

The Trends in Mobile Learning

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Abstract. This paper reviewed research studies published on the topics related to mobile learning and investigate its trends. One hundred and five articles were selected based on a set of criteria. The contents were then analyzed, and results were summarized to highlight the key findings. The review revealed that there was an increase of mobile learning research studies being published, compared to two previous similar studies. However, comparable themes appeared: (1) the importance of strategic planning and implementation of mobile learning; (2) the need for effective instructional designs; and (3) mobile technology still has limitations. The conclusions of the findings may provide researchers or any interested educators with more information on the trends in mobile learning.

Keywords: Mobile Learning, M-Learning, Instructional Design.

1 Introduction

According to the Cisco Visual Network Index Global Mobile Data Traffic Forecast for 2011 to 2016, worldwide mobile data traffic will increase 18-fold during this time period, reaching 10.8 exabytes per month - or an annual run rate of 130 exabytes - by 2016. The expected sharp increase in mobile traffic is due to a projected surge in the number of mobile Internet-connected devices, which are expected to be more than 10 billion—exceeding the number of people on earth, which the United Nations estimates to be 7.3 billion by 2016. [1]

A recent survey conducted by the Pew Research Centre in the US showed that, as of 2012, some 78% of teens had a cell phone, and 47% of them (up from 23% in 2011) had a smart phone, 23% of teens had a tablet computer, while only 21% of adults had one; and 95% of teens used the Internet. [2]

The American Society of Training and Development (ASTD) in its ASTD-i4cp research reported that 65% of employers are either using, considering, or currently developing learning for mobile platforms. [3] More institutions are now integrating mobile technology into their academic curriculums so that their students can access course contents on mobile devices. Mobile learning is here already; their presence is expected soon to be ubiquitous.

This paper presents an overview of research studies published in 2012 peer reviewed journals focusing on the use of mobile technology in a learning environment. There were two studies published previously on reviewing literature

covering mobile learning. Hung and Zhang used text mining techniques and bibliometrics analysis to examine literature published between 2003 and 2008. Wu et. al. who selected publications between 2003 to 2010. [4] A comparison between these two studies will be presented in a later section of this paper.

2 Definition of Mobile Learning

Mobile learning is defined as the method in which materials are delivered using mobile technology, such as mobile devices and wireless networks. Many define mobile learning as borderless, where learning can take place anywhere, anytime, as the learners will not be at a fixed, predetermined location as long as there is network connection available. [5]

Klopfer and Squire attempted to define mobile learning in 2008 when mobile smart phones were just in their infancy and handheld devices, such as PDAs, were gaining popularity. However, their definition covering the fundamental concept of a mobile learning space in the following five areas: (a) portability – can take the computer to different sites and move around within a location; (b) social interactivity – can exchange data and collaborate with other people face to face; (c) context sensitivity – can gather data unique to the current location, environment, and time, including both real and simulated data; (d) connectivity – can connect handhelds to data collection devices, other handhelds, and to a common network that creates a true shared environment; (e) individuality – can provide unique scaffolding that is customized to the individual’s path of investigation. [6]

The eLearning Guild defines mobile learning as “Any activity that allows individuals to be more productive when consuming, interacting with, or creating information, mediated through a compact digital portable device that the individual carries on a regular basis, has reliable connectivity, and fits in a pocket or purse.” [7] Geddes included the word, “knowledge”, in his definition, whereas mobile learning is “the acquisition of any knowledge and skill through using mobile technology.” [8] Mobile learning environments have been described as “human networks that afford the opportunity to participate in creative endeavors, social networking, organize/reorganize social contents, and manage social acts at anytime, anywhere through mobile technologies.” [9]

3 Selection Criterion

Given the vast information available on the Internet, it is almost close to impossible to define the selection criteria. In order to set reasonable parameters for selecting the literature for this review, the author attempted to construct the following search parameters: (1) Publications must have appeared in printed or electronic formats between January 1, 2012 and December 31, 2012; (2) All publications must be in English; (3) Only those papers that were published in refereed scholarly journals or conference proceedings would be included. This excluded all editorials, book reviews, etc.; (4) One of the following phrases must have appeared either in the title or

abstract: “mobile learning,” “m-learning” or “mlearning”; (5) Full text must be available online; and (6) The contents must be relevant to mobile learning. Articles on applying learning theories in mobile learning would not fall within the scope of this paper. The search was done electronically on the University of Toronto Libraries website, using their articles search functions. A total of 5,600+ articles were retrieved from databases such as ProQuest, Wiley, ACM Digital Library, JSTOR, Elsevier, etc. Unfortunately, some articles from ERIC were not accessible due to issues of privacy and were blocked by ERIC. After further filtering using the criteria, there were about 364 articles that fit within the criteria. Each article was then reviewed for its relevance. As a result, 105 articles were selected for the review.

4 Applications of Mobile Learning

In this section, selected research studies were presented to reflect the diversity of the mobile learning as published in 2012. This selected list also reflected the wide scope of research being done in mobile learning in different subject disciplines. Table 1 summarized the key elements of each study, including its geographical samples.

Table 1. List of Selected Research Studies

Source	Area of Application	Specific Device(s)	Sampling Size & Methodology	Country
Luanrattana, Win, Fulcher & Iverson	Medical Education	PDAs	15 medical school stakeholders [Interviews]	Australia
Chang, Yan & Tseng	English As A Second Language	PDAs	158 college students [Surveys]	Taiwan
Charitonos, Blake, Scanlon & Jones	Museum Learning	iPhones	29 Year 9 secondary school students [Surveys and Tweets analytics]	UK
Jain & Farley	Economics	VotApedia – Free mobile phone based application	400+ university students in economics [surveys and focus groups]	Australia
Alnabhan, Al-Sarairoh & Matar	Learning Tools and Applications	HP 614c HTC p3300 Dell XPS Nokia N95	20 computer science students [surveys and focus groups]	Jordan
Cortez & Roy	English Language	iPod	5 advanced ESL university students [focus group]	Japan
Cingel and Sundar	English Grammar	Mobile Devices	288 Grades 6 th to 8 th Students [Surveys]	US
Muñoz-Organero & Muñoz-Merion	Computer Engineering	Mobile Devices	178 computer and engineering students [Course assignments]	Spain

Source	Area of Application	Specific Device(s)	Sampling Size & Methodology	Country
Tu, McIsaac, Sujo-Montes & Armfield	Social Presence	Mobile devices	14 graduate students [Participant observation and interview]	US
Wallace, Clark & White	Medical Education	iPhones	213 medical science student and faculty [Online survey and interviews of 18 participants]	Canada
Chen, Balijepally & Sutanto	Mobile Learning Experience	Tablet PC	32 undergraduate and graduate students [Surveys]	US
Liestel, Doksreed, Ledas & Rasmussen	Mobile Augmented Reality	iPad	200 school children and 8 senior citizen [Observations and surveys]	Norway
Narayan, Davis & Gee	Mobile Web 2.0	iPhone 4/iPad 2	36 university students [Surveys, focus groups, Web 2.0 data analytics]	New Zealand
Gromik	Mobile Video	Mobile Phone	9 language students [Video recording & surveys]	Japan
Alemi, Reza & Lari	MALL – Vocabulary Learning	Mobile Phone	45 English learning students [Text analysis, surveys & interviews]	Iran

4.1 Mobile Assisted Language Learning (MALL)/ESL

There were quite a number of studies published in 2012 on using mobile technologies in the areas of MALL and ESL. One of the obvious reasons mobile technologies are being applied in learning is that the learners found that these technologies are convenient; it has been proven that learners can access the knowledge anywhere, at any time. This was confirmed in a study conducted by Chang, et. al., with a group of 158 college students using PDAs to learn English. They concluded that “perceived convenience and perceived ease of use were the antecedent factors that affected perceived usefulness and attitude toward using.” They also added that designers of mobile learning activities should be noted to “enhance the convenience and ease of use.” [10]

Cortez and Roy’s research focused on the usability of iPod screen interface as a language learning tool for a group of advanced English learning students in a Japanese technical university. Although the sample size was relatively small, with

only five volunteers from the students, the analysis was an in-depth focus group discovery. The results supported the importance of a user-friendly interface design, as well as an effective use of games, listening and reading activities in language learning. [11] This finding continues to support the importance of instructional design for mobile devices.

Cingel and Sundar studied the impact of using mobile devices on texting and tweens for learning written grammar based on a survey of 228 6th to 8th grade students. Although it was obvious that the level of grammatical skills was different among the grade levels, the results “lend support to a general negative relationship between text messaging and adolescent grammar skills” and students who prefer text messages would likely use the technology more often. One of the findings was that most students were not able to “switch between writing text messages and using correct English grammar for class work.” This leads to the need for further discussions on how school curriculum should be designed to fit the use mobile texting. [12] A similar study supported this finding and noted the practice design of contextualizing a MALL. [13]

Another study on using mobile devices in ESL learning “revealed that for learners with lower English levels, the presence of concurrent written text elicited higher performance efficiency in the immediate recall task of the English listening comprehension.” [14] A smaller scale study looked into using mobile phone to produce a weekly 30-second video on a selected topic as part of a language learning tool. In the video performances, the participants suggested that this was an effective learning process that could increase the number of words they spoke in monologue. [15] Alemi, et. al. studied the effectiveness of SMS (short messaging service) on learning vocabulary based on the Academic Word List [16] and the results indicated that SMS had a more significant effect on vocabulary retention compared to using a dictionary. [17]

Huang, et. al. conducted a student on the mobile English learning, but focused on student knowledge acquisition, i.e. to investigate “the role of mobile technology playfulness, users’ resistance to change and self-management of learning in mobile English learning outcomes (MELOs).” The empirical results of this study confirmed that “perceived playfulness and self-management of learning had positive influences on MELO and that users’ resistance to change was negatively associated with MELO.” [18] This further reflects the importance of the understanding needed to improve the effectiveness and efficiency of mobile learning.

4.2 Engineering and Science

Munoz-Organero and his colleagues conducted a study on “using mobile devices in class to provide students with contextualized learning pills” where the “pills” were defined as a “simple exercise that summarizes some of the key concepts explained in class and promotes reflection and self-study.” As expected, implementing the “learning pills” via mobile devices did improve the class attendance ratio and student performance as well as motivational pattern. [19]

A group of 29 students from a secondary school in the UK visited the Museum of London and each one was given an iPhone to use Twitter to tweet their learning experience during the tour. The tweets were then analyzed. The results indicated that mobile learning using Twitter could “enhance the visitor experience and extend the social spaces in which learners interact with each other” and significantly improve “students’ impressions, participation and enthusiasm during the trip.” [20]

A free mobile phone based audience response system, *VotApedia*, was used as a tool to engage students in large students. The results confirmed the authors’ hypothesis that “*VotApedia* arouses student interest, encourages participation and inclusivity and allows tailoring of lectures to suit the student cohort instantly”; and “improves student engagement” (p. 437). The students surveyed were quite positive about their experience; on the other hand, overuse of *VotApedia* might lead to loss of interest; and the system was only available in Australia. [21]

Luanratta, et al. investigated the use of mobile devices, such as PDAs (personal digital assistants), in problem-based learning (PBL) medical education, and confirmed that PDAs “enable students to record and update their clinical experience...to have immediate access to clinical resources and information on-the-spot... and to communicate among peers...while offsite.” [22]

Wallace, et al. examined how medical teachers and learners are using mobile computing devices such as the iPhone in medical education and practice, and how they envision their being used in the future. They concluded that mobile technology “offers the potential to enhance learning and patient care, and also has potential problems associated with it.” This will have an impact on teaching methods in medical science and also present the importance of leadership in medical schools and healthcare organization to discuss ways to maximize the benefits of mobile technology. [23] This theme of organizational strategic involvements in the planning and implementation of mobile learning has also appeared in several other studies as seen below.

4.3 Mobile Learning Environment

Tu et al. conducted a study to understand mobile social presence and how it influences online interaction and relates to online social presence and network social presence. Using the participant observation method with a sample size of 14 graduate students in a US university, they concluded that “mobile social presence is similar to online and network social presences but is different from online and network social presences in the aspects of personalized control, and location-free digital interaction.” A model to build a digital social presence was presented in this study. [6] Another study found that students were more engaged in the learning process when using mobile web 2.0 tools. The learners felt encouraged; “self-regulation, nurtured a sense of ownership, creativity and innovation.” [24]

Based on a student-centric perspective, a study was conducted by Chen, et. al. to investigate if mobile technology had an influence on students’ learning experience. Selecting from one undergraduate and one graduate classes, the authors’ finding is

that “the mobility features of technology appear to reshape the students’ learning satisfaction and future expectation of technology.” [25]

Liestol, et.al did a comparative study on how two age groups of users, senior citizens and school age children respectively, interacted with an iPad on a historical site with audio sound and interactive historical contents. They concluded that the “senior citizens, primarily interested in the subject matter, saw through the medium itself, while the school children were more focused on the mediation process itself, its new features and functions.” [26] This interesting finding confirms the variances in mobile learning environment of users at different age groups.

Tortorella, et. al proposed an approach for “providing personalized course content in mobile settings” based on students’ learning styles and context in order to provide them with the right level of personalized contents. [27] However, it is essential that the learning contents to be retrieved through the adaptation mechanism built in the learning management system are context-sensitive. [28]

5 Benefits of Mobile Learning

Is mobile learning the future classroom? Or will it change the dynamics of learning space? It has already been noted that a mobile technology learning environment helps empower students and provides new and exciting learning opportunities. [29, 30, 31]

Many research studies support the theory that using mobile technologies would enhance and improve the learning environment for learners. Mobile technology allows students to interact and collaborate with their peers, synchronously or asynchronously. They can share ideas using various digital forms, audio or video recordings, images, text, etc. At the same time, they can access the massive information resources on the Internet via their mobile devices.

Tracking of learners’ progression is possible through the design of the mobile apps. This will help generate useful and powerful analytics in understanding learners’ behavior and their patterns of usages. This will make adaptive learning much easier to implement and easier to understand the progression of learners and their learning experience.

Mobile technology has changed the method of learning and teaching in a traditional classroom environment. Like any type of technology, mobile technology can change rapidly, particularly in the design for various types of mobile devices. Adapting to this type of changing technology can be a challenge to many instructors, as they have to know how to develop support strategies when working with existing technology with the anticipation that this may be dated in a year or less. Even using the same tools, changes may occur over time due to the frequency of software upgrades and possible incompatibility between each upgrade.

On the other hand, mobile technology has already integrated into many students’ daily lives. It is also important that the students will need to develop self-discipline and good skills to manage their time and behavior to avoid being side-tracked by the same tools used during the course. If not, the students will start using these apps for reasons other than course work.

Before using mobile technologies in a class, instructors must forewarn students of the potential distraction and advise them on the importance of self-discipline and time management so as to complete the required course work. Previous work has shown that personality traits and maturity in learning are likely to be equally important with computer literacy. [32] Success in mobile learning depends on the discipline and commitment of a student.

Research supports the premise that the use of mobile devices increased students' participations in their studies and engaged them in the classroom, for example, by using the interactive online voting system [33,34]. Mobile technology also provides students with convenience, connectivity, and portability. [35,36] However, as Merchant pointed out, mobile technology had already been encompassed in students' daily life and the most challenging issue to most educators "is to consider how educational experiences might be enhanced or transformed through the use of mobile technology." [37] This further confirms the needs of innovative mobile instructional design in order to offer effective and engaging contexts effectively in a small screen with appropriate bandwidth. It is also essential that institutions should "implement strategic efforts to build m-learning implementation plans, such as design guidelines, development phases and articulating norms, and consider the current level of students' readiness." [38]

The principle of mobile technology is that it is "always on" and accessible, as there is no closing time. The learners can complete the course at their own pace and on their own schedule. They can interact with each other—even when the instructors are not available—by using SMS, discussion boards, etc., and to learn collaboratively with Wiki-based forums. [27] Baloch, et al. studied mobile collaborative learning effectiveness using activity theory, even though further studies would have been needed. [39]

Another challenge in using mobile technologies is the Internet accessibility and bandwidth availability. The delivery of course contents to a mobile device is completely dependent on the reliability and stability of wireless networks, including coverage, bandwidth, etc. The speed of the connection has been an issue raised in several research studies, [40] where it was suggested that using more interactive, audio-video enhanced learning modules, would improve the effectiveness of mobile learning. However, this relied completely on the learner's mobile connections. If courses were made available to other countries, students could have difficulty accessing certain types of materials due to the country's government policies. In addition, depending on the Internet connection plan to which the learners subscribed, there might be additional network costs.

There are limitations in using mobile technologies, or any kind of technology. Battery life is always a challenge, as is the screen size, which must be overcome in order for course designers to effectively fit the course contents. However, a study confirmed that "contextualizing the use of mobile devices can promote students' attitudes toward the use of mobile devices in learning" when it was combined with the ambient artifacts. [41] With the right design for the contents for the mobile devices, mobile learning can still be as effective as other instructional technologies. [42] It is suggested that "content delivery needed to be spread out over more time", not only to

compensate the smaller screen size, but engage students more in short messages, something that they are already accustomed to when using their mobile devices. [43]

Another challenge in mobile learning is the development of course materials that can fit in so many different types of mobile devices. Testing is easy to do on a desktop browser, as the size is manageable even with different browsers. But testing mobile learning materials requires the actual mobile devices. Although iOS and Android allow users to run simulated environments on a Mac or Windows-based system, it is still best to test it on actual devices. The rapidly changing devices will require regular upgrades and changes. This will incur additional development costs.

It has already been noted in a number of research studies that the importance of instructional designs contributed to the success of mobile learning. Creative and innovative applications should be made available as part of the mobile learning process. It has been considered as “traveling ideas in which the innovative idea of using mobile technology for learning purposes was tailored to the specific needs of the distance students” of a local university in South Africa. But the traveling idea was short-lived, as the course context kept changing in order to adapt the mobile technology of their students’ needs. [44] On the other hand, Sung and Mayer found that there were differences in the perception of mobile devices between two countries, specifically South Korea and the US. Their findings were that “USA students were more sensitive to whether an instructional lesson is prepared on a mobile device or a personal computer, whereas South Korean students conceptualized both media as equivalent” while USA students tended to “have more positive beliefs for desktop computers, rating them higher than mobile devices compared [to] being fast, sharp, meaningful, good, and realistic; where South Korean students tended to have more positive beliefs for mobile devices, rating them higher than desktop computers on being open, attractive, changeful, stimulating, immediate, and exciting.” [45] This study reflects the importance of context localization and cultural differences regarding the perception of mobile learning.

6 Conclusion

Using mobile devices as learning tools has received more attention as the technology becomes more accessible and popular with this generation of learners. Many educational institutions and corporations have already started using them as the primary tools, or allowing students to use these tools to access supplementary class materials. Gedik, et. al. discovered in their research that “m-learning can be considered to be more suitable for supporting f2f instruction.” [40] Mobile learning allows the teaching and learning process to be individualized and encourages networking and collaboration among students while keeping them independent in contributing to the course content. This allows students to feel much more comfortable participating in an online collaborative environment. Mobile devices are considered personal tools as well as having the capability to support intense and ubiquitous cooperative learning, social interaction and sharing. [46] It is important to

find ways to embrace mobile apps in learning and build a sound mobile learning integration with social network connectivity.

Mobile learning does not apply to all subjects, some which cannot be taught using mobile technologies, for example, technical IT materials, e.g. programming or SQL. [47] However, supplementary course materials can be made available on mobile devices for easy access and reference.

It is also found that numbers of articles stressed that a sound strategy is needed to best incorporate mobile technology into a curriculum and learning process with the focus of a creative, innovative and effective instructional design. [9,17]

Further research needs to be conducted to understand the effectiveness, levels of quality assurance and IT infrastructure support required in using mobile technology as learning tools. A large scale study is also needed to verify the feasibility of mobile learning in active curriculum development.

Mobile learning is here, and it is a choice of tools for learning of our next generation of students – the millennial students. The question then becomes, do we want to participate, embrace, and guide these learning activities, or do we want to ignore these activities as not part of the student learning process?

New technologies will always bring new users and create new opportunities for learning. If they are being used in the right way, technologies can engage learners, foster profound and meaningful learning, and result in an enriched learning environment. [48]

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