff in multiple locations and through multiple channels. Also, we have to ensure that students are able to manage their learning in a more meaningful way and can relate their education to real-life situations.

Research on OER in Education

Researchers who have utilised OER for delivering courses (CEMCA & UNESCO, 2011; Naidu & Mishra, 2014) found that designing a course using the scenario-based learning (SBL) approach was the most challenging task initially undertaken by the Open University of Sri Lanka course team for their teacher education course (Karunanayaka & Naidu, 2013). A great deal of effort was required to design offline and online activities which provided variety but did not overload the students, so that the e-learners would be involved in activity-based learning. Clarity was necessary in the learning outcomes, which would be aligned to interesting learning activities, and the evaluation tools would need to be properly integrated into the learning experiences.

The distance educators had to take on an increased workload to support the distance learners in coping with a new pedagogy as well as new technologies. To find appropriate and relevant OER and integrate them into the instructional design was also demanding. The instructional design of the course content, learning experiences and learning resources should enable effective usage of ICT and OER so that learning is enhanced. OER were embedded in the course so that the teaching-learning process was further enriched. Integration of the OER was done in a more meaningful manner through the SBL pedagogical approach adopted in the course design, and so OER became an integral component within the instructional design. These research findings helped the course team to improve the teacher education course; and at the end, it was evident from the feedback that significant capacity-building had occurred among the academic staff.

Open Licensing and the Emergence of OER

Open content licences have emerged in an effort to secure the authors' rights in environments where content (particularly when digitised) can easily be copied and shared on the Internet without permission. OER have evolved out of this idea, promoting use, reuse and adaptation of materials for local contexts and learning environments, simultaneously allowing authors to have their work acknowledged.

Although the OER are 'free', institutions have to provide budgets for programme/course design, material development and acquisition; and faculty time has to be invested in developing courses and materials. The greatest achievement would be to find appropriate OER (Banerjee, 2011) by utilising existing OER and negotiating

copyright licensing (if material is not openly licensed). The ICT infrastructure (for authoring and content-sharing purposes) and bandwidth also have to be maintained.

Research has also been carried out by the course team for PGDEL, an innovative programme, at IGNOU. The programme development time and costs were considerably reduced by using available and appropriate OER. Obviously, in this case also, the workload of the faculty increased significantly due to the online programme.

Ubiquitous Learning

The way in which theory and research can be used to incorporate ICT in the instructional design for ubiquitous learning can be focused. In the process, we can also find the way instructions are to be given, models and frameworks for course design and applications of mobile and social media tools to create, implement and deliver a ubiquitous learning (u-learning) environment. Those involved in research in the area of educational technology, information sciences, adult learning and other learning and performance fields – as well as university faculty, teachers, administrators, policy-makers and industry leaders – would be interested in research on OER for u-learning, as they can examine their individual roles in education. Anyone who aims to improve the way of engaging students through the use of technology would certainly like to utilise the strategies for pedagogy, course design and technology with respect to u-learning.

At present, there are research findings on Web-based learning to mobile learning (Chen, Chang, & Wang, 2008) and mobile learning to context-aware ubiquitous learning, where students' behaviours can be detected by the learning system and they may be guided to continue learning in the real world with digital support which caters for them personally (Hwang, Yang, Tsai, & Yang, 2009).

We must understand that the mobile phone is not indispensable in ubiquitous learning. It must be seen that the student is able to carry out studies in different situations or contexts. For a particular situation, the student should be able to use a netbook computer or a smartphone on campus and during the lectures to verify certain activities demonstrated by the instructor. In another scenario, the student may do some homework on a desktop computer at home, using VLE (virtual learning environment) forums, instant messengers and e-mail so that he/she would be able to collaborate with multiple friends at the same time. Innovative technology, like the Compendium Platform (CP), has been designed. Here 'Compendium' denotes a document with (open access) references to (remotely) archived computations (which may include data, metadata and software) and allows the reader to reproduce, and reuse, the analysis inherent in the data. This new definition allows new (and ubiquitous) environments in which we may get similar research results because we no longer need to store or compute anything locally – the only requirement is to have an active Internet connection (Wessa, 2008).

Ubiquitous learning is an extension of the idea of ubiquitous computing, a term which describes the presence of computers all the time in our lives. Personal and

portable computers are the order of the day and are indispensable for learning, work and community living. At this point, one is considered disadvantaged if one does not have access to a computer networked with a reasonable bandwidth. Such a person may be considered as a 'have not' on the wrong side of the 'digital divide'.

But ubiquitous computing and u-learning are not limited to portable computers. With the evolution of modern technologies, more pervasive forms of technology have emerged. Thus, in future, computers will become 'invisible' and will be embedded – they will be seamlessly integrated into our world in a phenomenon referred to as 'calm technology'. We will emerge into an era of wearable computers and embedded microchips. The telephone, television, PCs, the Internet and mobile phones, all with embedded computer functions, have been in our daily lives for quite some time now, and we have adapted to them very well. Mobile phones, televisions, global positioning systems, digital music players, personal digital assistants, video cameras, still cameras and game consoles are some of the devices increasingly resembling the computers. These devices are seen widely, and as they become cheaper, their size is decreasing and portability is increasing, and also they are increasingly networked with each other. New media and technologies, in particular, Web 2.0 technologies, enable learners to be creators, cocreators and owners of their learning and communication environments (Lin, 2008).

It is quite disheartening that our classrooms are mostly not smart ones. The students cannot access digital learning contents and there are no work spaces. The curriculum is so heavily loaded with content that the practice sessions are often quite unimaginative; and the questions asked in activities are rather conventional. So the teaching-learning situation is quite disappointing – it is time to consider how ICT has made a paradigm shift in the learning and communication outside the classroom.

Also the question of affordance has arisen. Technology has made many things much easier to do. In a conventional classroom, collaborative and inquiry learning was not straightforward, but now with computers collaborative and inquiry learning is the order of the day. Social learning, which is much desired, has become quite prominent. Thus, there is a major shift in learning activities from within the classroom to outside of the classroom: the younger generation can learn in coffee houses, the workplace and places for leisure – everywhere. The entire learning processes, motivations and relevance to the practical contexts of ordinary life have had a paradigm shift, and so it is necessary that school and classroom should be smart enough to cope with this situation.

From an instructional standpoint, research in a variety of disciplines has suggested that when classroom instruction is integrated with ICT in meaningful ways, student interest increases and thus learning improves.

In the new environment of u-learning, more documentation on learning processes is required so that teachers can share their lesson plans or learning resources with the teaching community, so that there is collaboration among the teachers and schools become 'knowledge hubs'. The transactions which were taking place inside the closed doors of the classroom are now 'open to the public', and educational institutions, parents and communities can also have a view on them.

Ultimately, once the knowledge is organised, the learning becomes organised. This is the basis of the 'learning organisation' where the sum of knowledge is greater than the individual components of knowledge in the heads of individuals (Kalantzis & Bill Cope, 2009).

Another term which has arisen along with these developments is the OCW – OpenCourseWare. MIT was one of the first universities to introduce OCW, and it formed the OpenCourseWare Consortium in 2005 and by 2007 published virtually all its courses online. MIT OpenCourseWare (ocw.mit.edu) currently has 1,900 courses on the Internet at no cost for noncommercial purposes, and many other institutions have followed its lead. Lecture notes, reading lists, course assignments, syllabi, study materials, tests, samples and simulations all fall under the umbrella of OCW (www.ocwconsortium.org). It is a collaboration of more than 200 higher education institutions and associated organisations which are spread worldwide. Most recently, 'The Cape Town Open Education Declaration' mentioned the increased variety of openly licensed course materials – including lessons, games, software and other teaching and learning materials – that contribute to making education more accessible. This is giving rise to a culture of creating and sharing knowledge which is necessary for knowledge societies. The open education movement and paradigm has arrived, having evolved from a history which is complex. Its future development is linked to open source, open access and open publishing movements, as well as the concept of the open society. OER sources, such as university OCW initiatives, content creation initiatives, subject-specific OCW and OCW search facilities, provide a useful starting point with regard to the extent of the content publicly available. For example, online catalogue maintained by OER Africa is accessible at www.oerafrica.org/FindingOER.

Future Trends

Developments in OER Worldwide

Another important repository is the Multimedia Educational Resource for Learning and Teaching Online (MERLOT) for higher education (www.merlot.org). In addition, some OCW institutions such as John Hopkins Bloomberg School of Public Health have developed an Opensource Opencourseware Prototype System (OOPS), which translates educational resources into Chinese. Many Indian institutions are providing digitised course materials, and a good number of open courseware have been set up. In India, the University Grants Commission (UGC) has established the Consortium for Educational Communication (CEC), an interuniversity centre on electronic media. CEC's Learning Object Repository (LOR) has OER in Archaeology, Biology, Botany, Chemistry, Commerce, Computer Science, Economics, Education, English and Fine Arts. The National Programme on Technology Enhanced Learning (NPTEL) wishes to improve the quality of engineering education in India

by developing curriculum-based video and Web courses. Seven premier institutions are collaborating on this project. Also, articles, open access journals and books are becoming frequently published.

A content-sharing initiative iTunes U has gained immense popularity. Launched in 2007, Apple's iTunes University allows higher education institutions to make audio and visual content freely available for downloading (as well as making provision for subscriptions for those wishing to sell content). Although the content is free to use, iTunes U accounts can be set up by any institution, and they lay down certain rules for further use (with many opting to use a Creative Commons licence).

Also, the website OpenLearn (openlearn.open.ac.uk), from a distance education university with a very good reputation, provides free access to UK Open University course materials. As a catalyst for further research, open educational resources have a significant part to play. The rigidity of the educational components is creating pressure in the education system, and OER will possibly be the future trend in teaching-learning.

The Open University of Hong Kong (freecourseware.ouhk.edu.hk) also provides fee waivers for those interested in seeking a genuine experience of distance education; the National University of Colombia (www.virtual.unal.edu.co) provides many choices for Spanish-speaking students; and there are many African OCW initiatives, for example, by the University of Western Cape (freecourseware.uwc.ac.za). Lately, the UCT (University of Cape Town) open content (opencontent.uct.ac.za) has been established, which allows users to access open teaching and learning content.

Subject-Specific OCW OER

There are also various subject-specific OER initiatives in higher education. One example is the Teacher Education in Sub-Saharan Africa (TESSA) initiative (www.tessafrica.net). In this project, teachers and teacher educators working in sub-Saharan African countries are given guidance on designing their courses. OER have been developed in four languages which will help school-based teacher education and training.

Conclusion

We need to realise that when we invest in OER and u-learning, we are investing in better teaching and learning environments, not merely in OER. All governments and educational institutions who are serious about improving the quality of teaching-learning should invest in OER. Within the framework of investing in material design and development, however, the most cost-effective approach should be utilised for

creating OER, and we have to ensure that there is not any repetitive effort. The costs of copyright negotiation and clearance should be removed. Also, open communities should be engaged in the practice of ongoing quality improvement and assurance.

References

Banerjee, K. (2011). *Evaluation of digital resources which are potential resources for ODL in chemistry* (Minor Project Report (DEC/RP/2006-07/07-08/5243) submitted to the Distance Education Council, New Delhi)

CEMCA, & UNESCO. (2011). *Guidelines for Open Educational Resources (OER) in higher education. UNESCO/Commonwealth of Learning*. Retrieved from http://www.col.org/PublicationDocuments/Guidelines_OER_HE.pdf

Chen, G. D., Chang, C. K., & Wang, C. Y. (2008). Ubiquitous learning website: Scaffold learners by mobile devices with information-aware techniques. *Computers and Education, 50*(1), 77–90.

Collis, B., & Moonen, J. (2008). Web 2.0 tools and processes in higher education: Quality perspectives. *Educational Media International, 45*(2), 93–106.

Dourish, P., & Bell, G. (2011). *Divining a digital future: Mess and mythology in ubiquitous computing*. Cambridge, MA: MIT Press.

Hwang, G., Yang, T., Tsai, C., & Yang, S. (2009). A context-aware ubiquitous learning environment for conducting complex science experiments. *Computers & Education, 53*, 402–413.

Kalantzis, M., & Cope, B. (Eds.). (2009). *Ubiquitous learning*. Urbana, IL: University of Illinois Press.

Karunanayaka, S., & Naidu, S. (2013). Capacity building of academic staff in the integration of ICT and OER in teacher education programs at the Open University of Sri Lanka. In *Proceedings from Pan Commonwealth Forum (PCF7)*. Abuja, Nigeria. Retrieved from http://hdl.handle.net/11599/1845

Lin, L. (2008). An online learning model to facilitate learners' rights to education. *Journal of Asynchronous Learning Networks, 12*(1), 127–143.

Naidu, S., & Mishra, S. (Eds.). (2014). *Case studies on OER-based e-learning*. CEMCA: New Delhi, India.

Wessa, P. (2008). Learning statistics based on the compendium and reproducible computing. In *Proceedings of the international conference on education and information technology*, Berkeley, San Francisco, USA.

Wiley, D. (2006). Open source, openness, and higher education. *Innovate Journal of Online Education, 3*(1), 1–6.

Chapter 17
Using Videos in Blended Learning: Pitfalls and Success Factors

Billy Tak Ming Wong and Beryl Yuen Yee Wong

Abstract The past decade has witnessed a broad range of practices in blended learning. Among these, the use of videos has been a prominent development, especially with the advances in broadband networks and mobile technology that have made possible the playing and authoring of high-quality videos in an easy manner.

This paper reviews the use of videos in blended learning. Empirical studies related to this area were collected from databases in the scholarly literature. Based on these studies, the following aspects were identified: the types of videos used and the ways in which they were used, the benefits for various stakeholders, the pitfalls in practice and the factors leading to successful use. The results indicate the key aspects for the effective use of videos in blended learning.

Keywords Videos · YouTube · Blended learning · Pitfalls · Success factors

Introduction

Blended learning has been gaining popularity for its flexibility and effectiveness in integrating various approaches to education (De George-Walker & Keeffe, 2010). Despite being defined and understood in diverse ways, one common theme is the mixture of virtual and physical environments. As Poon (2014) points out, "blended learning is usually considered to have a combination of face-to-face learning experiences, such as on-campus classroom contact and online learning experiences" (p. 157). Blended learning also emphasises students' individual differences by shifting the focus from "teaching" to "learning" and facilitating the learning process with various media which fit students' needs (Woltering, Herrler, Spitzer, & Spreckelsen, 2009; Yen & Lee, 2011).

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_17

In applying blended learning, emphasis needs to be placed on questions such as how to put it into practice and what tools are to be used. Indeed, blended learning allows flexible use of a broad range of elements, from widgets to social networks and from games to videos, according to the actual contexts and learners' needs.

Among those media, video has been shown to be a rich and powerful medium which is widely used in various educational settings (Tiernan, 2015). Existing scholarly work also frequently mentions using videos for elaborating the features or usefulness of blended learning. However, the use of videos has usually been a subordinate aspect of blended learning and has rarely been studied independently, with detailed consideration of its features, benefits, pitfalls and success factors.

This paper examines how this tool functions in blended learning, according to relevant research studies. It explores the types of videos and the ways in which they have been used, summarises the benefits and difficulties reported in relevant studies and discusses the factors leading to its successful implementation.

Research Method

This paper elaborates various aspects of using videos in blended learning—ranging from features to benefits and from pitfalls to success factors—through a comprehensive review of the relevant literature. The research studies were collected from scholarly journals using databases, including Google Scholar, ProQuest and ScienceDirect. The keywords used for locating the articles included "blended learning", "video and blended learning", "YouTube and blended learning", "blended learning and effectiveness" and "blended learning and success factors".

The articles were reviewed to include only those reporting an empirical study and to confirm the use of videos in the blended learning practice. Relevant information was then identified from the studies and summarised.

Types of Videos Used in Blended Learning

The videos used in blended learning are of two main types, viz. (1) ready-made videos that are not produced by the users (e.g. online videos and video discs) and (2) custom-made videos that are developed by the users, including educators and learners (e.g. video lectures, self-recording videos and Facebook video messages).

Ready-Made Videos

With the development of Web 2.0 technologies, online video is one source of ready-made videos that can be directly adopted in blended learning. For example, on

YouTube, there is an online video repository where users can share their videos worldwide without cost (Terantino, 2011; YouTube, 2013); and current studies have shown that it serves as an educational tool which is widely applied in various disciplines, such as medicine (Clifton & Mann, 2011; King, Greidanus, Carbonaro, Drummond, & Patterson, 2009), language learning (Terantino, 2011), educator training (Sun, 2014) and the promotion of cross-cultural understanding (Bloom & Johnston, 2010). Fleck, Beckman, Sterns and Hussey (2014), who evaluated the applicability of YouTube clips in the classroom teaching of a psychology course, found positive feedback from the students.

Video discs, such as VCDs and DVDs, are another type of ready-made videos. Pfeiffer, Scheiter, and Gemballa (2012), for example, used an instructional DVD that included 15 videos with verbal explanations as a learning resource to assess students' performance in identifying fish species; and they examined the extent to which using video in blended learning is more beneficial to learners than using instructional materials alone in a conventional approach. Table 17.1 summarises the types of ready-made videos used in blended learning.

Custom-Made Videos

Custom-made videos require the engagement of educators and/or learners in their production. According to the role of the creator, the videos can be divided into three types: video lecture, video assignment and video message, as summarised in Table 17.2.

Video lectures are produced by teachers. Kabassi et al. (2016) observed the use of learning management systems in blended learning in Greek higher education, with video lectures produced by course tutors as learning materials for students' reference and revision anytime at their own pace.

Another type of custom-made videos is generated by learners for completing assigned tasks or submitting assignments. For instance, in the experiment by Luo and Pang (2010), students had to submit assignments in a video format. Shih (2010)

Table 17.1 Types of ready-made videos used in blended learning

Types	Examples	Sources
Online videos	YouTube	Fleck, Beckman, Sterns, and Hussey (2014)
Video discs	Instructional DVDs	Pfeiffer et al. (2012)

Table 17.2 Types of custom-made videos used in blended learning

Creators	Examples	Sources
Educator	Video lectures	Kabassi et al. (2016)
Learner	Video assignments	Luo and Pang (2010) and Shih (2010)
Both educator and learner	Video messages	Borup, Graham, and Velasquez (2011)

also required students to create video clips recording their practice of English public speaking and then upload the products online.

Custom-made videos are used also as a communication tool in blended learning in which both teachers and students mutually exchange their self-made video messages in an online private group to serve as a substitute for conventional face-to-face conversation. For instance, Borup et al. (2011) studied the use of asynchronous video communication in blended learning, giving insight into the instructor-student conversations achieved by video messaging.

Roles of Videos in Blended Learning

In terms of their functions in blended learning, videos play four roles following Laurillard's (2002) classification of learning technology: (1) the narrative role for attending and exploring,(2) the communicative role for discussing and debating, (3) the adaptive role for experimenting and practising and (4) the productive role for expressing and presenting. Table 17.3 summarises the four roles and their respective functions.

The Narrative Role

Showing YouTube video clips in classroom teaching illustrates the narrative role of using videos, which is characterised by its noninteractive features. In blended learning, this kind of video is used for initiating conversation and as support materials in classroom teaching.

Fleck et al. (2014) assessed the effectiveness of using YouTube videos to support the teaching of psychology concepts, showing how they were integrated into a conventional classroom setting for narrative support. A short YouTube video on assigned reading materials was played at the beginning of a lesson, and, following the video content, students then participated in discussion and teachers gave relevant hands-on activities or group projects.

Table 17.3 Roles and functions of using videos in blended learning

Roles	Functions	Examples	Sources
Narrative	To initiate conversation and support classroom teaching	YouTube video	Fleck et al. (2014)
Communicative	To provide an alternative method for interaction	Facebook video messaging	Borup et al. (2011)
Adaptive	To provide intrinsic feedback for enhancing learning performance	Video annotation	Luo and Pang (2010)
Productive	To share among peers for review and to learn from them	Video blog	Shih (2010)

The Communicative Role

Videos also play a communicative role in blended learning. In the use of Facebook video messaging reported in Borup et al. (2011), videos served as a medium for asynchronous communication between teachers and learners, offering flexibility to hold conversations online beyond time and geographical constraints. Such a case showed the usability of videos for improving the social presence and response time of instructors with a minimum amount of face-to-face instruction.

In that case study, the instructor created a Facebook group for the whole class of students and produced weekly video-sharing in the group. The videos were for giving feedback on students' overall performance during the previous week, addressing common student questions and issues and orienting them to current assignments. Following up on the instructor's videos, students had to record and submit to the instructor weekly video messages through the Facebook messaging function to express their perceptions of the week's assignment, report on individual progress in doing the assignment and raise any concerns or difficulties they had encountered. After receiving the video messages, the instructor replied individually with video responses providing individualised feedback and encouragement (Borup et al., 2011). These videos served as a substitute for face-to-face conversation in blended learning. Passive students who were not used to communicating with a teacher in a conventional approach were more comfortable and willing to express themselves through the cameras.

The Adaptive Role

Videos with an adaptive role demonstrate another kind of use in blended learning, where the videos are produced for facilitating students' improvement by giving specific feedback. Following Laurillard's (2002) concept of "adaptive media", videos with an adaptive purpose provide students with intrinsic feedback as natural consequences of students' engagement in learning. Unlike extrinsic feedback that is comparatively generic—such as "very good" and "should try harder"—intrinsic feedback enables learners "to know how close they are to a good performance, and what more they need to do. It is individualised, private, formative feedback, which helps to build their understanding of the internal relations between theory and practice" (Laurillard, 2002, p. 127).

Luo and Pang (2010) gave an example of using videos for blended learning of physical education, in which students had to submit video homework recording a group of designated movements. After the submission, teachers reviewed and gave intrinsic feedback to students. Through reviewing the videos, teachers can give specific individual advice for improving students' performance, which is more effective than in conventional face-to-face and one-to-all instruction.

The Productive Role

Videos with a productive role are mainly created for peer review and sharing. The production of such videos, despite aiming at improving individual performance via learning from others, does not necessarily involve a review by teachers/seniors in a formal way.

Shih (2010) presented a case involving blended learning for English public speaking, where productive videos were created by students for sharing with their peers. Each student had to make a video clip of a speech in English and upload it to their blogs which allowed comments by peers. It is up to the students' preference whether or not to accept the peer comments.

Benefits of Using Videos in Blended Learning

Blended learning—when practised by a systematic combination of face-to-face and technologically mediated interactions among students, teachers and learning resources—involves a broad range of asynchronous and synchronous activities (Bliuc, Goodyear, & Ellis, 2007). As such, using videos is one of the instructional approaches in blended learning. Its benefits can be viewed from four perspectives: (1) teachers, (2) learners, (3) both teachers and learners and (4) institutions.

Teachers

Increasing Teaching Efficiency

The enormous number of videos online can save teachers' time in preparing teaching materials. For example, the Blinkx video website (http://www.blinkx.com) has nearly seven million hours of online videos; YouTube EDU, established in 2009 as a collection of educational content, has been used by a wide variety of parties (Fleck et al., 2014); and Learners TV (http://www.learnerstv.com) is a comprehensive educational website that provides thousands of free downloadable specialised video lectures in a broad range of subject fields, such as physics, chemistry and biology (Al-Jarf, 2012). Through these websites, teachers can easily identify suitable videos and include them in their teaching materials. In short, these available resources facilitate the preparatory process.

Another enhancement of teaching efficiency lies in collective engagement in teaching. Using videos can maintain students' attention to the teaching contents for a longer period of time (Clifton & Mann, 2011; Hudock & Warden, 2001; Mayer, 2010). Learners' retention will also be improved as it is easier to recall something using visual clues rather than by only the verbal delivery of instructors (Clifton &

Table 17.4 Benefits to teachers

Benefit	What is achieved by using video	Sources
Increasing teaching efficiency	It saves teachers' time on preparation by using available materials	Fleck et al. (2014) and Al-Jarf (2012)
	The class runs smoothly by enhancing students' engagement through using videos as an instructional tool	Hudock and Warden (2001), Mayer, (2010), and Clifton and Mann (2011)

Table 17.5 Benefits to learners

Benefits	What is achieved by using video	Sources
Enhancing learning effectiveness	It provides education with a multidimensional and multilayered experience	Zhang, Zhou, Briggs, and Nunamaker (2006)
	It achieves effective peer-learning through video assignments	Shih (2010)
Enhancing learning motivation	It makes the learning activities more interesting	Kirkgöz (2011)

Mann, 2011). Mayer (2010) evaluated the use of multimedia in medical education and showed that medical students, who need to memorise a great amount of subject knowledge, found the visual materials very helpful for memorisation. In this way, teachers can run a class smoothly without spending too much effort in helping students to revise and memorise the course content. Table 17.4 summarises the benefits for teachers of using videos.

Learners

Enhancing Learning Effectiveness

Table 17.5 shows the benefits for learners from using videos in blended learning. Learning effectiveness can be enhanced because videos can help in absorbing knowledge and building up understanding of concepts. Unlike conventional textual materials, videos are dynamic visualisations that allow students to view actual objects and realistic scenes, to see sequences in motion and to listen to narration (Zhang et al., 2006). More specifically, videos are useful in speeding up time (e.g. watching an organism grow) or slowing it down (e.g. examining the trajectory of a bullet) and learning about remote locations or unsafe events (e.g. forest fires). Also, they bring expert lecturers to the classroom (Fleck et al., 2014; Snelson & Perkins, 2009). Learning effectiveness can be strengthened by receiving the multidimensional and multilayered experience given by videos.

Apart from watching videos, learners can also record video clips on their own. Looking again at the case study on students recording videos for practising English

public speaking, the learners gave positive comments on its effectiveness. As they noted, "I think it is a good way to train us to be brave in front of people. We can also see our own strengths and weakness and [that of] others as well", and "I think it's better than just having the blog video. You can see the video on the blog then you can learn how to speak better" (Shih, 2010, p. 893). Both educators and learners can review the videos repeatedly at their own pace.

Enhancing Learning Motivation

Another benefit for learners is an increase in motivation. Combining the use of videos with other teaching strategies in blended learning can help to solve the problems of using videos alone, such as the lack of interactivity (Hadidi & Sung, 1998). Kirkgoz (2011) observed that students responded very positively to integrating videos into speaking classes and seemed to prepare better for lessons when they knew that their performance would be video-recorded. The students were motivated by making use of videos in the study, as shown in the following quotation:

> We haven't used video for recording our speaking and evaluating ourselves before so it was the first experience to study speaking this way. The use of video made the lessons more enjoyable and close to [a] real life situation. (p. 7)

Both Teachers and Learners

Providing Flexible Interaction

With its flexibility in time and location, using videos in blended learning promotes better interaction among teachers and learners. In Borup et al.'s (2011) study of using Facebook video message, students were positive about the convenience and efficiency: "I thought it was a great way to quickly stay in touch and much more personal", and "It was nice to still feel connected to an actual professor, and it allowed prompt feedback if I needed help or had a question" (p. 45). Video-based conversation improves teacher-student connections through enriched expression that cannot be offered in textual communication via emails or instant messaging. Teachers can understand students' emotions by reading their facial expressions and listening to their voices in the videos, which helps them to make an individualised response (Borup et al., 2011). Also, students' excitement and motivation is seen in the following comments:

> It was good to know that if I needed help, I could get it and it wasn't just emails. I was actually able to see the professor and get adequate feedback.
>
> I like it a lot actually. It made the instructor seems more "real."
>
> . . . I felt like I was part of the class and able to express my opinions and talk about my concerns or things I was learning. (ibid., p. 45)

The flexible feature of blended learning allows students to choose their preferred means of learning engagement. The Facebook video message, as an example, offers a choice for students to interact with their instructor, rather than a replacement of face-to-face conversation. Students can express themselves flexibly by the available means, according to the different contexts, the types of messages to deliver and their favourite communication styles.

Providing Flexible Teaching and Learning Schedules

Blended learning enables teachers and students to make a flexible teaching and learning schedule through video lectures. Teachers can give teaching or supplementary explanation in videos for students to review anytime and anywhere; and students can achieve self-paced and self-directed learning. This benefit is crucial for students in particular disciplines, such as nursing, who have shift duties at placements (Clifton & Mann, 2011).

Table 17.6 summarises the benefits to teachers and learners in terms of its flexible nature.

Institutions

Enjoying Financial Benefits

Table 17.7 presents the benefits to institutions, especially in terms of cost-effectiveness, as video lectures can be reused in different ways. For instance, Auster (2016) illustrates the financial benefits through providing online courses using video lectures, which can be accessible to a large number of students breaking through physical limitations such as class time and class size. Moreover, the large number of

Table 17.6 Benefits to teachers and learners

Benefits	What is achieve by using video	Sources
Providing flexible interaction	It provides a convenient and an interactive alternative platform for conversation	Borup et al. (2011)
Providing a flexible teaching and learning schedule	It allows flexible supplementary teaching or self-paced and self-directed learning	Clifton and Mann (2011)

Table 17.7 Benefits to institutions

Benefits	What is achieved by using video	Sources
Enjoying financial benefits	Reusable video lectures can increase enrolment	Auster (2016)
Providing resources for analysis	Institutions are provided with data for analysis through the record of progress created	Kirkgöz (2011)

students can learn at their own pace, stop at, and repeat playing the episodes as they wish, without the constraints imposed by conventional video library within the learning institutions. Besides, making good use of video lectures helps to overcome the capacity limitations of institutions' facilities, such as lecture halls and classrooms, for catering for large numbers of courses and students (Auster, 2016)—so institutions can now allocate more financial resources for video production than the physical space—to contain the students and/or the human resources for face-to-face teaching delivery.

Providing Resources for Analysis

Institutions can more easily evaluate and enhance the quality of education by utilising videos in blended learning. Videos can serve as an ideal means to record students' practice and progress, for teachers to compare, evaluate and analyse students' learning performance. Through reviewing the recorded videos, students can also be clear about their improvement and gain a sense of satisfaction in learning. Below is an extract about a student's feelings towards video-recording:

> We have become aware of our strengths and weakness. Comparing my first and the last speaking task, I can see great improvements in my pronunciation, vocabulary and grammar. I definitely see a great progress in my speaking skills. (Kirkgoz, 2011, p. 7)

Pitfalls

Despite the potential benefits of using videos, a number of difficulties may also arise in the process of introducing blended learning. Based on the literature, these difficulties include technical challenges, the extra time required and problems of video quality.

Technical Difficulties

Capability in using technology is a critical factor in the effective use of videos in blended learning. Technical difficulties with the hardware and software are one of the major pitfalls in such practices, as summarised in Table 17.8.

The hardware aspect includes accessibility to the Internet in terms of the users' equipment and the Internet connection in a region's infrastructure. Poon (2014) illustrated students' poor experience in watching online videos because of the slow Internet speed, as the broadband services in some regional or remote areas were not well developed. Also, the capacity for Internet access of users' personal devices influences the effectiveness of watching off-campus videos, especially for long video lectures which require a comparatively larger storage capacity for the devices.

Table 17.8 Technical difficulties hampering the effectiveness of using videos

Types of difficulty	How effectiveness is hampered	Sources
Hardware	Cannot access online videos due to poor network infrastructure and the limited capacity of personal devices	Poon (2014)
Software	Cannot utilise videos effectively because of insufficient knowledge and skills	Poon (2014)

Table 17.9 Extra time consumption hampering the effectiveness of using videos

Types of difficulty	How effectiveness is hampered	Sources
Extra time consumption for teachers	Teachers have to spend extra time on using videos if they are unfamiliar with the relevant applications	Poon (2014)
Extra time consumption for learners	Learners have to spend extra time on uploading their video assignments in a poorly connected environment	Shih (2010)

The software aspect refers to students' personal ability in mastering the necessary skill set for utilising technology, including using videos. According to Poon (2014), the fast-changing technology is one of the major challenges for Australian academics in making use of blended learning. As she noted, "technology moved too fast; we just learnt one technology and then we were told technology that we are required to use" (p. 167).

Relevant knowledge for accessing and producing videos is thus demanded from both educators and learners. For instance, the use of video cameras to record a video of high quality involves professional skills and technical knowledge that should be acquired—otherwise, the effectiveness of using videos as a teaching and learning medium may be impeded.

Extra Time Required

Using video as an education delivery tool can also be time-consuming. As noted in Table 17.9, this is especially the case for those who are not good at using Web technology. Poon (2014) showed that "staff time" was selected by the majority of respondents in a survey as the most important resource for the preparation of blended learning.

The issue of time consumption can also disturb learners. From the students' feedback on recording their practice of English public speaking, Shih (2010) found that nearly half of the students "agreed that recording and uploading the videos can be very time-consuming if their Internet speed is not fast enough or the size of the video [is] too large" (p. 895). These findings suggest that, apart from personal ability at mastering Web technologies, the broadband condition also potentially hampers users from employing videos in blended learning in a convenient way.

Table 17.10 Problems of video quality hampering the effectiveness of using videos

Types of difficulty	How effectiveness is hampered	Sources
Unauthorised content	Some videos cannot be used in teaching due to the copyright issue	Cha, Kwak, Rodriguez, Ahn, and Moon (2007) and Clifton and Mann (2011)
Misinformation	Videos with misinformation may hamper learners from receiving accurate knowledge	Hossler and Conroy (2008)
Biased content	Without taking precaution against biased content, learners may be negatively influenced	Freeman and Chapman (2007)

Problem of Video Quality

The quality of videos is another issue in using them in blended learning, especially for online videos such as those on YouTube. Table 17.10 summarises various aspects of the problem. It has been found that some of the online videos from websites such as YouTube are not suitable for teaching purposes. For example, Fat, Doja, Barrowman, and Sell (2011) point out that, from a sample of 100 YouTube videos, about half of them were poor materials for teaching. As YouTube is a public resource of user-generated content with very loose quality regulations and authorisation checks, the platform is known to have content duplication and illegal uploads (Cha et al., 2007; Clifton & Mann, 2011).

Apart from unauthorised content, attention should be paid to the choice of online videos included in blended teaching since misinformation may appear in some cases. Hossler and Conroy (2008) found that YouTube users might be misled by misinformation in online videos.

The quality issue is also of concern to learners doing independent learning at home without sufficient guidance from teachers. Freeman and Chapman (2007) pointed out the risk of YouTube being used as a subversive advertising channel and reported a wide range of tactics exploited by companies, such as tobacco companies, to sponsor their products in video content. In this way, when individual learners and distance learners access the videos for learning, they may be influenced by such biases.

Success Factors

Successful use of videos in blended learning thus requires a broad range of factors to become effective. The following section describes the success factors as reported in the relevant literature.

Well-Designed Implementation

As blended learning is defined as "thoughtful integration of classroom face-to-face learning experiences with online learning experiences" (Garrison & Kanuka, 2004, p. 96), one of the challenges lies in accomplishing such integration. To add videos haphazardly to a course without careful consideration and planning will certainly not produce the advantages of blended learning (Fleck et al., 2014; Hussey, Fleck, & Richmond, 2013; Osguthorpe & Graham, 2003).

When integrating the use of videos into conventional teaching, one needs to think carefully about how to maximise its effectiveness. According to Harris, Connolly, and Feeney (2009), "consideration should be given to the learning process, learning outcomes, and the learning environment" (p.159).

Al-Jarf (2012) developed guidelines for selecting online videos, as well as instructional strategies for teaching English as a foreign language. According to the guidelines, factors such as the video length, content difficulty, students' expectations, speed of speaking and the provision of subtitles and availability of switch-off captions should be taken into account. As regards the instructional strategies, Al-Jarf suggests that instruction with online videos can proceed in three phases: (1) before watching a video, (2) while watching it and (3) after watching it. In each phase, instructors should perform various tasks in class, such as giving pre-questions and instruction before watching a video, developing students' listening comprehension skills while watching a video and asking students to describe the video content verbally after watching it. Although these guidelines were designed for a specific context, they show the significance of thoughtful planning when implementing blended learning with videos.

Consideration should also be given to contexts other than the classroom—for instance, to the ways in which learners use the videos. In a survey (Kabassi et al., 2016) about Greek students' experience of blended learning, the results showed that 90 percent of the students were not satisfied with video lectures in relation to the course requirements, but highly valued the videos as further course materials (29 percent) or note-taking supplements (21 percent). Such dissatisfaction may result in poor motivation for using videos for learning, as well as an unappealing learning performance. It is therefore very important for educators to decide the positioning of videos as learning materials in blended learning. Clarification and coordination should be made in advance on online activities and assessment for a course so as to manage stakeholders' expectations (Beadle & Santy, 2008). Consideration of learners' individual needs and managing learners' expectations and understanding is vital for the success of introducing blended learning (Bliuc et al., 2007).

Technological Assistance

Providing adequate technological support and training is important for successful implementation (Harris et al., 2009). Poon (2014) showed that technological training is essential for students who are not "all-round" IT-literate —a conclusion that Australian and UK academics tended to agree. Some also consider that workshops and skill-based videos on the use of relevant software and technologies would be useful for colleagues. Childs, Blenkinsopp, Hall and Walton (2005) suggest it is important to have a range of skilled IT staff, design staff, trainers, support staff and administrators for providing comprehensive technological support to make blended learning effective.

Poon (2014) also identifies the significance of the quality of digital equipment for producing appealing videos for teaching. Equipment, e.g. a large television, a good quality camera and recording facilities, is as important as technology and course design for successful implementation of blended learning. The use of high-quality hardware for producing the video lectures will enable learners to experience learning which is more like "real-time" study.

Control of Videos

Learners are more empowered if they have full control of video play, where they are allowed to have "proactive and random access to video content based on queries or search" (Zhang et al., 2006, p. 17). Students are not only motivated; their learning effectiveness will also be enhanced because of the increase in "learner-content interactivity" (Zhang et al., 2006). When learners can entirely determine how to make use of the videos and the way of watching them—such as when to pause and replay, what to fast forward and skip and so on—they are more likely to learn effectively in terms of meeting the learners' needs (Shang, Shi, & Chen, 2001).

Protection of Learners' Privacy

For videos produced by students in blended learning activities, or for fulfilling the requirements of course assignments, learners' privacy has to be adequately protected. Lin, Chang and Yau (2013) reported a study on the effectiveness of blending learning in teaching t'ai chi ch'uan (a kind of Chinese martial art) in a university in Taiwan, where the privacy problem was highlighted when making use of the videos produced by students. In that study, students were required to create videos recording their practice of t'ai chi ch'uan and to share them with other classmates through an online social platform. By doing so, students were expected to learn from each other through studying others' videos. However, it was found that,

due to the insufficient privacy protection of the platform, the videos became open for public access, which has negatively influenced the willingness of the students to engage in the video-making task.

Shih (2010) presented another study about learner-produced videos in an English public speaking course, showing that some students who were not confident enough, or having low self-esteem, felt nervous about making videos of their own performance. These findings suggest the importance of providing a secure online environment for students to share videos with a particular audience. Otherwise, anxiety about the leaking of videos, as well as apprehension about showing a poor performance to the public, may reduce students' enthusiasm or willingness to participate in the video-producing learning activities.

Regular Evaluation and Timely Adjustment

Empirical studies on the effectiveness of using videos in blended learning usually come with comments and suggestions from students on ways for improvement. For instance, according to Poon's (2014) study, some students expressed difficulty in downloading video lectures online outside the campus owing to poor Internet infrastructure and suggested the use of streaming videos instead.

Harris et al. (2009) recommend that, to facilitate successful adaptation, regular evaluation and timely adjustment are necessary for pedagogical improvements. The evaluation can cover a broad range of perspectives, such as a sense of community, student engagement and interaction and examination performance, which can be observed through teacher-student daily interaction (Harris et al., 2009). Also, by collecting and reviewing students' feedback and perceptions regularly, teachers become acquainted with the problems of the practice, thus making appropriate and individualised adjustments in response to students' needs (Bliuc et al., 2007).

Table 17.11 summarises the factors discussed above.

Conclusion

This paper has reviewed the features, benefits, challenges and success factors of using videos in blended learning, reflecting a macro and general perspective beyond context boundaries. The relevant literature reveals not only the applications of videos but also the strengths and weaknesses of such a blended approach.

The success factors reviewed in this paper are worth noticed in order to assure the effectiveness of using videos in blended learning. Although institutions with more financial resources have an advantage in producing more effective blended learning materials, nonfinancial factors such as staff time, instructors' experience, students' acceptance, the size of classes and the course curriculum may also influence its implementation.

Table 17.11 Factors for successful implementation of videos in blended learning

Factors	Measures	Sources
Well-designed implementation	Implement with thoughtful and effective integration	Al-Jarf (2012) and Harris et al. (2009)
	Implement in response to learners' expectations, as well as to balance different stakeholders' needs	Beadle and Santy (2008) and Bliuc et al. (2007)
Technological assistance	Equip users with knowledge and skills for using IT applications	Childs, Blenkinsopp, Hall, and Walton (2005) and Poon (2014)
	Strengthen the quality of IT-related equipment	Poon (2014)
Control of videos	Provide learners with a greater degree of freedom in the control of video play	Shang et al. (2001)
Protection of learners' privacy	Protect learners' privacy when designing learning activities with learner-produced videos	Lin et al. (2013)
Regular evaluation and timely adjustment	Adjust the use of videos in response to students' needs as identified through regular evaluation	Harris et al. (2009)

It is worth noting that "no two blended learning designs are identical" (Garrison & Kanuka, 2004, p. 97). Although there are common and general foundations, such as technology, which could be upheld as factors for successful implementation, the adoption of any blended pedagogical theory is by itself a "change process" (Mitchell & Honore, 2007) that requires cooperation among various stakeholders to capitalise on the flexibility offered by the pedagogical theory.

Acknowledgements The work described in this paper was partially supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (UGC/IDS16/15).

References

Al-Jarf, R. (2012). Online videos for specific purposes. *Journal of Educational and Social Research, 2*(6), 17–21.

Auster, C. J. (2016). Blended learning as a potentially winning combination of face-to-face and online learning: An exploratory study. *Teaching Sociology, 44*(1), 39–48.

Beadle, M., & Santy, J. (2008). The early benefits of a problem-based approach to teaching social inclusion using an online virtual town. *Nurse Education in Practice, 8*(3), 190–196.

Bliuc, A.-M., Goodyear, P., & Ellis, R. A. (2007). Research focus and methodological choices in studies into students' experiences of blended learning in higher education. *The Internet and Higher Education, 10*(4), 231–244.

Bloom, K., & Johnston, K. M. (2010). Digging into YouTube videos: Using media literacy and participatory culture to promote cross-cultural understanding. *Journal of Media Literacy Education, 2*(2), 113–123.

Borup, J., Graham, C. R., & Velasquez, A. (2011). The use of asynchronous video communication to improve instructor immediacy and social presence in a blended learning environment. In A. Kitchenham (Ed.), *Blended learning across disciplines: Models for implementation* (pp. 38–57). Hershey, PA: IGI Global.

Cha, M. Y., Kwak, H. W., Rodriguez, P., Ahn, Y. Y., & Moon, S. D. (2007). *I Tube, You Tube, everybody Tubes: Analyzing the world's largest user generated content video system*. Retrieved from http://an.kaist.ac.kr/traces/papers/imc131-cha.pdf

Childs, S., Blenkinsopp, E., Hall, A., & Walton, G. (2005). Effective e-learning for health professionals and students – barriers and their solutions. *Health Information and Libraries Journal, 22*, 20–32.

Clifton, A., & Mann, C. (2011). Can YouTube enhance student nurse learning? *Nurse Education Today, 31*(4), 311–313.

De George-Walker, L., & Keeffe, M. (2010). Self-determined blended learning: A case study of blended learning design. *Higher Education Research & Development, 29*(1), 1–13.

Fat, M. J. L., Doja, A., Barrowman, N., & Sell, E. (2011). YouTube videos as a teaching tool and patient resource for infantile spasms. *Journal of Child Neurology, 26*(7), 804–809.

Fleck, B. K. B., Beckman, L. M., Sterns, J. L., & Hussey, H. D. (2014). YouTube in the classroom: Helpful tips and student perceptions. *The Journal of Effective Teaching, 14*(3), 21–37.

Freeman, B., & Chapman, S. (2007). Is 'YouTube' telling or selling you something? Tobacco content on the YouTube video-sharing website. *Tobacco Control, 16*(3), 207–210.

Garrison, R. D., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education, 7*(2), 95–105.

Hadidi, R., & Sung, C. H. (1998). *Students' acceptance of web-based course offerings: An empirical assessment*. Retrieved from http://aisel.aisnet.org/amcis1998/359

Harris, P., Connolly, J., & Feeney, L. (2009). Blended learning: Overview and recommendations for successful implementation. *Industrial and Commercial Training, 41*(3), 155–163.

Hossler, E. W., & Conroy, M. P. (2008). YouTube as a source of information on tanning bed use. *Archives of Dermatology, 144*(10), 1395–1396.

Hudock, A. M., & Warden, S. A. G. (2001). Using movies to teach family systems concepts. *The Family Journal, 9*(2), 116–121.

Hussey, H. D., Fleck, B. K. B., & Richmond, A. S. (2013). Promoting active learning through a flipped course design. In J. Keengwe, G. Onchwari, & J. Oigara (Eds.), *Promoting active learning through the flipped classroom model* (pp. 23–46). Hersey, PA: IGI Global.

Kabassi, K., Dragonas, I., Ntouzevits, A., Pomonis, T., Papastathopoulos, G., & Vozaitis, Y. (2016). Evaluating a learning management system for blended learning in Greek higher education. *SpringerPlus, 5*(1), 1–12.

King, S., Greidanus, E., Carbonaro, M., Drummond, J., & Patterson, S. (2009). Merging social networking environments and formal learning environments to support and facilitate interprofessional instruction. *Medical Education Online, 14*(5), 1–9.

Kirkgöz, Y. (2011). A blended learning study on implementing video recorded speaking tasks in task-based classroom instruction. *Turkish Online Journal of Educational Technology, 10*(4), 1–13.

Laurillard, D. (2002). *Rethinking university teaching: A conversational framework for the effective use of learning technologies* (2nd ed.). London: Routledge.

Lin, C. H., Chang, Y. J., & Yau, C. Y. (2013). Blended learning in the teaching of Tai-Chi Chuan. *Chung Yuan Physical Education Journal, 2*, 17–27.

Luo, G. L., & Pang, Y. J. (2010). Video annotation for enhancing blended learning of physical education. In C. L. Zhao (Ed.), *2010 international conference on artificial intelligence and education* (pp. 761–764). Piscataway, NJ: IEEE.

Mayer, R. E. (2010). Applying the science of learning to medical education. *Medical Education, 44*(6), 543–549.

Mitchell, A., & Honore, S. (2007). Criteria for successful blended learning. *Industrial and Commercial Training, 39*(3), 143–149.

Osguthorpe, R. T., & Graham, C. R. (2003). Blended learning environments: Definitions and directions. *The Quarterly Review of Distance Education, 4*(3), 227–233.

Pfeiffer, V. D. I., Scheiter, K., & Gemballa, S. (2012). Comparing and combining traditional teaching approaches and the use of video clips for learning how to identify species in an aquarium. *Journal of Biological Education, 46*(3), 140–148.

Poon, J. (2014). A cross-country comparison on the use of blended learning in property education. *Property Management, 32*(2), 154–176.

Shang, Y., Shi, H. C., & Chen, S. S. (2001). An intelligent distributed environment for active learning. *Journal on Educational Resources in Computing, 1*(2), 1–17.

Shih, R. C. (2010). Blended learning using video-based blogs: Public speaking for English as a second language students. *Australasian Journal of Educational Technology, 26*(6), 883–897.

Snelson, C., & Perkins, R. A. (2009). From silent film to YouTube: Tracing the historical roots of motion picture technologies in education. *Journal of Visual Literacy, 28*(1), 1–27.

Sun, Y. (2014). Microteaching writing on YouTube for preservice teacher training: Lessons learned. *CALICO Journal, 31*(2), 179–200.

Terantino, J. M. (2011). Emerging technologies YouTube for foreign languages: You have to see this video. *Language Learning and Technology, 15*(1), 10–16.

Tiernan, P. (2015). An inquiry into the current and future uses of digital video in university teaching. *Education and Information Technologies, 20*(1), 75–90.

Woltering, V., Herrler, A., Spitzer, K., & Spreckelsen, C. (2009). Blended learning positively affects students' satisfaction and the role of the tutor in the problem-based learning process: results of a mixed-method evaluation. *Advances in Health Science Education, 14*(5), 725–738.

Yen, J. C., & Lee, C. Y. (2011). Exploring problem-solving patterns and their impact on learning achievement in a blended learning environment. *Computers and Education, 56*(1), 138–145.

YouTube. (2013). About YouTube. Retrieved from YouTube Website: http://www.youtube.com/yt/about/

Zhang, D. S., Zhou, L., Briggs, R. O., & Nunamaker, J. F. (2006). Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness. *Information & Management, 43*(1), 15–27.

Chapter 18
Factors Affecting the Media Literacy of Young Students

He Xuan

Abstract This paper examines the current situation of differences in media literacy and explores the factors that affect this core competence among young Chinese students. The sample for this study included 534 young people aged between 12 and 18. Principal components analysis revealed a five-factor structure that corresponded closely to the underlying conceptual model. This scale facilitates the measurement of factors affecting media literacy. Based on these findings, a number of recommendations are made.

Keywords Media literacy · Factors · Young students

Introduction

As the media have become an integral part of our lives, they have been widely used in classroom teaching, and it has been found that making use of the media in teaching does make learning easier, and this way of teaching is also found to be more interesting for young students. Channels for accessing media, such as televisions, computers, mobile phones and the Internet, are gradually entering classrooms and changing the ways of teaching and learning – for searching, selecting, gathering, storing and conveying knowledge in various forms (Jenkins, 2006; Kuiper, Volman, & Terwel, 2009).

Increasing access to knowledge through the media brings both advantages and disadvantages. It is important for educators to enhance students' ability to identify the good components of knowledge through the media by distinguishing between fact and opinion and by judging whether the source of information conveyed in the media is truthful and reliable. It is also important for the students to develop an ability to avoid referring to unreliable media in the process of soliciting news and information. For example, the negative messages disseminated in the media can be

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_18

avoided by developing the students' skills of questioning, evaluating and analysing media messages. Therefore, it is vital for students to develop media literacy, for making the best use of technology to access media for learning and for interpreting and processing properly the messages delivered in the media (Enochsson, 2005; Thoman, 2003).

There are two general views regarding the level of media literacy of contemporary youth. One view is that those who have grown up in an environment saturated with media in various aspects of life may be skilful in using technologies to access and generate information. Another view is that young people are still immature in cognitive and emotional development, as well as life experience; and so they may not have been equipped with the abilities to seek and consume media information effectively (Flanagin & Metzger, 2008).

Within this context, the purpose of this study is to describe the current situation and differences in media literacy and explore the factors that affect the core competence of media literacy among young Chinese students.

Research Methodology

A Conceptual Framework for Media Literacy

With the aim of exploring media literacy, an attempt was made to identify the ways in which people use the media by mapping the dimensions involved through adopting the conceptual framework for digital competence proposed by Calvani, Fini and Ranieri (2009). This framework includes the co-existence and integration of three dimensions – technological, cognitive and ethical. The *technological* dimension refers to the ability to 'explore and face problems and new technological contexts in a flexible way' (p. 161). The *cognitive* dimension addresses the ability to 'read, select, interpret and evaluate data and information taking into account their pertinence and reliability' (Calvani et al., 2009). Finally, the *ethical* dimension focuses on the ability to 'interact with other individuals constructively and with a sense of responsibility towards oneself and towards others' (Calvani et al., 2009). Integration among these three dimensions refers to 'understanding the potential offered by technologies that enable individuals to share information and collaboratively build new knowledge' (Calvani et al., 2009).

Data Collection

The target population for this study was middle and high school students (aged 12 to 18 years) in Beijing, the capital of China. A purposive sample of students who were studying in digital campus demonstration schools was recruited.

The survey consisted of multiple-choice questions using a 5-point Likert scale and open-ended questions. The questionnaire had six parts: the demographics of participants, the media environment, the use of the media, attitudes to the media, media ethics and the core competencies of media literacy.

Data Analysis

Characteristics of the Students

A total of 534 students participated in the study, after excluding the incomplete questionnaires. The majority of the participants were male (53%) aged between 15 and 18 (53.4%) who were studying in urban areas (60.5%). Most students (nearly 90%) were satisfied with their media-rich environment at home and in school. Table 18.1 presents the descriptive statistics on the students.

Table 18.1 Descriptive statistics of the student participants

	Variable	Frequency	(%)
School district	Haidian	23	4.3
	Xicheng	300	56.2
	Shunyi	211	39.5
Gender	Male	283	53.0
	Female	251	47.0
Grade	Middle	249	46.6
	High	285	53.4
Ranking	Lead	183	34.3
	Middle	248	46.4
	Behind	103	19.3
Hardware conditions (home)	Good	214	40.0
	General	295	55.2
	Poor	25	4.7
Hardware conditions (school)	Good	79	14.8
	General	368	68.8
	Poor	87	16.2
Extent of media usage	High	70	13.2
	Middle	229	42.8
	Low	235	44.0
Frequency of media usage	Often	189	35.4
	Sometimes	252	47.2
	Seldom	93	17.4

Table 18.2 KMO and Bartlett's test

Kaiser-Meyer-Olkin measure of sampling adequacy		.920
Bartlett's test of sphericity	Approx. chi-square	6327.016
	df	276
	Sig.	.000

Factor Analysis

A factor analysis was conducted to categorise the data into a number of variables. Prior to factor extraction, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity (BTS) were applied to the data to ensure the suitability of the dataset for exploratory factor analysis. The results showed a KMO of 0.92 which is above the minimum value of 0.5 (Kaiser, 1974). The BTS result ($p = 0.000$) in Table 18.2 also demonstrated that the correlation between the items was strong enough for conducting a factor analysis. With principal component analysis in extraction and varimax in rotation chosen, the results showed that there were three components in the data (showed in Table 18.3), which was consistent with the three dimensions in the conceptual model, and confirmed the content validity of the questionnaire.

Media Literacy Education

Table 18.4 shows the level of popularity of media literacy education, which was not high (ranging from 44.2 to 65.5%). There were some school and classroom activities about media literacy, but a significant expansion is still needed. As the enhancement of media literacy has not been an emphasis in mainstream education, the findings suggest that it is important to increase the educational activities and research on media literacy and to raise students' awareness of media questions which are of central importance for education.

In China, there is no separate subject for media literacy, which is integrated into the syllabuses of other subjects. Although students are in favour of having media literacy as a part of formal education, this is an area that requires further effort in order to respond to fast-emerging societal changes in relation to the wide exposure to the media.

Correlational Analysis

Table 18.5 presents the results of correlational analysis. Gender, area, diversification of media use, frequency of media use and media education were positively correlated

Table 18.3 The factor structure of instrument

Item description	Factor component		
	Technological	Cognitive	Ethical
I was able to apply what I have learned to help myself, parents, friends and community to solve practical problems	.652		
I can quickly filter irrelevant information, focusing on what content I need when I read through the information on the Internet	.642		
I can use some computer software to help myself, parents, friends and community to solve practical problems	.620		
On the Internet I know where I can get the information I need	.606		
Although much homework, I still can prioritise, identify priorities, a reasonable allocation of time and effort to learn efficiently	.528		
I can put different digital material reassembled to produce my new works		.720	
I usually can create a new work by dismantling and restructuring		.697	
I can use the software drawing concept maps to help myself sum up the law, refining the model		.695	
In comments on the Internet, I sometimes use a number of overheated rhetoric			.792
I sometimes find ways to ascertain a person's privacy through the Internet and other means			.777
For some information on the web, I will forward the information is true regardless of whether or not			.732
Writing or completion of a work, I will copy some content from the Internet written by someone else's article, paste it directly into my own article			.713
I sometimes go to try to set broken school or other local network password			.689
I download movies and novels from the network, regardless of piracy			.592

with media literacy. Male students were better at technical operations, while females were stronger in moral sense. Not surprisingly, higher-grade students were more media literate than lower-grade students on the cognitive dimension. The best students were outstanding in achievement in the cognitive and moral aspects. In contrast, the hardware conditions at home and in schools did not seem to have an impact on the students' media literacy.

More diversified results were present in the ethical dimension. For example, the students tended to disapprove cyber bullying, while they did not have clear ideas about respect for privacy and personal safety. The students seemed to have difficulties in answering the question about the digital divide, which shows their scant awareness of the access problems and technical difficulties in Internet

Table 18.4 The survey results on media literacy in school education

	Agree (%)	Disagree (%)	No comment (%)
The teacher let us use computers to solve practical problems	59.7	40.3	0
The teacher taught us how to quickly browse complex information	54.5	23.2	22.3
The teacher gave us tasks which required us to use different digital resources to create new works	44.2	41.4	14.4
The teacher told us the websites and forums we can access to get the information we need to learn	61.8	19.1	19.1
The teacher taught us how others think through role-playing or virtual games	65.5	16.1	18.4
The teacher told us how to analyse and evaluate information on the Internet	51.9	19.3	28.8
The teacher recommended or taught us about software to summarise information	59.6	16.5	23.9
The teacher assigned us the use of Wiki cooperation to complete the composition or project tasks online	52.6	16.2	31.2
The teacher taught us skills of communication and negotiation for online discussion	56.4	21.7	21.9

Table 18.5 Results of correlational analysis

Variable	Cognitive	Technological	Ethical	Media literacy
Ascription of human capital				
Gender (female)	−.031	−.239*	.463*	.166*
Hardware conditions (home)	.075	.087	−.129	.055
Grade (middle school)	−.162*	−.022	.046	−.015
Induced by human capital				
Area (Haidian)	.557*	.069	.124	.281*
Area (Xicheng)	.176*	−.121	−.151	−.016
Score (lead)	.210*	.031	.525*	.027
Score (middle)	−.056	.096	.363*	.033
Hardware conditions (school)	.069	.111	.039	.074
Independent variables				
Extent of media usage	.437*	.650*	.312	.398*
Frequency of media usage	.048	.144*	.069	.058*
Media education	.345*	.568*	.171*	.363*

*Statistically significant, $p < 0.05$

communication. About half of the participants responded that the quality of communication depends only on the number of pictures, audios and videos used and did not agree with the idea that an excessive quantity of multimedia can lead to problems.

Discussion and Conclusions

Firstly, the study found that students from various schools in Beijing were significantly different in terms of the cognitive dimension of media literacy, which suggests an unbalanced development among the various schools in providing education related to media literacy. Therefore, in order to achieve a balanced development of education among the various schools and regions, media literacy education should be strengthened, for example, by promoting sharing of related teaching resources and experiences.

Secondly, age and gender were important factors affecting the level of media literacy of young students. The students' age was inversely proportional to their cognitive level. Schools should strengthen the training on the technical aspects for female students, as well as the moral aspects for male students.

Thirdly, the results showed that the higher the frequency of the students' use of computers and networks, the better their performance at the technical level. The use of computers and networks thus had a positive impact on students' cognitive abilities, and it is recommended that this is promoted by schools. By increasing the use of computers and networks, both within and outside the school environment, students are expected to enhance their media literacy at the cognitive level.

The findings of this study thus suggest factors in three areas that may affect students' development of media literacy. Future research can focus on further exploration of these factors as well as their impacts on students' learning outcomes.

References

Calvani, A., Fini, A., & Ranieri, M. (2009). Assessing digital competence in secondary education – Issues, models and instruments. In M. Leaning (Ed.), *Issues in information and media literacy: Education, practice and pedagogy* (pp. 153–172). Santa Rosa, CA: Informing Science Press.

Enochsson, A. (2005). The development of children's web searching skills – a non-linear model. *Information Research*, *11*(1), paper 240. Retrieved from http://informationr.net/ir/11-1/paper240.html

Flanagin, A. J., & Metzger, J. M. (2008). Digital media and youth: Unparalleled opportunity and unprecedented responsibility. In M. J. Metzger & A. J. Flanagin (Eds.), *Digital media, youth, and credibility* (pp. 5–28). Cambridge, MA: The MIT Press.

Jenkins, H. (2006). *Confronting the challenges of participatory culture: Media education of the 21st century*. Retrieved from http://www.nwp.org/cs/public/print/resource/2713

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika, 39*, 31–36.

Kuiper, E., Volman, M., & Terwel, J. (2009). Developing web literacy in collaborative inquiry activities. *Computers and Education, 52*, 668–680.

Thoman, E. (2003). Media literacy: A guided tour of the best resources for teaching. *The Clearing House, 76*(6), 278–283.

Part IV
Tracking and Analysis of Student Learning

Chapter 19
Instruction in College Physics Experiments in the Context of Big Data

Jun Lv, Ning Sheng Ma, Kai Fang, and Xian Chao Ma

Abstract Mining big data produced by students learning through mobile learning (m-learning) and ubiquitous learning (u-learning) can promote instructional effectiveness. So, in learning physics experiments, the big data should be recorded, mined and used. This paper analyses the research results on m-learning, u-learning and educational big data. It includes five parts. Firstly, it deals with the promotion of personalised adaptive learning, where educational data mining and learning analytics can be used to help students find the best learning methods and resources for physics experiments, when needed. Secondly, it considers the digitising of a university physics experiment course for recording resource usage and the experimental operation process. Thirdly, it examines the reform of the teaching of physics experiments, in which teachers provide rich e-learning resources and a useful communication platform for recording the data produced by students and adjust their teaching methods and strategies for different students. Fourthly, it discusses the reform of the method for learning physics experiments, in which students adopt blended learning which combines informal after-class learning and formal classroom experiment learning, and uses the prediction function of big data to change their learning method for different experiments. Finally, the paper looks at the reform of the evaluation method for physics experiments to reflect more objectively students' actual levels of performance by analysing the whole process.

Keywords Big data · College physics experiment · Teaching · Learning

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_19

Promoting Personalised Adaptive Learning with Educational Big Data

The launching of the China Education and Research Network can be viewed as the beginning of Chinese informatisation in colleges and universities (Zhu, 2011), a process which has now covered 22 years. With the society becoming more information-based, the type and amount of data generated in education has far exceeded expectations at the start of the process – our education system has entered the era of big data. How to mine and use these accumulated data is an important issue we need to face. In February 2015, China's Ministry of Education issued *Educational Informatisation Priorities for 2015*, which pointed out that the application of big data, for monitoring, evaluating, forecasting and early warning, provides the basis for scientific decision-making and macromanagement. Research and the formulation of measures for educational data management and use can standardise planning, acquisition, sharing and use (China Department of Education, 2015). Educational big data have become an important part of educational informatisation, which will penetrate all aspects of education, especially at the level of management and decision-aiding; and they are of great significance for promoting teaching and learning. In October 2012, the US Ministry of Education issued *Enhancing Teaching and Learning through Educational Data Mining and Learning Analytics: An Issue Brief*, which argued that educational data mining, learning analytics and visual data analysis can produce a personalised adaptive learning system and realise personalised learning (US Department of Education, 2012).

The course College Physics Experiments is a basic course for undergraduate students in science and engineering, which is important for learning experimental knowledge, cultivating operational skills and improving overall quality. It is the beginning of experimental skills training and the basis for the follow-up of the experimental course (Gong, 2012; Liu, Xing, & Su, 2014). The curricular organisation of this course is subject-centred, and its teaching still follows the conventional teaching mode – 'theory study + experiment + experiment report'. Modern education theory places more emphasis on making the students the centre of the curriculum and meeting their needs, which requires us to change our conventional course organisation and teaching mode. In this context, educational big data, which are much superior in realising such personalised learning, should become the technical foundation for modern educational ideas. This course should be reformed in accordance with such educational concepts and should start from the construction of educational big data for it.

Digitising a College Physics Experiment Course

The digital construction of the college physics experiment course should meet students' personalised adaptive learning and provide the data for data mining and learning analysis. It should be carried out in several respects, including the digitisation of students' basic information, the learning content and process and the experiment report. In this way, the multi-data of each student can be obtained and used to establish a mathematical model of experiment learning; and, by comparing the established mathematical model and each student's data, students' learning progress can be predicted and evaluated.

The Digitisation of Students' Basic Information

Students' basic information can be used to analyse their characteristics, which include both intellectual and nonintellectual factors. The intellectual factors refer to the general features of an individual's cognitive development, such as his/her knowledge level, cognitive characteristics and cognitive structure. The nonintellectual factors refer to interest, motivation, emotion, attitude, anxiety, will, personality and the cultural and religious background (He & Li, 2009). Through students' registration on the e-learning platform, this basic information can be obtained by a questionnaire and test. The information thus acquired is a prerequisite for setting up a basic model for each student; and students use the model for getting help in choosing physical experiments and predicting the knowledge and psychological difficulties involved.

The Digitisation of the Experiment Learning Content and Process

The digital construction of the students' basic information can help us to establish the students' situation before an experiment, but it does not fully predict what will happen in the specific learning process. The experimental learning process is generative, and students' intellectual and nonintellectual factors are constantly changing. So, in a specific experimental learning process, the students' learning of mathematical models should be adjusted continuously, according to the data generated in the learning process. To acquire these data, students' experimental learning content and process must be digitised.

The digitisation of experiment content requires teachers to provide rich learning resources in the e-learning platform, such as micro lectures and virtual experiments. These resources used at different stages in learning experiments will broaden the students' choices. At the same time, the details of students' learning resources – such

as their length of study time, the number of mouse clicks, the content of comments and the type of errors – will be recorded in the e-learning platform, and the data will be incorporated into each student's individual database. The digitisation of the experiment learning process will not only record the process but is also related to the digital construction of the experimental instruments. The digitisation of the experimental instruments shows digitised experimental results which are measured by the sensors to remake the experimental instruments and record a student's operational process. This has an important significance for the students for analysing their own experimental process to find the advantages and disadvantages of their experiments. At the same time, recording the complete experimental operating process is also important for teacher as it allows them to analyse students comprehensively.

The Digitisation of the Experiment Study Report

Experiment reports are important for teaching the college physics experiment course. Improving the quality of students' experiment reports and establishing a scientific scoring mechanism will promote the reform of the course in colleges and universities (Guan, 2011). Conventional experiment reports have several disadvantages, such as the slow speed of updating content and form, the use of the same format for students with different professional backgrounds, plagiarism, and the difficulties teachers have in scoring similar reports. The digitisation of experiment reports has the following advantages: (1) teachers can send personalised reports to different students according to their characteristics and ability; (2) such reports help to record the operational process and data, which reflect the real process of the students' experiments; (3) they can be easily corrected by teachers, while some questions with fixed answers can be corrected directly by the system; and (4) the reports can be saved and analysed conveniently to evaluate students objectively and establish a mathematical model for the physics experiments.

Reform of the Teaching of Physics Experiments

The goal of using educational big data in the course College Physics Experiments is to digitise teaching and, more important, deepen its reform. Introducing big data into the course is a challenge, which requires teachers to carry out reforms in teaching content, method and mode.

Teaching Content

The course is usually carried out around specific type of experiment. The teaching content is mainly based on the textbook and guidance for the experimental operation. In the era of educational big data, the teaching content should be changed to adapt to students' personalisation and content digitisation. Firstly, rich digital teaching resources should be provided. The type of learning can be divided into three categories: visual learning, auditory learning and tactile learning. Rich learning resources should be made available which can satisfy different types of students who can choose suitable teaching resources according to their needs. Video, audio and virtual experiments are therefore provided on the e-learning platform for students' preview and review. Secondly, there should be teaching content on the operation of the digital experiment instruments. Many conventional physical experiment instruments are not digitised, and even though some are, their level of digitisation is unable to meet the requirements of big data. When the instruments are digitised, the operational steps may be changed. Therefore, the content of the experiment operation must not follow the previous teaching content, but be redesigned with the new experiment methods and instruments. Having diverse and digitised teaching content is significant for breaking a discipline-centred approach and establishing a student-centred one.

Teaching Method

The teaching of the college physics experiment course is generally divided into two elements, the teaching of theory and guidance on experiment operation. The theory teaching often adopts a macro-teaching approach, which improves the efficiency of knowledge propagation in physics, but cannot meet personalised requirements. In the operation guidance process, demonstrations and individual counselling are mainly used. These teaching methods can help students to complete operating the experiments, but it is hard for them to understand and construct the experimental knowledge. Also, as teaching theory is sometimes separated from the experiment operation, when students do experiments, they may not remember the relevant physics theory.

Teaching the course based on educational big data changes these imperfect methods. Firstly, the teachers arrange the experiment project according to the big data analysis, which is based on students' basic information. When they present the teaching content according to the characteristics of experiments and students, students will accept it, completely or partially, based on the methods adopted. Secondly, the e-learning platform provides rich digital teaching resources, which allow students to learn experiment theory using out-of-class time, where it can be repeated without limits of time and space. At the same time, if students encounter some problems during the learning process, they can ask questions directly, with the

questions and answers being recorded in the database to facilitate retrieval by other students. Finally, through educational big data analysis, students can be divided into different groups to carry out experiments. In a specific experiment, students in the same group may have a similar level of knowledge, ability and problems. In this way, teachers can be more targeted in guiding students' operations and facilitate their understanding of the experiment.

Exploring New Teaching Modes

In the era of educational big data, some fundamental changes will take place in the teaching content and method. To fully exploit the advantages, teachers should explore new teaching modes for each specific physics experiment, which should give full play to the functions of data mining and learning analytics, as follows. Firstly, through data mining, students' prior knowledge can be understood, and personalised experiment projects can be presented to them. Secondly, through learning analytics, students' learning progress and behaviour can be understood, and targeted learning interventions can be carried out for learning difficulties found. Thirdly, students use the rich teaching resources on the e-learning platform to learn experiment theory and to understand the steps in operating experiments by themselves. Teachers should organise classroom teaching according to the situation reflected in the e-learning platform. Finally, educational big data can be used to record students' learning process, make a formative evaluation for students, and help them to improve their learning methods. Each kind of teaching mode should be based on the specific teaching background and pursue educational value. The effective implementation of the teaching mode is therefore bound to be restricted by many factors, such as the teaching situation and the teaching target (Zhang, 2015).

The Reform of the Physics Experiment Learning Method

In reforming the course, the focus is to establish a student-centred teaching mode and so meet the students' personal needs. It should introduce information technology into the process and help students to construct its cognition. The rapid development of information technology makes m-learning and u-learning possible and brings informal learning into our real lives. The reform should draw on these kinds of learning methods.

Personalisation of the Physical Experiments

Personalised learning emphasises that the learning process should conform to students' personality and development potential and use appropriate means, methods, content, starting point, process and evaluation methods to promote their development fully, freely and harmoniously (Li & Jiang, 2005). Combined with pedagogy and learning psychology, educational big data help to build mathematical models of students' learning progress, which can be used to analyse their personality and development potential. At the same time, these mathematical models change, with the data becoming richer. The mathematical models are basic to personalised learning and allow students to make choices based on them.

The experiment projects and contents should be personalised. Ordering the projects refers mainly to systems which can present an experimental project appropriately to students, which they can modify. In this way, both the instructional objectives and students' real needs can be addressed together. Ordering experimental content mainly involves the use of big data to analyse its progress and cognitive characteristics – and then the content for students can be provided based on the results of the analysis. When necessary, teachers can also organise students to carry on with the face-to-face tutoring. Of course, the ordering of personalised experimental content also includes predicting student achievement and potential learning difficulties.

Blending the Learning of Physics Experiments

Singh and Reed defined 'blending learning' as follows: "... in the 'appropriate' time, using 'appropriate' learning technology that fits 'appropriate' learning style, transferring 'appropriate' ability to 'appropriate' learners to obtain optimal learning effect" (Singh & Reed, 2001). The conventional learning of physical experiments is based primarily on textbooks and classroom teaching. In this approach, learning is relatively limited in terms of efficiency and cannot meet the needs of all the students. Blending learning of physical experiment involves many aspects, viz. the blending of (1) textbook learning and multimedia learning resources, (2) formal classroom learning and informal u-learning, and (3) offline and online communication. The blending is not random and chaotic, but should meet the five 'appropriates' as mentioned above.

Today, textbook is still the main learning resource for physics, but multimedia resources, with their rich forms of expression, are good for enhancing students' understanding of the specific knowledge in this subject. Physics experiment theory can be completed by u-learning anytime and anywhere. The experiment learning process involves people interacting with instruments and interpersonal interaction; and online communication is an extension of real communication which can broaden communication time and space and enable students to get help when necessary.

U-learning and online communications generate a great deal of data which, through mining and analysis, can guide the next round of experiment learning and can even arrange the time for textbook learning, classroom learning and offline communication.

Reform of the Physics Experiment Evaluation Method

Evaluation is an important link in college physics experiment instruction. Summative evaluation can be used to examine students' overall ability; and diagnostic and formative evaluation can be employed to identify problems in the learning process and provide students with timely feedback. The evaluation of physics experiments includes an experiment preview, observing students' operational process and experimental exercises. This evaluation process is coarse-grained and its effect is very limited. Because of the educational big data records of the complete experimental learning process, we know much more details about the students and can evaluate them more comprehensively.

Individualised Evaluation

Students have varying knowledge background, experiment requirements and problems. All these factors require us to adopt different evaluation methods for different students. The course involved in this study is composed of many specific experiments, so the same evaluation criteria cannot be used for all students' experiment evaluation. The evaluation of students based on their background and the learning resources not only addresses their differences in mastering the knowledge and ability in a specific experiment but helps them to discover problems, resolve problems and make improvements.

With the availability of educational big data, it becomes possible to carry out individualised evaluation. The e-learning platform can be used to record each student's information, including his/her background, experimental requirements, experimental operation process and progress in learning. This educational big data can be used as the basis for giving different evaluation data to different students. Students get feedback on time; and it is not simple feedback about what is right and wrong but also includes the next learning plan and recommendations for each student.

Evaluation of the Complete Learning Process

By collecting bits and pieces of information and using strict and detailed logical reasoning, big data show a student's complete image objectively. In the cloud, the separate databases can be connected to each other and can be used for multidimensional online analysis. In this way, the whole educational scene will be shown, with each student placed in it to be examined and evaluated (He, 2014). The conventional evaluation for students' experiments is mainly the experiment report result and teachers' feelings about the students' experimental operation. Big data record the complete process, which can objectively reflect students' actual learning outcomes.

When students choose experiments, educational big data help them to make a diagnostic evaluation in selecting appropriate experiments. In the preview process, students should study the resource presented in the system and their learning progress will also be recorded by the system. In operating the physics experimental process, the digital instrument records the process and data that are generated by students. After the experiment, in order to consolidate understanding, students are required to complete reports designed by the big data system. In the context of educational big data, the whole learning process of physics experiments is a quantified self-process for students whose results can also be used to evaluate them.

Conclusion

The prospects of big data are considerable and are changing our way of teaching. Educational big data will also affect the education ecology, which requires us to make reforms based on them. To integrate the college physics experiments with educational big data, digital experiment instruments and e-learning platforms with big data mining and analysis should be established. The present teaching and learning methods should be reformed to make teaching and learning student-centred. Although such integration has very significant advantages, it is still in the initial stage.

References

China Department of Education. (2015). *Educational informatization priorities for 2015*. Retrieved from http://www.moe.edu.cn/publicfiles/business/htmlfiles/moe/s3342/201503/184892.html

Gong, T. X. (2012). Problems and reflections in the teaching of college physics experiment. *Physics Bulletin, 9*, 83–85.

Guan, L. (2011). From single conservative to multivariate innovation – Research summary on the reform of college physics experiment report. *University Laboratory Work Study, 1*, 88–91.

He, K. K. (2014). Aspects of big data. *E-education research, 10*, 8–16.

He, K. K., & Li, W. G. (2009). *Educational technology* (pp. 159–160). Beijing Normal University Publishing Group.

Li, G., & Jiang, Y. J. (2005). Theory constructing and characteristics: Analyzing of personalized learning. *Journal of Northeast Normal University (Philosophy and Social Sciences), 3*, 152–156.

Liu, J. H., Xing, H. H., & Su, X. J. (2014). Improvement of teaching of university physics experiment based on ability training. *Experimental Technology and Management, 31*, 189–191.

Singh, H., & Reed, C. (2001). A white paper: Achieving success with blended learning. *Centra Software Retrieved, 12*, 206–207.

U.S. Department of Education. (2012). *Enhancing teaching and learning through educational data mining and learning analytics: An issue brief*. Retrieved from http://tech.ed.gov/wp-content/uploads/2014/03/edm-la-brief.pdf

Zhang, J. (2015). A theoretical perspective of the progress of reforms of teaching modes. *Journal of He Bei Normal University (Educational Science Edition), 1*, 96–100.

Zhu, Z. T. (2011). China educational informatization for ten years. *China Educational Technology, 1*, 20–25.

Chapter 20
A Study of the Relationship Between Instant Messaging Communication and Student Assessment Results

Francis Yue

Abstract The use of instant messaging is increasingly popular among local university students and teachers. This paper studies the possible relationship between instant messaging communication and student assessment results. It involves a large group of university students who were tutored through two teaching methods. The extent of instant messages exchanged by the students with their tutor is examined. It was found that the use of instant messaging is related to the final assessment results obtained by the students. Also, students who were involved in instant messaging with their tutor included those who were more capable as well as those less capable.

Keywords Instant messaging communication · Feedback · Assessment

Introduction

The possession of mobile phones is very high in Hong Kong. According to the Office of the Communications Authority in Hong Kong, the mobile subscriber penetration rate reached 240% in early 2016. Many local undergraduate students can afford to possess smartphones and often use instant messaging for communication. Timely communication between teachers and students – in both open universities and conventional tertiary institutions – is considered to be important for achieving a better learning experience. Many students use instant messaging (IM) software communication tools, such as WhatsApp (2016), for communication purposes; and this has been the focus of recent research by, for example, Yue (2014a, 2014b). The target participants in these research studies were mainly students who worked on individual dissertations or small-group projects.

This paper aims to study the effect of using instant messaging communication on the assessment results obtained by a large group of students studying a university

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_20

course. It includes a statistical analysis of the relationship between assessment results and the extent of using instant messaging communication, as well as other factors, such as the gender of the students and the teaching method.

Relevant Research

Formative assessment of learning is used as students' progresses through a course. It is widely accepted that students should receive feedback on how they have performed through formative assessment before any summative assessment. Summative assessment is usually held in the form of a final examination for most university courses. However, these summative examinations normally provide little or no feedback to students on how they have performed.

Learning and Feedback

Bruner (1970) pointed out that learning depends on feedback given to the learner, and several factors – such as the location and timing of the feedback – can affect whether or not it is useful to the recipient. Another researcher, Jacobs (1974), proposed that there are two important properties of feedback: the informational and hedonic components. The first component enables the recipients of feedback to change and improve their performance, while the second component influences the recipients' motivation. Also, there are two important types of feedback: positive and negative. Positive feedback can reinforce the likelihood of recipients repeating desirable behaviour, while negative feedback can affect their reception of feedback information and subsequent action(s). Jacobs (ibid.) discusses further the advantages and disadvantages of the order in which positive and negative feedback are received.

The Role of Teachers

Bangert-Drowns, Kulik, Kulik, and Morgan (1991) emphasise that feedback is important in the interaction between learners and the associated environment, including the teachers who provide the feedback. Jonassen and Grabowski (1993) suggest that feedback should be aligned with the learner's characteristics, pointing out that learners differ in their ability to interpret feedback and apply it to new situations. Falchikov (1995) considers the importance of feedback in assessing students' performance. He notes that effective learning depends on feedback to the learner and that providing quick and helpful feedback is very beneficial to students. Cowan and George (1997) and Cowan (1998) consider the role of the teacher in formative assessment, commenting that the teacher can understand the learners'

learning progress during the teaching and learning activities conducted. Also, in the distance education context, Stone (2012) found that a positive relationship between teachers and students can produce better academic achievement in the latter. In a similar context, Yates, Brindley-Richards, and Thistoll (2014) suggest that staff members should be more student-centred to improve students' course completion rate.

Effective Feedback

Hedberg and McNamara (1985) identified two types of learners: field-dependent learners who tend to make fewer errors when their mistakes are explained and they are given advice to correct them and field-independent learners who make fewer errors when they are told whether or not their answers are correct. Mory (1996) indicates that feedback is essential in learning and instruction; and Mason and Bruning (2001) point out that effective feedback aims to (1) help learners to identify their misconceptions and inadequacies, (2) help them to establish performance expectations and understand their learning progress and (3) support learners in achieving their learning goals.

Bangert-Drowns et al. (1991), Mory (1996) and Mason and Bruning (2001) discuss different types of feedback by considering the information provided in it. Other researchers, such as Sales (1993) and Jackson, Krajcik and Soloway (1998), introduce the concept of adaptive feedback in which the feedback suits learners' needs or preferences. They emphasise the need to provide customised or personalised information instead of generic feedback to learners. In their study, Arroyo Beck, Beal, Wing, and Woolf (2001) found that male learners benefit more from brief and concise explanations, while female learners can understand explanations and perform better if the feedback is clear, structured and interactive. Gouli, Gogoulou, Papanikolaou, and Grigoriadou (2006) propose an adaptive feedback framework that is able to accommodate different characteristics and needs.

In the distance learning context, Stone (2012) considers the important relationship between tutors and students and notes that a positive relationship enables better student academic achievement. Also, as mentioned above, Yates et al. (2014) suggest that staff members should be more student-centred so that students' course completion rate can be improved.

Feedback and Instant Messaging

Yue (2014a) commented that teachers can use IM to send customised feedback to students. This issue has been considered by Yue (2014a), who examined students' reaction to the use of a typical IM tool in supervising dissertation projects. In his study, he found that undergraduate students were very positive about the use of IM

and that female students were more active than male students in exchanging instant messages with their supervisor during the dissertation supervision process. In a later paper, Yue (2014b) discussed several quantitative measures of student engagement in the process of exchanging instant messages with their tutor; and Yue (2015) examined the use of IM in tutoring a larger group of students enrolled in a typical university course.

Methodology

There were 243 participants who are undergraduate accounting students involved in the present study. These participants were the same as those considered in Yue (2015). These students were classified into 11 tutorial groups, and they were studying an information system (IS) course in an accounting in the bachelor's degree programme. There were 15 h of intensive lectures, followed by six weekly tutorial classes, each lasting for one and a half hours. The lectures covered the basic background knowledge for the course, and the face-to-face tutorial classes were conducted by a male tutor. Students had to prepare answers to tutorial exercise questions and tasks sent out in advance, and they were expected to be able to complete the course essay assignment after attending the tutorial classes.

As regards assessment, the students enrolled in the course are required to submit an essay assignment not exceeding 2500 words. The essay – which must be submitted 3 weeks after the last tutorial class is held – is a formal piece of work, and its completion accounts for 100% of the overall assessment. It is an individual assignment, and each student has to choose and work on one of the three assigned IS-related topics – supply chain management, the Internet and customer relationship management – relating to a business organisation [and its information system(s)]. The completed assignments are marked according to performance on the following aspects: the topic and business organisation chosen, business analysis of strategic challenges and opportunities that the IS addresses and presentation of the assignment report.

There were two different teaching (tutoring) methods: tutor-centred (Method A) and student-centred (Method B). For Method A, there were five tutorial groups of 113 students, without the need to answer the tutorial questions orally. These tutorial classes involved a minimal amount of group discussion – the tutor took a leading role in presenting answers to the tutorial questions, followed by some in-class discussion with the students. For Method B, six tutorial groups of 130 students were involved. Each tutorial group of about 20 students was divided into six teams, and each team had to present prepared answers orally once during the whole six-week tutorial period. The students who presented answers to the tutorial questions played an active role for the first half-hour of the tutorial class, followed by comments and discussion initiated by the tutor. After that, the tutor related the discussion to the written assignment that the students had to complete.

At the beginning of the tutorial period, all the students were invited to contact their tutor when they wanted to consult him on questions about the course. The students were welcome to send electronic mail/instant messages or telephone their tutor directly throughout the course. Each student's tutorial attendance, details of any communication with the tutor and overall assessment marks were all recorded for analysis.

Findings

Throughout the six-week tutorial period, only a few face-to-face contacts and electronic mails were exchanged between the students and tutor. The classroom teaching involved some discussion about the written assignment irrespective of whether Method A or Method B was adopted for teaching. Students initiated IM (using WhatsApp communication software) with their tutor only after the tutorial classes had ended. There were virtually no face-to-face and electronic mail exchanges between the students and tutor. About 18% of the students (44 out of 243 students) exchanged instant messages with their tutor before the assignment submission deadline on 29 September 2014. Out of these 44 students, 10 were male and 34 female. These instant messages were related to the essay assignment as well as its submission.

The average number of issues raised in the IM exchanges for each student was 2.52, with each issue involving a number of IM exchanges. On the other hand, the average number of days on which an individual student exchanged messages with their tutor was 6.77. Most students only exchanged instant messages with their tutor after the tutorial class period. It was found that, on average, the students started to exchange instant messages with their tutor 14.9 days before the assignment submission deadline.

Some other statistics were compiled as listed in Table 20.1. The average class attendance rate (for the six tutorial classes) for those students who were involved in IM with their tutor (5.39) was much higher than that (4.57) of those who had no IM exchanges. It can be seen that, for the students involved in IM with their tutor, their class attendance rates (5.62 for Method A and 5.17 for Method B) were much higher than those (4.58 for Method A and 4.57 for Method B) for students who had not done so.

The assessment marks obtained by students ranged from 37 to 71. Most of the students completed their course successfully (40 is the minimum mark required for passing the course). As can be seen in Table 20.1, the average assessment mark for female students was higher than that for male students for the four IM-Method combinations, except the last one. Also, the average assessment mark obtained by the students who had participated in IM with their tutor was 56.09, which was higher than that (54.83) of those who were not involved in IM. For the students who participated in IM with their tutor and were taught using Method A, the average assessment mark (60.00) was the highest among all four IM-Method combinations.

Table 20.1 Assessment marks for different combinations of IM and teaching method

		IM-Method combination					
		WhatsApp (YES)			*WhatsApp (NO)*		
		Method A (tutor-centred)	*Method B (student-centred)*		*Method A (tutor-centred)*	*Method B (student-centred)*	
	Overall	(1)	(2)	*Subtotal*	(3)	(4)	*Subtotal*
Number of students	243	21	23	44	92	107	199
	105 (M)	4 (M)	6 (M)	10 (M)	43 (M)	52 (M)	95 (M)
	138 (F)	17 (F)	17 (F)	34 (F)	49 (F)	55 (F)	104 (F)
Average attendance (out of 6)	4.72	5.62	5.17	5.39	4.58	4.57	4.57
	4.30 (M)	5.75 (M)	5.67 (M)	5.70 (M)	4.12 (M)	4.19 (M)	4.16 (M)
	5.04 (F)	5.59 (F)	5.00 (F)	5.29 (F)	4.98 (F)	4.93 (F)	4.95 (F)
Average assessment marks (out of 100)	55.06	60.00	52.52	56.09	55.17	54.53	54.83
	53.89 (M)	59.25 (M)	51.83 (M)	54.80 (M)	52.88 (M)	54.54 (M)	53.79 (M)
	55.95 (F)	60.18 (F)	52.76 (F)	56.47 (F)	57.18 (F)	54.53 (F)	55.78 (F)
Correlation between assessment marks	0.217	−0.332	−0.074	0.009	0.376	0.140	0.243
	0.239 M)	0.440 (M)	−0.031 M)	0.110 (M)	0.404 (M)	0.137 (M)	0.241 (M)
and attendance	0.138 (F)	−0.363 (F)	−0.056 (F)	0.023 (F)	0.199 (F)	0.155 (F)	0.174 (F)

Note: M stands for male students and F for female students

On the other hand, for the students taught with Method B who were involved in IM with their tutor, the average assessment mark of 52.52 was the lowest among all four IM-Method combinations.

Also, the correlation coefficient (0.009) of assessment marks and class attendance for those students who were involved in IM with their tutor was very close to zero and was much weaker than that (0.243) for those who had not done so. As regards the overall correlation coefficient of 0.009, there was a negative value of −0.332 and −0.074 for Methods A and B, respectively. On the other hand, regarding the overall correlation coefficient of 0.243, there was a positive value of 0.376 and 0.140 for Methods A and B, respectively.

Conclusion

This study does not involve any formative assessment due to the nature of the course. In fact, students communicated with their tutor using IM only after the completion of the six tutorial classes. The use of IM served the purpose of supplementing the

teaching following the end of those scheduled face-to-face tutorial classes. Overall, it turned out that these students (who have exchanged instant messages with their tutor) performed better in the written assignment submitted.

It is of interest to note that, in the present study, irrespective of whether the students were involved in IM with their tutor or not, the tutor-centred teaching method (Method A), rather than the student-centred method (Method B), led to better average assessment marks for the accounting students. Students who exchanged instant messages (all related to the completion of their written assignment) with their tutor are likely to understand the requirements of the assignment better. Their completed assignments were of a better quality and therefore obtained higher marks than the students who had not contacted their tutor using IM. Those students who were involved in IM with their tutor under Method A scored higher in their assignments than those under Method B. This could be due to the fact that, under Method A, better explanations were given by the tutor rather than students in the tutorial classes than under Method B. Under Method B, the students' oral presentations took up some class time, leaving less time for the tutor to elaborate on the answers to the tutorial exercise questions and discuss the final written assignment the students have to complete. Some students under Method B expressed that the presentations of their classmates were not as good as the tutor's ones.

The Method A and Method B teaching situations related to the highest and lowest average assessment marks (corresponding to the average assessment marks of 60.00 and 52.52 marks, respectively) indicate that the more capable students, as well as those less capable, are more inclined to be involved in IM with their tutor. Based on the other results obtained, it was also observed that female students were more active than male students in exchanging instant messages with their tutor. Furthermore, the female students scored higher marks than the male students in the assignment. This observation is similar to that made in some recent research studies on the use of instant messaging during the supervision of some undergraduate dissertations for business students (Yue, 2014a). This observation is also somewhat in line with the findings obtained by Arroyo et al. (2001) in that male and female learners differ in academic performance in the light of the feedback received.

This study does not examine formative assessment. In fact, students communicated with their tutor using IM only after the completion of the six tutorial classes. The use of IM served the purpose of supplementing the teaching following the end of those scheduled face-to-face tutorial classes. Overall, it turned out that these students performed better in the written assignment submitted.

The correlation coefficient between the assessment marks and students' class attendance was weaker for the students who were involved in IM with their tutor when compared with those who had not done so. This could be due to the fact the former were more in need of the tutor's assistance in completing their essay assignment. It was also found that the average class attendance for those students who were involved in IM with their tutor was higher than for those who had not done so. This indicates that these students, with higher class attendance, were more inclined to communicate with their tutor using instant messages after the face-to-face tutorial classes. This could be due to the fact that a certain positive relationship

had been established between the tutor and these students who had achieved better results. The provision of timely feedback in the form of customised or personalised information, instead of generic feedback, would lead to better academic student achievement, as pointed out by Sales (1993) and Jackson et al. (1998).

This paper considers student performance in the situation where students focus mainly on the completion of their assignment which accounts for the overall assessment. This situation is very common in the offering of courses via the open and distance teaching mode. Further research in this area will be needed, especially examining student performance in relation to both formative and summative assessment. Another line of research that justifies further work is for other university courses in which there are both continuous assessment and a final examination for formative and summative assessment respectively.

References

Arroyo, I., Beck, J., Beal, C., Wing, R., & Woolf, B. (2001). Analyzing students' response to help provision in an elementary mathematics intelligent tutoring system. In R. Luckin (Ed.), *Papers of the AIED-2001 workshop on help provision and help seeking in interactive learning environments* (pp. 34–46). Texas, USA.

Bangert-Drowns, R., Kulik, C., Kulik, J., & Morgan, M. (1991). The instructional effect of feedback in test-like events. *Review of Educational Research, 61*, 213–238.

Bruner, J. (1970). Some theorems on instruction. In E. Stone (Ed.), *Readings in educational psychology*. London: Methuen.

Cowan, J. (1998). *On becoming an innovative university teacher: Reflection in Action*. Buckingham, UK: SRHE/Open University Press.

Cowan, J., & George, J. (1997). *Formative evaluation-bordering action* (Research report 97/5). Edinburgh, Scotland: Open University in Scotland.

Falchikov, N. (1995). Improving feedback to and from students. In P. Knight (Ed.), *Assessment for learning in higher education*. London: Kogan Page.

Gouli, E., Gogoulou, A., Papanikolaou, K., & Grigoriadou, M. (2006). An adaptive feedback framework to support reflection, guiding and tutoring. In G. Magoulas & S. Chen (Eds.), *Advances in web-based education personalized learning environments* (pp. 178–202). Hershey, PA: Information Science Publishing.

Hedberg, J., & McNamara, S. (1985). *Matching feedback and cognitive style in a visual CAI task*. Paper presented at the annual meeting of the American Educational Research Association, Chicago (ERIC Document Reproduction Service NO. ED 26015).

Jackson, S., Krajcik, J., & Soloway, E. (1998). The design of guided learner-adaptable scaffolding in interactive learning environments. In *Proceedings of ACM, CHI'98 Human factors in computing systems* (pp. 187–194).

Jacobs, A. (1974). The use of feedback in groups. In A. Jacobs & W. Spradlin (Eds.), *The group as agent of change*. New York: Behavioral Publications.

Jonassen, D., & Grabowski, B. (1993). *Handbook of individual differences, learning and instruction*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Mason, B., & Bruning, R. (2001). *Providing feedback in computer-based instruction: What the research tells us.* Unpublished paper.

Mory, E. (1996). Feedback research. In D. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 919–956). New York: Simon & Schuster Maxmillan.

Sales, G. (1993). Adapted and adaptive feedback in technology-based instruction. In J. Dempsey & G. Sales (Eds.), *Interactive instruction and feedback* (pp. 159–176). Englewood Cliffs, NJ: Educational Technology Publications.

Stone, C. (2012). Engaging students across distance and place. *Journal of the Australia and New Zealand Services Association, 39*, 49–55.

WhatsApp. (2016). Retrieved from http://www.whatsapp.com

Yates, A., Brindley-Richards, W., & Thistoll, T. (2014). Student engagement in distance-based vocational education. *Journal of Open, Flexible and Distance Learning, 18*(2), 29–43.

Yue, F. (2014a). Use of instant messaging communication in teaching and learning. In *Proceedings of the inaugural international conference on open and flexible education*. Hong Kong, China.

Yue, F. (2014b). Student engagement in the use of instant messaging communication in flexible education. In *Proceedings of the inaugural international conference on technology in education*. Hong Kong, China.

Yue, F. (2015). Use of instant messaging communication in tutoring undergraduate students. In *Proceedings of the 2nd international conference on technology in education*. Hong Kong, China.

Chapter 21
Using the xAPI to Track Learning

Kin Chew Lim

Abstract This paper investigates how the xAPI (Application Programming Interface) – which is a new open-source-based learning technology specification – can be used to track learning in a mobile and flexible learning environment. The xAPI allows one to capture data about a person or group's activities from many technologies, either online or offline. There are several advantages in using the xAPI. For example, xAPI takes e-learning outside the browser; it allows for both informal and formal learning; and it focuses on tracking learning activities. Also, xAPI can be used to track learning via games, simulations, virtual worlds, social learning, self-directed learning, collaboration and team-based learning.

Keywords Experience API · Learning record store · Learning activities · Informal learning · Formal learning

Introduction

When computers were first invented in the late 1940s and early 1950s, they were developed for, and used mainly by, the military, government and large corporations. It was only in 1960 that the first computer-based training (CBT) programme was introduced for other purposes (Bersin, 2004). This was PLATO, or Programmed Logic for Automatic Teaching Operations (Lombat, 2011), which was originally designed for students at the University of Illinois but ended up being used in schools throughout the area (Epignosis LLC, 2014). Technology-based training (TBT) and teaching using technology accelerated after personal computers were introduced by IBM in the early 1980s, and, subsequently, many courseware titles were developed and delivered via CD-ROMs and laser disks. These gave way gradually to the learning management systems (LMSs) when computer systems became more powerful and could store more contents. It was the AICC (Aviation Industry CBT

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_21

Committee) which released the first specification for the LMS, which allowed students' scores to be tracked on the computer system used. When the Internet became a worldwide sensation in the mid-1990s, Web-based training (WBT), virtual classrooms and e-learning in general became fashionable. At about the same time, several learning standards consortia were founded, which included the IMS Global Learning Consortium ('Better learning from better learning technology', n.d.) and the Advanced Distributed Learning (ADL) Project ('Advanced learning through innovative science and technology', 2015). SCORM (Shareable Content Object Reference Model) was released by the ADL Project in the year 2000.

SCORM is the de facto specification for packaging learning content in a standard format which allows the package to work in different LMSs. However, SCORM is tied very closely to the LMS and will not work outside the LMS and the browser.

Shortcomings of the Present LMS-Centric and Content-Centric e-Learning

So far, the approach in e-learning is to deal with how the content is to be structured, packaged and moved from one system to another. This is a very LMS- and content-centric model, and SCORM is thus very LMS- and content-centric and has many restrictions.

For example, multiple-choice quizzes are used widely in the LMS-centric model. These quizzes usually involve single-answer assessments, but questions with single answers do not reflect real-world situations in which there may not be single-solution answers, and learners can also guess the answers. The materials provided in the LMS are mostly textual in nature, although occasional video and animation clips have been used. The LMS-centric model will always place the teacher as the knowledge dispenser; and participants in this model do not share much. In addition, it is difficult for contents from other devices (e.g. smartphones, tablets and social media) to be consolidated with those on the LMS. Also, the LMS must be connected to the Internet all the time – otherwise, all the interactions between the learner and the learning contents cannot be updated on the LMS in real time. On the other hand, smartphones are not always connected to the Internet. Finally, it is difficult to ascertain how much learning a participant has done if he or she uses multiple devices to access information (Johnson, 2012).

What Led to the Development of the xAPI?

SCORM was first released in 2000 (Glahn, 2013). It has served its purpose of achieving interoperability in different LMSs, but since then the landscape has changed tremendously. Firstly, there is an extensive worldwide proliferation of

mobile devices and the mobile app ecosystem. People are now using different mobile devices to receive information, communicate, learn and collaborate among themselves. At the same time, wireless and Wi-Fi coverage are increasing everywhere, and people engage in games, using the console or mobile devices. Applications in augmented reality and simulations are spreading not only on desktop computers but on mobile devices such as iPads. People are also communicating extensively using social media tools, such as Facebook, Twitter, Instagram and blogs. The open source movement is gaining widespread use everywhere (Hruska, 2013).

A person might be texting one moment and, at the next moment, using a desktop computer to access an LMS to do an online quiz. After a while, he or she might be in a restaurant discussing a business deal with a client, for which an iPad is used; and later in the afternoon, he/she could be attending a 1-hour webinar using an Android smartphone. All these activities show that very little online learning happens on the LMS! The LMS is used only as a repository of learning materials.

Subsequently, in 2011, the Advanced Distributed Learning (ADL) Project of the US Department of Defense engaged an e-learning software company called Rustici to work on a new generation of e-learning specification. After extensive consultations with the e-learning community, Rustici developed the Tin Can API in 2013 (Rustici, 2013); and the ADL later renamed it the xAPI, standing for Experience API. Version 1 of this specification was released in April 2013 and is now at version 1.0.3 (Garemoko, 2016).

What Is the xAPI?

According to Dr. Kristy Murray, 'The Experience API is the first technology being developed under ADL's Training & Learning Architecture (TLA). The TLA is an umbrella term encompassing all technologies designed to create a rich environment for online training and learning' (Murray, 2012).

Experience API (shortened to xAPI and also known as 'the Tin Can API') is an open source e-learning software specification (Bowe, 2013). When a person has done some online or offline learning, the learning designer, using xAPI, can collect data about the learning experiences, which can be recorded in a Learning Record Store (LRS). Such an LRS can exist within a LMS or on its own (Brusino, 2012).

Experience API is commonly regarded as continuing from the SCORM specification (Tillett, 2012). Since 2000, SCORM has been the de facto e-learning standard for packaging e-learning content to be delivered to LMSs ('Shareable content object reference model (SCORM)', n.d.). However, there are several drawbacks to SCORM (Whitaker, 2012).

This API is stewarded by ADL. xAPI focuses on how the activities people do are evidence of a learning experience. It is a representational state transfer (REST) Web service. As regards the data format, it uses the JavaScript Object Notation (JSON). The Web service allows software clients to read and write experiential data in the

form of 'statement' objects. Statements are in the form of 'I did this', or more generally 'actor verb object' (Tillett, 2012). More complex statement forms can be used.

With the xAPI, e-learners can take e-learning outside of the browser (eLogic, 2012). In addition, xAPI allows e-learning to execute in native mobile applications (Brandon, 2012). There is therefore more control over the learning content when the xAPI specification is used (Tillett, 2012). There is also better security using a technology called 'OAuth' ('We need security/authentication', n.d.).

Another use of the xAPI is for platform transition – for example, an e-learner starts e-learning on a mobile device and finishes it on a computer. Other possibilities include the tracking of games and simulations (Brusino, 2012), real-world performance (Gautam, 2012), team-based e-learning (Brusino, 2012) and learning plans and goals (Downes, 2012).

The xAPI forms part of the Training and Learning Architecture (TLA) that the Advanced Distributed Learning (ADL) Project is working on (Poltrack, n.d.). This API (also known as the 'Tin Can API') is an open source e-learning software specification (Bowe, 2013) which makes it possible to collect data about the learning experiences a person has achieved either online or offline. These learning experiences are recorded in a Learning Record Store (LRS). LRSs can exist within conventional LMSs or on their own (Brusino, 2012).

xAPI is commonly regarded as the successor to the SCORM (Sharable Content Object Reference Model) specification (Tillett, 2012). Since 2000, SCORM has been widely used as the standard for packaging e-learning content to be delivered to LMSs. However, there are some drawbacks of using the SCORM specification (Whitaker, 2012).

xAPI is stewarded by Advanced Distributed Learning (ADL). xAPI focuses on how the activities people do are evidence of a learning experience. 'The xAPI was influenced by guidelines from the REST (*Representational State Transfer*) software architecture style. Consequently, the architecture of xAPI is based on Restful web-service APIs, JSON (*JavaScript Object Notation*) for its data format, and an abstract application interface for storing and retrieving the learning records' ('xAPI architecture overview', 2015).

Using the REST and JSON technologies allows the xAPI developer to read and write experiential data in the form of 'statement' objects. Statements are written in the form of 'I did this'. More generally, xAPI statements are in the form of 'actor verb object' (Tillett, 2012).

xAPI Statements

The xAPI is a Web service, which means that it supports applications on the World Wide Web (WWW) and makes use of the Hypertext Transfer Protocol (HTTP). As a web service, the xAPI makes it easy for statements of experience, typically learning experiences, to be delivered to and stored securely in a Learning Record Store (LRS).

These statements take the format ‘actor verb object’. For example, we can have a simple statement like ‘I read a storybook’. In the statement ‘Rob Faulkner attended Tin Can Learning Course’, ‘Rob Faulkner’ is the actor, ‘attended’ is the verb, and ‘Tin Can Learning Course’ is the object or activity. In terms of expressing this structure in the JSON (JavaScript Object Notation) format, we have the following entries:

```
{
‘actor’: ‘Rob Faulkner’,
‘verb’: ‘attended’,
‘object’: ‘Tin Can Learning Course’.
}
```

However, the above entries may not usually uniquely identify the particular Rob Faulkner. To uniquely identify the actor, the verb and the object, we can have the expanded descriptions given in Fig. 21.1.

Figure 21.1 is an example of a valid xAPI statement with the component parts identified uniquely. By doing so, there is only one xAPI statement (of the format ‘actor verb activity’) which will be stored uniquely on the LRS.

In addition, the xAPI statement can be expanded to include some details. For example, in Fig. 21.2, we can have the expanded xAPI statement, ‘Rob Faulkner completed the Tin Can Learning Course with a Pass and a score of 95 percent’. Such a statement enhances the learning activity description.

```
{
    "actor": { "mbox": "mailto:rob.faulkner@webanywhere.co.uk"},
    "verb": {
        "id": "http://adlnet.gov/expapi/verbs/attended",
        "display": { “en-US": "attended" }
    },
    "object": {
        "id": "http://learn.mydomain.com/activities/tin-can-learning-course",
        "objectType": "Activity",
        "definition": {
            "name": { “en-US": "Tin Can Learning Course“,
                      “fr-FR": “Cours d'apprentissage Tin Can",
                      “es-ES": “Tincan Curso de Aprendizaje"
                    },
        }
    }
    “extensions": {
        “http://learn.mydomain.com/extensions/languageChosen": “Spanish“
    }
    “results": {
         “grade": “pass",
         “score": 95
    }
}
```

Fig. 21.1 An example of a valid xAPI statement (from slide 21 in a presentation by Faulkner, 2015)

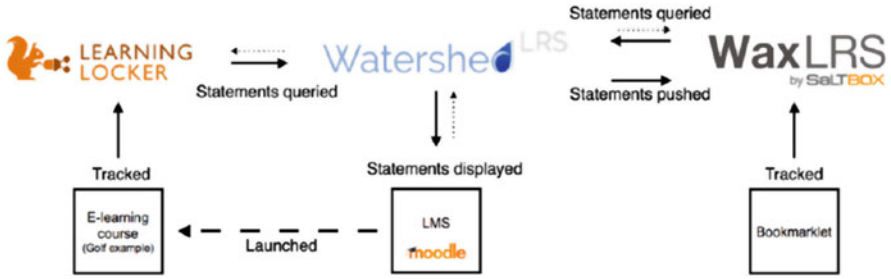

Fig. 21.2 Interactions between three LRSs and two LMSs (Downes, 2015) (Used under Creative Commons Attribution 3.0 License)

Learning Record Store (LRS)

When a student participates in an e-learning course, he or she engages in many learning activities. Each learning activity will generate a xAPI statement, e.g. 'I summarise three paragraphs into three sentences'. Such xAPI statements are then recorded in a database called the Learning Record Store (LRS), which can exist by itself as a stand-alone software system or can also co-exist with the LMS. These learning records can be accessed by the LMS or another software reporting tool. In addition, one can have several LRSs in the entire e-learning infrastructure. The xAPI statements in any particular LRS can be shared with other LRSs. Such learning records are regarded by the Human Resource Department as the employee's learning transcripts, and, as such, controls are imposed on who can access the learning records.

Figure 21.2 shows three LRSs (Learning Locker, Watershed and WaxLRS). When a student did a course from a Moodle LMS, his learning activities were tracked and recorded in the Learning Locker LRS. At the same time, another LRS, called 'Watershed LRS' could query the Learning Locker LRS; and yet another LRS, the WaxLRS, could query the Watershed LRS. This demonstrates that all the LRSs could query the database records in each LRS, which provides the flexibility.

xAPI Application

Since the xAPI specification was first released in April 2013, it has received much support from the industry, with many vendors jumping onto the bandwagon. There are now more than 100 vendors with software systems and authoring systems that conform to the xAPI specification ('Who's using the Tin Can API', n.d.). At the same time, many developers have developed their xAPI applications. The Oregon Trail Game will be used below to explain how xAPI statements can be used to track learning in this game.

There are other interesting examples of applications, such as an application that creates awareness of kinaesthetic learning using the xAPI (Corbi & Burgos, 2014), the PDF Annotation in the Cloud (Werkenthin, 2014) and the TREK Learning Experience Manager (LEM) ('TREK learning experience manager', n.d.).

Oregon Trail Game

The computer game known as 'Oregon Trail' was produced by the Minnesota Educational Computing Consortium (MECC) in 1974. It was designed and developed for school children to learn about the nineteenth-century pioneer life on the Oregon Trail. The game allows the player to play a wagon leader's role who can guide his or her party of settlers from a place in Missouri to another place on the Oregon Trail via a covered wagon in 1848. This game has been very successful and is available on many computer platforms. One can now play it by using an Internet browser such as Chrome (MECC, 2014).

Learning in this game is fun and interactive though, unfortunately, the learning activities that are created do not get recorded. These learning activities create valuable experiences for the learner, as well as for the teacher. Using the xAPI specification, the teacher can track the learning activities involved in the game. All the learning data generated by a game player can be recorded in a Learning Record Store (LRS). The learning data can be stored either independently by themselves or together with the other data generated by the game player and instructor. The teacher can then guide and advise the student on the various journeys taken by the student. Mistakes can be pointed out. For example, the student would have to make some decisions on how he/she intended to cross a river or, alternatively, would want to take another route to avoid the river.

The xAPI statements, as played by the character, Tan, are as follows (Table 21.1).

There are two ways to track the learning in the Oregon Trail game. The first way is to access the game's programme codes and incorporate the xAPI statements. However, this might not be possible if the game's codes are not accessible to other people. The second, preferred, way is to develop a simple programme which allows the various xAPI statements to be recorded directly into the LRS.

Games have been found to be effective in allowing a player not only to become immersed in the gaming environment but also to learn. However, people playing games in learning situations, especially students, have previously not had their learning tracked. The xAPI specification makes it possible to track many activities that go on in a game. The data that are collected can be stored either separately (as in an LRS) or in the same system as the other learning data (as in an LMS). The instructors can then make use of such data to improve their teaching methods.

Table 21.1 xAPI statements for Oregon Trail game (Partly modified from the source at 'A game's story', 2012)

Alan's experience	xAPI statement
Tan chose to be a carpenter	Tan completed 'choose occupation' with a result of 'carpenter'
Tan added Yan to his party	Tan completed 'add member to your party' with a result of Yan
Tan added Mei to his party	Tan completed 'add member to your party' with a result of Mei
Nancy got dysentery, and tan chose to continue his journey rather than take action	Tan experienced 'party member getting dysentery'. Tan experienced 'ignore dysentery and continue on journey'
Tan made it to the Kansas River	Tan completed 'arrival at Kansas River crossing'

Conclusions

xAPI continues to enjoy a growing adoption by many LMS vendors, and e-learning system and authoring system vendors, as can be seen from the increasing list of xAPI adopters (142 at 9 May 2015, from Rustici's website http://tincanapi.com/adopters).

The xAPI technology is simpler to implement as compared with the SCORM technology. As the focus is more on learning activities, xAPI statements support mobile and flexible learning environments. It also appeals to human resource managers as they can now link learning activities to competency achievements (Silvers, 2014). Management staff can use xAPI to link activities in sales training and the tasks sales professionals accomplish in CRM (customer relationship management) systems. Sales teams are making advances on design using xAPI. Feedback to sales trainers allows the company to tweak training approaches to achieve better outcomes.

The xAPI offerings report analytics on how the content is being used in more detail than what SCORM can provide. In other cases, organisations are developing job aids and other forms of performance support using xAPI. For example, Corbi and Burgos explain the xAPI and LIME (**L**earning, **I**nteraction, **M**entoring and **E**valuation) model case study which helped them to monitor their students (Corbi & Burgos, 2014) and make recommendations for their studies. In the future, more xAPI-based educational applications will be developed.

References

A game's story. (2012). Retrieved from http://tincanapi.com/a-serious-games-story/

Advanced learning through innovative science and technology. (2015). Retrieved from https://www.adlnet.gov/

Bersin, J. (2004). *The blended learning book: Best practices, proven methodologies, and lessons learned*. San Francisco, CA: Pfeiffer.

Better learning from better learning technology. (n.d.). Retrieved from http://www.imsglobal.org/
Bowe, M. (2013). *The open source landscape*. Retrieved from http://tincanapi.com/2013/07/11/the-open-source-landscape/
Brandon, B. (2012). *Making history: MLearnCon 2012 rocks attendees*. Retrieved from http://www.learningsolutionsmag.com/articles/958/
Brusino, J. (2012). *The next generation of SCORM: A Q&A with Aaron Silvers*. Retrieved from https://www.td.org/Publications/Newsletters/Learning-Circuits/Learning-Circuits-Archives/2012/06/The-Next-Generation-of-SCORM-a-Q-and-a-with-Aaron-Silvers
Corbi, A., & Burgos, D. (2014). *Review of current student-monitoring techniques used in elearning-focused recommender systems and learning analytics. The experience API & LIME model case study*. Retrieved from http://www.ijimai.org/JOURNAL/sites/default/files/files/2014/09/ijimai20142_7_6_pdf_27449.pdf
Downes, A. (2012). *I want this: Tin Can plans, goals and targets*. Retrieved from http://tincanapi.co.uk/pages/I_Want_This.html
Downes, A. (2015). *A tale of three LRSs*. Retrieved from http://tincanapi.com/2015/04/16/tale-three-lrss/
eLogic Learning partners with Rustici software to be an early adopter of the next generation of SCORM standards known as the 'Tin Can API'. (2012). Retrieved from http://www.prweb.com/releases/SCORM/e-learning/prweb9610860.htm
Epignosis, LLC. (2014). *E-Learning concepts, trends, applications*. Retrieved from http://www.talentlms.com/elearning/elearning-101-jan2014-v1.1.pdf
Faulkner, R. (2015). *How tracking learning analytics with xAPI will revolutionise your internal training*. Retrieved from http://www.slideshare.net/webanywhere_ltd/xapi-webinar-july-23rd-rob-faulkner
Garemoko. (2016). *Experience API*. Retrieved from https://github.com/adlnet/xAPI-Spec/blob/master/xAPI.md
Gautam, A. (2012). *Tin Can: My first impressions from mLearnCon 2012*. Retrieved from https://www.upsidelearning.com/blog/index.php/2012/06/21/tin-can-my-first-impressions-from-mlearncon-2012/
Glahn, C. (2013). *TinCan and the confusion about the next generation of SCORM*. Retrieved from http://lo-f.at/glahn/2013/05/the-confusion-about-the-next-generation-of-scorm.html
Hruska, N. (2013). *The experience API*. Retrieved from http://www.adlnet.org/wp-content/uploads/2013/04/The_Experience_API_in_Practice.pdf
Johnson, A. (2012). *An ADL perspective on next generation SCORM requirements as derived from project Tin Can*. Retrieved from http://www.adlnet.gov/wp-content/uploads/2012/01/NEXTGEN-SCORM-requirements-20120130_v1.pdf
Lombat, P. (2011). *PLATO (Programmed Logic for Automatic Teaching operations)*. Retrieved from http://whatis.techtarget.com/definition/PLATO-Programmed-Logic-for-Automatic-Teaching-Operations
MECC. (2014). *The oregon trail by MECC*. Retrieved from https://archive.org/details/msdos_Oregon_Trail_The_1990
Murray, K. (2012). *What is the experience API?* Retrieved from https://trainingmag.com/content/what-experience-api
Poltrack, J. (n.d.). *ADL: Capabilities: Training and Learning Architecture (TLA)*. Retrieved from http://adlnet.gov/wp-content/uploads/2014/07/ADL-Training-and-Learning-Architecture-1.pdf
Rustici, M. (2013). *The world just changed*. Retrieved from http://scorm.com/blog/2013/04/the-world-just-changed/
Shareable Content Object Reference Model (SCORM). (n.d.). Retrieved from https://www.trainingindustry.com/wiki/entries/shareable-content-object-reference-model-(scorm).aspx
Silvers, A. (2014). *Answers: How do i get started with xAPI?* [Web log post]. Retrieved from http://makingbetter.us/2014/11/answers-how-do-i-get-started-with-xapi/
Tillett, J. (2012). *Saltbox developers discuss Tin Can*. Retrieved from http://floatlearning.com/2012/07/saltbox-developers-discuss-tin-can/

Tin Can API: Statements 101. (2012). Retrieved from http://tincanapi.com/statements-101/
TREK learning experience manager. (n.d.). Retrieved from http://www.cognitiveadvisors.com/trek/
We need security/authentication. (n.d.). Retrieved from http://scorm.com/project-tin-can-phase-3-we-need-securityauthentication/
Werkenthin, A. (2014). *PDF annotation in the cloud: A real world xAPI application*. Retrieved from http://risc-inc.com/pdf-annotation-cloud-real-world-xapi-application/
Whitaker, A. (2012). *An introduction to the Tin Can API*. Retrieved from http://www.thetrainingbusiness.com/softwaretools/tin-can-api/
Who's using the Tin Can API? (n.d.). Retrieved from http://tincanapi.com/adopters/
xAPI Architecture Overview. (2015). Retrieved from https://www.adlnet.gov/adl-research/performance-tracking-analysis/experience-api/xapi-architecture-overview/

Chapter 22
Modelling the Process of Learning Analytics Using a Reinforcement Learning Framework

Samuel P. M. Choi and Franklin S. S. Lam

Abstract Learning analytics (LA) is a relatively new research field concerned with analysing data collected from various sources to provide insights into enhancing learning and teaching. A complete LA process typically involves five distinct, yet interrelated, stages – namely capture, report, predict, act and refine – which form a sequential decision process. So far, research efforts have focused mostly on studying independent research questions involved in individual stages. It is therefore necessary to have a formal framework to quantify and guide the whole LA process. In this paper, we discuss how reinforcement learning (RL), a subfield of machine learning, can be employed to address the sequential decision problem involved in the LA process. In particular, we integrate the LA stages with an RL framework consisting of state space, action space, transition function and reward function and illustrate this with examples of how the three most studied optimality criteria in RL – finite horizon, discounted infinite horizon and the average reward model – can be applied to the LA process. The underlying assumptions, advantages and issues in the proposed RL framework are also discussed.

Keywords Learning analytics · Learning analytics process · Reinforcement learning · Machine learning · Optimisation

Introduction

In recent years, the proliferation of learning management systems (LMS) and digital devices has captured a vast amount of data on learning activities. An emerging research field called 'learning analytics' attempts to apply analytics techniques

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_22

(e.g. data mining) to the collected data to enhance the learning experience. One of the most successful applications of learning analytics is Course Signals (Arnold & Pistilli, 2012), which applies learning analytics to increase students' success rate.

According to the definition adopted at the 1st International Conference on Learning Analytics and Knowledge, 'learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs' (Long, Siemens, Conole, & Gaševic, 2011). Learning analytics is also considered as the endeavour to enhance teaching and learning via the targeted analysis of student demographic and performance data (Fritz, 2011). Campbell and Oblinger (2007) propose five stages – capture, report, predict, act and refine – to model the LA process systematically. Clow (2012) later enriched the process by closing the feedback loop and developed the learning analytics cycle. Specifically, the cycle begins with *learners* whose information and learning activities are logged, and then the captured *data* are processed into *metrics*, based on which *interventions* are made so as to affect the learners' learning. Clow (2012) also pointed out that the speed and scale of the intervention is of paramount importance to the effectiveness of the feedback cycle. It is therefore necessary to have a formal framework that can quantify, automate and guide the whole LA process efficiently and effectively.

From the perspective of control theory, the LA process can be viewed as a sequential decision task, which refers to the class of problems needed to decide and perform a sequence of actions to achieve a goal with a clearly defined and quantifiable measure. For instance, a quantifiable goal for a university student could be to complete a degree with either a minimum study time or a maximum grade point average (GPA). It should be noted that the sequence of actions to be taken could have both short-term and long-term effects on the sequential decision tasks. In other words, a strategic plan must be carefully considered as it is sometimes necessary to take an action that sacrifices an immediate reward so that a larger reward can be obtained later. Following the previous example, a student may need to take a sequence of courses to satisfy a degree requirement. If the student wants to graduate within the shortest possible study time, he or she may tend to take as many courses as possible at a time and complete each one with the minimum passing grade. However, the student may soon find it difficult to pass other higher-level courses due to the poor foundation laid. As a result, the student may need to retake some courses and eventually spend an even longer time to complete the degree.

The ultimate objective in a sequential decision task is to find a policy that provides a response to react in each possible situation encountered such that the best result for the quantifiable goal is guaranteed. However, solving sequential decision tasks by human effort can be challenging. Due to the enormous number of possible situations and the uncertainty involved in real-world problems, it would be extremely difficult, if not impossible, to manually specify the optimal action for all possible states. Instead, reinforcement learning provides a theoretical framework to optimise this decision task.

A Reinforcement Learning Framework

Reinforcement learning (RL), a mature subfield of machine learning, has been addressing sequential decision tasks for a few decades. Modern RL originated from the Markov decision processes (MDP) (Puterman, 1994), but it is also closely related to psychology, control theory and operations research. RL methods have been widely adopted in many real-world applications, such as planning and control, robotics and many other problems, due to its generic framework and efficient algorithms for solving sequential decision problems. In general, RL is a paradigm that enables an agent to learn how to react in an environment with only numeric feedback signals and uncertain effects on actions. The goal of the agent is to perform a sequence of actions that optimises (i.e. maximises or minimises) the total feedback (i.e. rewards or penalties) in the long term. Modern RL problems are usually formulated into an MDP without any prior knowledge about the parameters of the MDP. Specifically, an MDP consists of four components – a state space (S), an action space (A), a transition function (T) and a reward function (R), as detailed below.

State Space

A state (denoted by s) is an observable situation that provides sufficient information to perform an optimal action. In the notion of RL, the set of all possible situations forms a state space (denoted by S). While states can be either discrete or continuous, most studies on RL are concerned with discrete state space. In learning analytics, states can consist of information from various sources, such as student demographics, grades in other courses, learning activities and logs in LMS and class attendance.

Action Space

An action space (denoted by A) is a collection of actions. In the learning context of learning analytics, actions (denoted by a) represent the set of available responses (interventions) during the learning analytics process. It could be an article suggested to a casual learner, a supplementary exercise for a student or an alert to the teacher calling for learning support.

Transition Function

In the real world, uncertainty often occurs. An action taken during the LA process may have many possible outcomes or could even fail somehow. For example, if the LMS suggests a reading to a student, the student may have various levels of understanding of the content or may simply not read it. In such a case, the resulting state could be different even if the same action is taken in the same state. The transition function indicates the probability from one state to another after taking an action. In the previous example, the transition function prescribes the chance that the student can achieve a given level of understanding after completing the suggested reading. Mathematically, the transition function is denoted as T: $S \times A \times S \rightarrow [0,1]$ or, equivalently, $T(s,a,s')$ which represents the probability of transferring from state s to state s' after performing action a in state s. Note that T is a probability distribution *function – in other words,* $T(s,a,s') \geq 0$ and $T(s,a,s') \leq 1$ for all states s and s', and all actions a. In addition, $\sum_{s' \in S} T(s,a,s') = 1$, for all states s and all actions a.

Reward Function

The reward function (denoted by R) quantifies the feedback or reward sent back to the system or learners in the form of a numeric number, i.e. R: $S \rightarrow \mathbb{R}$. Typically, a reward (denoted by r) is between 0 and 1, but it is also possible to have negative values to represent a penalty.

Optimality Criterion

The optimality criterion defines precisely what is going to be optimised. There are three common types of objective functions studied by the RL community, namely, finite horizon, infinite horizon and the average reward model, as shown in Fig. 22.1.

The *finite horizon model* optimises the expected rewards in the next h steps. In the above formulae, E[·] is the expectation over the stochastic rewards r_t, where t is the time index. Normally, h will be set to the lifespan of the RL problem, such as the maximum duration allowed for completing a degree. When h is not known beforehand, the *infinite horizon model* can be used to optimise the long-term expected rewards. The discount factor γ, where $1 > \gamma \geq 0$, guarantees the total rewards received to be finite, even with the infinite number of time steps. From the LA perspective, the discount factor can be interpreted as the memory retention rate during the learning process or the possibility of continuity of study in the next time step. Where no natural discount factor exists, such as maximising a student's GPA,

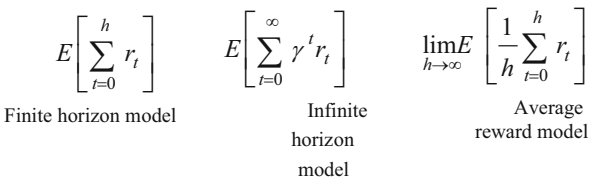

Fig. 22.1 Three commonly used optimality criteria in RL

the *average reward model* can be considered. It can also be viewed as the infinite horizon model when the discount factor is approaching 1.

Solving RL Problems

After the RL problem is defined, one may employ model-based or model-free RL algorithms (van Otterlo & Wiering, 2012) to obtain the optimal policy (i.e. a mapping from any given state to action) that assures the best performance with respect to the chosen optimality criterion. The optimal policy is basically a state-action lookup table that specifies what to do (action) in any given situation (state) so that the best result for the given LA problem is guaranteed.

An Illustrative Example

Consider the following simple LA problem. Suppose an LMS wants to guide a student to learn two concepts (*A* and *B*). Initially, the student does not have any knowledge about both the concepts. There are two types of study materials, including notes (N_a and N_b) and readings (R_a and R_b) for concepts *A* and *B*, respectively. An LMS may choose any one of four study materials and present it to the student for study. The goal is to facilitate the student's acquisition of both concepts as quickly as possible. The key question is whether the student should learn concept *A* before concept *B* or vice versa. Assuming that both concepts can be learned independently, but not at the same time, and their learning sequence may have a different effect on the learning, we can formulate and solve the problem using a RL framework, as follows.

Step 1: Define the Objective Functions

The goal is to guide the student to learn both concepts as quickly as possible (i.e. minimising the total learning time). Suppose there is no time limit for the learning, and the student will eventually learn both concepts. In such a case, the infinite horizon model without discount (i.e. $\gamma = 1$) can be adopted. Formally, the

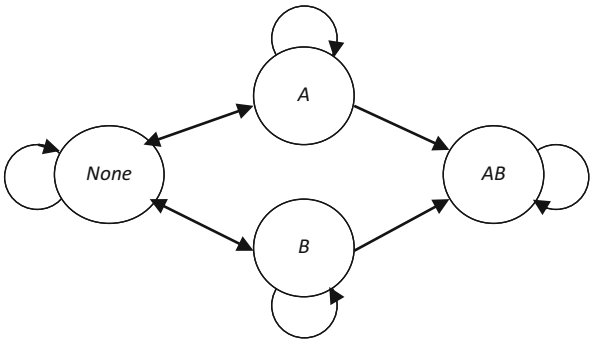

Fig. 22.2 Four-state learning analytic problem

objective function is to minimise $E\left[\sum_{t=0}^{\infty} \gamma^t r_t\right]$, where r_t is the study time required to learn each concept given by the reward function.

Step 2: Identify the State Space

The concepts acquired by the student after studying the notes and readings would be the states of the problem. So, the state space consists of four states in this example – *None*, *A*, *B* and *AB*. Note that the state *AB* is called the 'goal state' (or 'absorbing state'), and the learning process ends when reaching the goal state. Figure 22.2 illustrates how these states are related to each other.

Step 3: Identify the Action Space

As specified in the problem, the student must study the notes and readings in order to acquire the relevant concepts. Therefore, the action space consists of four actions – N_a, N_b, R_a and R_b. We also assume that all the study materials will be followed by a quiz to examine the student's understanding of the specific concept.

Step 4: Define the Transition Function

Data are collected from the LMS based on other students' learning history on concepts *A* and *B*. The transition probabilities $T(s, a, s')$ are presented in Table 22.1.

The transition function can be interpreted as follows. By presenting notes N_a to a student who does not have any knowledge of concepts *A* and *B*, there is a probability of $T(None, N_a, A) = 0.7$ that the student learns concept *A* successfully, and a

Table 22.1 The transition probabilities $T(s, a, s')$ of a four-state learning analytics problem

a			s'							
	N_a	R_a	*None*		*A*		*B*		*AB*	
	N_b	R_b								
s	*None*		0.3	0.1	0.7	0.9	0	0	0	0
			0.4	0.2	0	0	0.6	0.8	0	0
	A		0.1	0.05	0.9	0.95	0	0	0	0
			0.2	0.05	0.3	0.1	0.1	0.1	0.4	0.75
	B		0.3	0.2	0.1	0.1	0.4	0.2	0.2	0.5
			0.2	0.1	0	0	0.8	0.9	0	0
	AB		0	0	0	0	0	0	1	1
			0	0	0	0	0	0	1	1

Table 22.2 The reward function $R(s, a)$ of a four-state learning analytics problem

$R(s, a)$		a			
Study time (days)		N_a	R_a	N_b	R_b
s	*None*	3	5	4	6
	A	1	2	2	3
	B	2	3	1	2
	AB	–	–	–	–

Note that state *AB* is a goal state so that there are no effects on any actions taken

probability of $T(None, N_a, None) = 0.3$ of learning nothing. State *AB* is the goal state (also known as the 'absorbing state' as indicated by the transition probabilities). Based on the transition probabilities, we may note that concept *A* is easier to understand by studying and reading R_a, and acquiring concept *A* first helps in learning concept *B* because $T(A, N_b, AB) > T(B, N_a, AB)$ and $T(A, R_b, AB) > T(B, R_a, AB)$.

Step 5: Define the Reward Function

The reward function $R(s, a)$ specifies the study time required to learn each concept by presenting a specific piece of study material, as given in Table 22.2.

Step 6: Solving the RL Problem

After the RL problem is formulated, the optimal policy can be obtained by using offline model-based learning RL algorithms, such as value iteration. Based on our computation, the optimal policy can be found in 24 iterations, and the optimal

Table 22.3 The optimal policy of a four-state learning analytics problem

State	Action
None	N_a
A	R_b
B	R_a

expected learning time is 8.835 days with an error less than 9.17×10^{-6}. The optimal policy is shown in Table 22.3.

The optimal policy indicates that when a student has no prior knowledge of both concept *A* and *B*, notes N_a should be provided to the student for study in order to obtain the best learning result. If the student has already understood concept *A*, reading R_b should be presented instead. In the case where the student has acquired only concept *B*, reading R_a should be suggested for study.

Discussion and Conclusion

Reinforcement learning provides a rigorous and yet flexible model for formulating the learning analytics process. It serves as a mathematical tool which utilises data collected from various sources and suggests an optimal action to perform in any given situation during the learning process. As such, theoretical optimality can be obtained through existing RL algorithms. There are a number of advantages in using a RL framework for modelling learning analytics. First, RL defines a quantitative measure for a learning objective and offers actions (interventions) that optimise the learning objective. It also allows both deterministic and probabilistic effects on the actions taken. Second, formulating LA as RL problems can often be solved effectively and efficiently with theoretical optimality. RL and related problems have been studied for decades, and many efficient algorithms have been developed. The underlying MDP can be solved by online or offline algorithms with optimal policies or approximated solutions depending on resources such as computation time. In addition, the model allows comparison of the quality of policies and learning performance in a quantifiable measure. Third, the characteristics of various RL models are well understood, and previous research efforts in RL can shed some light on understanding LA problems. There might also exist some research problems that are unique to LA and have not been thoroughly considered before by the RL community. It would be interesting and beneficial to see the exchange of ideas and the joint effort in both communities.

Despite the promising future, there are also some issues in applying an RL framework to LA. First, the huge amount of data collected from various sources implies that the size of the state space to consider could be enormous. As a result, the sizeable state space may greatly affect the effectiveness of the RL algorithm, and this problem is known as ‘the curse of dimensionality’ in the RL community. Second, in order to find the optimal policy, an RL agent must first collect sufficient data about

an environment. However, the data collected from the LMS could be biased, and the complete dynamics of an environment may not always be available. In particular, some actions taken on a state may be rare in LMS data, and its effect is therefore uncertain. This is related to the issue of exploration-exploitation in RL. Finally, MDP assumes the so-called Markovian property where all the information required for determining an optimal action is captured by the current state. In reality, states may not be fully observable and need to be inferred through a series of observations. In such cases, the RL model should be extended to partially observable MDP (Spaan, 2012).

References

Arnold, K. E., & Pistilli, M. D. (2012). Course signals at Purdue: Using learning analytics to increase student success. In *Proceedings from the 2nd international conference on learning analytics and knowledge* (pp. 267–270). Vancouver, BC.

Campbell, J. P., & Oblinger, D. (2007). Academic analytics. *Educause Quarterly*, October 2007. Retrieved from http://net.educause.edu/ir/library/pdf/pub6101.pdf

Clow, D. (2012). The learning analytics cycle: Closing the loop effectively. In *LAK12*: *The 2nd international conference on learning analytics & knowledge.* Vancouver, BC.

Fritz, J. (2011). Classroom walls that talk: Using online course activity data of successful students to raise self-awareness of underperforming peers. *The Internet and Higher Education, 14*(2), 89–97.

Long, P., Siemens, G., Conole, G., & Gaševic, G. (2011). *Proceedings from the 1st international conference on learning analytics and knowledge* (LAK11), Banff, AB, Canada. New York: ACM.

Puterman, M. L. (1994). *Markov decision processes—Discrete stochastic dynamic programming*. New York: Wiley.

Spaan, M. T. (2012). Partially observable Markov decision processes. In M. Wiering & M. van Otterlo (Eds.), *Reinforcement learning: State-of-the-art* (pp. 387–414). Berlin/Heidelberg: Springer.

van Otterlo, M., & Wiering, M. (2012). Reinforcement learning and markov decision processes. In M. Wiering & M. van Otterlo (Eds.), *Reinforcement learning: State-of-the-art* (pp. 3–42). Berlin/Heidelberg: Springer.

Chapter 23
A Study of High School Students Doing Physics Experiments with Arduino and Other Data-Logging Devices

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Abstract Conventional high school physics labs rely on manual data logging or logging devices with a slow data acquisition rate and low precision. This study aims to design data-logging devices and a modelling tool for high school physics labs with low-cost modern electronics, including smartphones, Lego Mindstorms NXT and Arduino, equipped with an ultrasonic sensor. For NXT and smartphones, experimental data were first logged in the devices and then manually copied to a personal computer for data analysis. For Arduino, experimental data were transmitted to a PC via Bluetooth in real time. With the data in a PC, each student used a modelling tool on a Web browser to try to find an equation that fitted the data with a small error. The equation was a function that related one variable to another. For example, in a free-fall experiment, the equation expressed distance as a function of time. With each submitted equation, the tool plots the model against a background of lab data with a measure of error. Based on the visual plot and the error information, the student can then try to reduce the error by revising the equation. The results indicated that both students and the instructor enjoyed using the modern data loggers and the acquired data to find equations that fitted the data well.

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K. C. Li et al. (eds.), *Innovations in Open and Flexible Education*, Education Innovation Series, https://doi.org/10.1007/978-981-10-7995-5_23

Keywords Physics labs · Data loggers · Mobile devices · Scientific modelling · Model revision

Introduction

In the physics laboratories in high schools in Taiwan, students generally encounter two problems when doing physics experiments. First, many students still log data manually or by using logging devices with a slow data acquisition rate and low precision. Second, they follow step-by-step instructions to get data to fit known equations of physics laws. For many students, this approach to confirming known laws takes away the fun of scientific exploration from lab work. This study proposes to address these two problems with modern low-cost, easy-to-access mobile devices, with a model-building approach (e.g. Lesh & Zawojewski, 2007; Papert, 1980; White & Fereriksen, 2000).

In physics classes, textbooks are often too abstract for many students to comprehend and may result in negative feelings about physics. In contrast, physics labs are a perfect solution to this problem as it is fun to work with measurements of the attributes of concrete objects. Moreover, interesting experiments can train students to think critically, solve problems, make decisions and develop positive attitudes towards science (e.g. Kaya & Boyuk, 2011; Shih, Chang, Chen, Chen & Liang, 2012). In several studies (Kuhn & Vogt, 2013; Martínez & Garaizar 2014a, b, Monteiro, Cabeza, Marti, Vogt, & Kuhn, 2014), smartphones, which were embedded with sensors, were used to log data in scientific experiments. However, smartphones have evolved quickly, and different brands and models generally use different sensors with varying sensitivity and precision. Also, the specifications of these sensors are often not revealed for commercial reasons. These issues sometimes cause difficulties for smartphones to serve as general data loggers in a physics class.

In a study by Church, Ford, Perova and Rogers (2010), Lego Mindstorms NXT was used in several physics projects in high school curricula. For example, a sound sensor was used to explore sound waves. The loudness of a sound wave was related to a wave's amplitude, energy, power and intensity. One issue with using NXT in physics labs in high school is its price tag. In this study, we focus on the use of an Arduino development board, the sensors for which are more affordable in general, in several labs.

The mobile devices this study uses include smartphones, Lego Mindstorms NXT and Arduino. Here, a restricted form of model building is adopted. Students first do physics experiments and collect data with mobile devices. After the data are plotted, they are asked to find an equation which best fits the data. The target equation is not revealed to the students until after they finish finding their equations. The model-building process is restricted because both the independent and dependent variables of the equation are predetermined by the instructor, so the students can focus on the function finding, i.e. the data-fitting process.

Free fall - with digital video-recorder

Motion on slope - with ticker tape timer

Newton's second law of motion - with photogates

Fig. 23.1 Physics labs with conventional data-logging methods

In some earlier research, various mobile devices were tried out in a series of empirical studies (e.g. Wong, Chao, Chen, Lien & Wu, 2015). In these studies, after the running of each experiment, students needed to transfer acquired data from mobile devices to a PC so that model building could be done on a web page with Internet access. Some students experienced difficulties in transferring data due to equipment problems or lack of experience; and some had wiring problems on Arduino boards. In order to fix these problems, a low-cost data-logging device based on Arduino was custom-made with the help of a vendor. Then an empirical study was carried out to discover more about the students' experiences in using this new device and other devices with a model-building approach to doing physics in labs.

Figure 23.1 shows three physics labs on motion: free fall, slope motion and Newton's second law of motion. In these labs, traditional data-logging methods are used. In the free-fall experiment, a digital video recorder recorded the images of a free-fall body, which looked blurry, resulting in low precision of the distance measurements. In the experiment on slope motion, the ticker tape timer was time-consuming and difficult to set up properly. Finally, in the experiment on Newton's second law of motion, three photogates were set up to capture the times at which the cart passed them. The distance between each pair of neighbouring photogates was known, and three pairs of distance-time data were measured.

In these three cases, the measured data generally suffered from one or more of three problems: low precision, a low sampling rate and few data. Low precision means that each distance measurement might be accurate to up to 1 mm instead of 0.1 mm. The low sampling rate refers to the number of data measured in one second – for example, in the third experiment, only three datapoints were measured in 0.2 s. Though some modern ticker tape timers might have a higher sampling rate (e.g. 50 dots per second), most high school physics labs might not want to get such modern timers due to budget constraint.

To address these problems, the authors proposed the use of low-cost, accessible modern electronic devices to serve as data loggers in the above physics experiments, including smartphones and Lego Mindstorms NXT and an Arduino development board. Smartphones and NXT are very handy as data loggers since no wiring is needed for them and sensor connecters are ready to use. However, the Arduino

Fig. 23.2 Three data-logging devices used in this study

development board needs some wiring work to connect to sensors through resistors. In a preliminary study, the students using the Arduino development board experienced some setup problems due to wiring and loose connections. In order to fix these, as noted above, a custom-made logging device using an Arduino board was made with the help of a vendor. Thus, this research conducted a more thorough empirical study using smartphones, NXT and an Arduino data logger.

The Arduino data logger is equipped with an ATmega328 processor with 2 KB SRAM and 14 I/O pins. NXT comes with an ARM7 AT91SAM7S256 processor with 256 K Flash and 64 K RAM and three output ports and four input ports. The smartphone was an HTC One S with 80 M pixels and slow-motion video capture. This study attempted to compare the strengths and weaknesses of these three logging devices (Fig. 23.2).

Literature Review

Simple Harmonic Motion with Arduino

In a study by Galeriu, Edwards and Esper (2014), the researchers used an Arduino Uno board with an ultrasonic sensor to measure the simple harmonic motion of a mass hanged on a spring freely swaying up and down. The distance between the sensor and the mass was recorded by the sensor. A plot of position versus time with ORIGIN showed a simple harmonic graph. The first author was a college instructor, and the other two researchers were instructors in a vocational high school. They wrote their programs and did the wiring to connect all the necessary hardware components. Their hardware cost about USD $37.77 and the sampling rate was 100 data per second.

If students have to set up the same equipment and wiring, they have to spend a considerable time in fixing many hardware problems. In order to minimise the wiring difficulty, we custom-make a data-logging device based on Arduino Uno. Moreover, in Galeriu's setup, the UNO board was connected to a PC with USB. This could

cause a problem in our experiments, where the data-logging device might be so far away from the lab equipment that a common USB cable would be too short. The data logger in this study is equipped with a Bluetooth transmitter that can send data wireless from the data logger to a PC with a Bluetooth dongle.

Mobile Devices and a Modelling Tool for Physics Labs

In a study by Wong et al. (2015), an Arduino Mega ADK2560 development board with a MX2125 accelerometer, a NXT with a gyro and a smartphone with an embedded gyro were used as data loggers in a pendulum experiment. Each data logger also served as the bob mass of the pendulum hanging on a light, thin flat long piece of wood. Each of three groups of students did the pendulum experiment with a particular logger. After acquiring the data, they plotted them on a web page. A good set of data showed a simple harmonic motion graph with decreasing amplitude. Then, from a plot, each student took ten measures of period by checking the distance between two neighbouring maxima and obtained an averaged period. Each group of students did six trials with pendulums with six different arm-lengths. After the six trials, each student got six datapoints of length versus period. Then, with a modelling tool called InduLab, each student tried to find an equation to fit the data with minimum error. If the equation found was a quadratic equation with 10% error or less, the model was considered a success. The success rates for the three groups of students were 80%, 20% and 50%, respectively.

In this previous study, a development board of Arduino ADK Rev3 was used as a data logger. This board was based on an ATmega2560 processor with 54 I/O pins and 8 KB SRAM. In short, this board computed faster than the Arduino Uno board used in this study. There are two reasons for using a slower board. First, the labs in this study did not need the fast computation supported by ATmega2560. Second, the Uno board costs less, which is an important factor since a lower cost could attract more high schools to adopt this data logger. Also, sensors are provided to work with this data logger so that students need not do any breadboard wiring, and hardware accidents due to loose connections can be avoided.

Empirical Study

The present research is an empirical study in a 10th grade physics lab elective course in a high school. Twenty-eight students took the course and they were divided into six groups. Four groups had five members each, and the other two groups had four members each. Over 8 weeks, they did two labs: free fall and motion on a slope (Table 23.1). Each lab took 4 weeks and was supervised by the physics teacher and one of the authors, Mr. Guo. In each week, two consecutive lessons were used for lab work. In the first week, Guo explained and showed the students how to set up the

Table 23.1 Labs and their data-logging devices

Lab		Free fall	Motion on a slope
Mobile device	Arduino	PING ultrasonic distance sensor	
	Smartphone	Slow-motion video capture	N/A
	NXT	N/A	Ultrasonic distance sensor
Data modelling tool		InduLab	

equipment and run an experiment; in the second week, they did an experiment with one type of data logger; in the third week, they did the same experiment with another type of logger; and in the fourth week, for the first lesson, each student found equations to fit two sets of data (obtained with two different loggers), one set at a time. In the second lesson, the physics instructor explained what their findings meant by referring to textbook theories.

Free Fall

In the free-fall lab, an Arduino logger was also used. The other logger was an HTC One S smartphone equipped with a camera that could take slow-motion video with an 8 megapixel, backside-illuminated sensor. In a free-fall experiment with the Arduino logger, a ball fell down a transparent acrylic tube (Fig. 23.3). The logger, with an ultrasonic facing down, was placed a few centimetres directly above the top of the tube. As the ball fell, its distance was recorded by the logger and transmitted to a PC simultaneously. A different setup was used for the smartphone logger. A paper scale was taped to a wall, where a ball fell in front of the scale. The falling ball was video recorded in slow motion by the smartphone. The slow-motion video reduced the blur considerably compared with a video recorded with regular motion speed. Then a student manually checked the position and the time of the ball frame-by-frame in the video played on a PC with avidemux, which was a free software. The textbook theory of a free-fall mass is given below, where S is the distance travelled, t is the elapsed time, v_0 is the initial velocity and a is the gravitational constant:

$$S = v_0 t + \frac{1}{2} a t^2 \tag{23.1}$$

Motion on a Slope

In this lab, Arduino and NXT were used as data loggers. A cart ran on a tilted track, which is a common piece of equipment in a physics lab. At the top of the track, an Arduino data logger was mounted with an ultrasonic facing the cart about to slide down the slope (Fig. 23.4). A vertical board was fixed at the end of the cart so that the

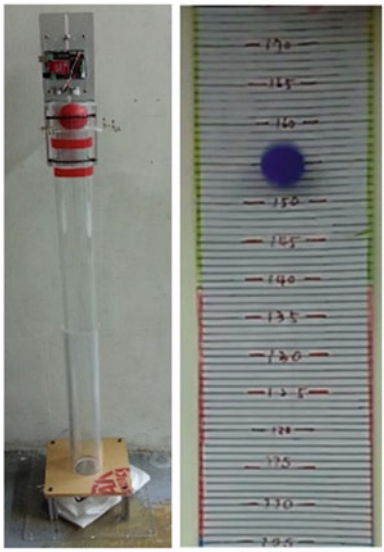

Fig. 23.3 An Arduino logger and a smartphone logger for the free-fall lab

Fig. 23.4 Slope motion recorded by an Arduino logger with an ultrasonic sensor

ultrasonic signals could be reflected back to the ultrasonic sensor. The distance data logged were simultaneously transmitted to a PC equipped with a Bluetooth dongle. In another setup with NXT, the NXT logger with its ultrasonic sensor replaced the Arduino logger at the same location. In contrast to the Arduino logger, the NXT can keep the logged data in its memory. After all the data were logged, the data file was then copied to a PC via a USB cable. The textbook equation for the motion on a slope is shown below, where S is the distance travelled, t is the time, g is the gravitational constant, h is the height of the highest point of the track and l is the length of the track:

$$S = \frac{1}{2} * \frac{h}{l} * gt^2 \tag{23.2}$$

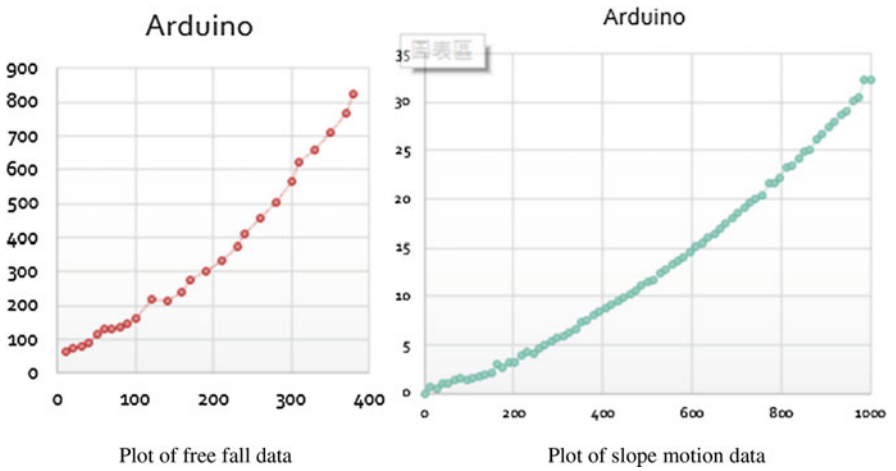

Fig. 23.5 Data obtained by the Arduino logger were plotted with Excel

Scientific Modelling

After the data of an experiment were acquired on a PC, Excel could be used to plot the distance against its time. In both the free-fall and the slope motion labs, the data plots looked quadratic (Fig. 23.5).

Mathematical Model

After the lab data were ready to use on a PC, each student used a Web browser to connect to a modelling tool called InduLab and picked the proper lab and logger type she used to collect the data and then entered 30 datapoints of time and distance. After the data were submitted, a data plot appeared; and then each student entered an expression on the right side of an equation, given that the left side of the equation was S (the distance travelled). In the example on the bottom right of Fig. 23.6, a student first entered $S = t*t/2$, resulting in an error of 26.0. Then she entered $S = t*t/1.5$, resulting in a smaller error of 17.3. The model $S = t*t/1.5$ was plotted on a background of datapoints in order to give the student some visual clue of how good the model-data fit was.

An Example of Modelling

Another example of data fitting is shown in Fig. 23.7. On the left side, a student entered a model $S = 4/2430\ t*t + 1/1000\ t$, resulting in a fitting error of 10.8. On the

Fig. 23.6 A modelling tool called InduLab

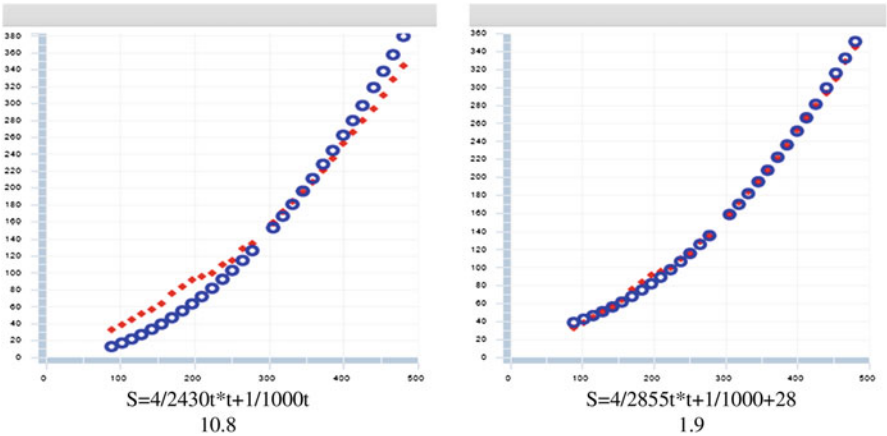

Fig. 23.7 Model revision for the data of a slope motion experiment

right side of the figure, the student revised the model to be $S = 4/2855\ t*t + 1/1000\ t + 28$, resulting in a small error of 1.9. This reduction in fitness error matched the intuition of comparing the two plots. Clearly, the new model fitted the data much better than the old one. Both the visual cue and the numeric error feedback were helpful for the student to revise and improve the model to reduce the fitting error. All models entered by the student were recorded in a database that can be used for later analysis by the researchers.

Since the sampling rate of a data logger affected the quality of the data acquired, which in turn affected the quality of the model entered by the student, it is important

Table 23.2 Sampling rates of the data loggers

	Arduino	Smartphone	NXT
Free fall	60/s	30/s	N/A
Slope motion	70–80/s	N/A	30/s

Table 23.3 Success rates for modelling the data of different logger types

		Arduino	NXT	Smartphone
Free fall	Success	25	N/A	26
	Total no. of students	27		27
	Rate	92.59%		96.3%
Slope motion	Success	22	21	N/A
	Total no. of students	25	24	
	Rate	92%	87.5%	

Table 23.4 Comparison of the features of logger types

Logger	Arduino	NXT	Smartphone
Cost(USD)	$313	$469–$625	Less than $313
Sampling rate	High	Medium	Medium
Data collection procedure	Easy (wireless)	More steps	More steps
Expandability	High	High	N/A
Error rate of ultrasonic data	±2.71%	±9.38%	N/A

to compare the sampling rates of the data loggers (Table 23.2). In the free-fall lab, the Arduino logger offered a sampling rate of 60 data per second, which was better than the 30 data per second for the smartphone. In the slope motion lab, the Arduino logger offered a sampling rate of 70–80 data per second, depending on the steepness of the slope, which was better than 30 data per second for the NXT logger (see Table 23.2).

Then the success rates of modelling for different types of data loggers were compared. A final model confirmed by a student was considered successful if it was quadratic. Table 23.3 shows the success rates for students using data recorded by different loggers. For the free-fall lab, the models for the data of the Arduino logger achieved a success rate of 92.59%, compared with 96.3% for the smartphone data. For the slope motion lab, the models for the data of the Arduino logger achieved a success rate of 92%, compared with 87.5% for the data of the NXT logger.

Table 23.4 compares various features of the three data loggers used in this study. The Arduino logger costs about US$313 (which included the acrylic tube shown in Fig. 23.8), while NXT costs more and the smartphone less. But Arduino and NXT are more expandable since more sensors can be added to the logger kit. Moreover, the simultaneous wireless transmission of the data logged by Arduino was a desirable feature since it saved time and the trouble of copying data with a USB cable. Also, the ultrasonic sensor of the Arduino has a smaller error rate (±2.71%) than the NXT logger (±9.38%). The above considerations showed that the Arduino logger would be a better choice than the other two for labs involving ultrasonic sensors.

Fig. 23.8 A custom-made Arduino experimental kit

Conclusion

In order to address the problems of conventional physics labs in high school, this research conducted an empirical study in which students did the experiments on free fall and slope motion with three modern mobile devices and a modelling tool. The devices were Lego Mindstorms NXT, smartphone and Arduino, which provided greater precision and a better sampling rate than the data-logging methods of conventional labs. In measuring distance, the ultrasonic sensor of the Arduino logger and that of the NXT logger were more convenient than the video of the smartphone because students needed to check the measurement manually frame-by-frame in a video. With the Arduino logger, the logged data were transmitted in real time to a PC with a wireless connection during the experiment. In contrast, the data from the NXT logger were copied manually to the PC by the students. Overall, the Arduino logger had some advantages over the other two devices. Moreover, the modelling tool helped the students to improve their models with the guidance of a visual plot of real lab data against the theoretical data of a model and a numeric measure of the modelling error.

At the end of this study, the physics teacher of the class made a few comments about the use of the data loggers in the two labs, e.g.:

'Conventional experiments of a physical body in motion often suffer from data of low accuracy. This study showed that modern data loggers can obtain accurate digital data automatically, which can then be plotted visually and analysed numerically with minimum effort by the students. The data loggers were great tools for scientific exploration'.

The students also reacted to this study with great enthusiasm. They enjoyed using modern, familiar technology for learning. At first, they might have felt a bit clumsy in handling these loggers, but after some training, they could use the loggers and the modelling tool with little difficulty. After this study, they had more ideas about how to use these loggers in other experiments. They also wished that they had more time to work on the labs and that the researchers could design more labs for them.

Acknowledgements This study is supported by the Department of International Cooperation and Science Education, Ministry of Science and Technology, Taiwan, under contract 101-2511-S-224-001- and 102-2511-S-224-002-MY2.

References

Church, W., Ford, T., Perova, N., & Rogers, C. (2010). Physics with robotics using LEGO MINDSTORMS in high school education. In *Proceedings from AAAI Spring Symposium* (pp. 157–159). Palo Alto, CA.

Galeriu, C., Edwards, S., & Esper, G. (2014). An Arduino investigation of simple harmonic motion. *The Physics Teacher, 52*(3), 157–159.

Kaya, H., & Boyuk, U. (2011). Attitudes towards physics lessons and physical experiments of the high school students. *European Journal of Physics Education, 2*(1), 38–49.

Kuhn, J., & Vogt, P. (2013). Smartphones as experimental tools: Different methods to determine the gravitational acceleration in classroom physics by using everyday devices. *European Journal of Physics Education, 4*(1), 16–27.

Lesh, R., & Zawojewski, J. S. (2007). Problem solving and modeling. In F. Lester (Ed.), *The second handbook of research on mathematics teaching and learning* (pp. 763–804). Charlotte, NC: Information Age.

Martínez, L., & Garaizar, P. (2014a). Learning physics down a slide: A set of experiments to measure reality through smartphone sensors. In *Proceedings of Global Engineering Education Conference (EDUCON)* (pp. 1153–1156). Istanbul, Turkey: IEEE.

Martínez, L., & Garaizar, P. (2014b). Learning physics down a slide: A set of experiments to measure reality through smartphone sensors. *International Journal of Interactive Mobile Technologies (iJIM), 8*(3), 40–43.

Monteiro, M., Cabeza, C., Marti, A. C., Vogt, P., & Kuhn, J. (2014). Angular velocity and centripetal acceleration relationship. *The Physics Teacher, 52*(5), 312–313.

Papert, S. (1980). Computer-based microworlds as incubators for powerful ideas. In R. Taylor (Ed.), *The computer in the school: Tutor, tool, tutee* (pp. 203–210). New York: Teacher's College Press.

Shih, B. Y., Chang, C. J., Chen, Y. H., Chen, C. Y., & Liang, Y. D. (2012). Lego NXT information on test dimensionality using Kolb's innovative learning cycle. *Natural Hazards, 64*(2), 1527–1548.

White, B. Y., & Frederiksen, J. R. (2000). Technological tools and instructional approaches for making scientific inquiry accessible to all. In M. J. Jacobson & R. B. Kozma (Eds.), *Innovations in science and mathematics education: Advanced designs for technologies of learning* (pp. 321–359). Mahwah, NJ: Lawrence Erlbaum Associates.

Wong, W. K., Chao, T. K., Chen, P. R., Lien, Y. W., & Wu, C. J. (2015). Pendulum experiments with three modern electronic devices and a modeling tool. *Journal of Computers in Education, 2*(1), 77–92.

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