

1. Introduction

Mobile learning, as short for m-learning, is a kind of learning model allowing learners to obtain learning materials anywhere and anytime using mobile technologies and the Internet (Ozdamli & Cavus, 2011). With the fast update speed of the mobile devices and wireless service, mobile technologies have been widely applied in different fields, such as business, education, commerce, health and entertainment, etc. The arrival of 3G (third generation) wireless service has just heard of and its convenience has just reflected in our daily lives. We can pay for our shopping on our mobile phones, enjoy the movies, and play online games in our own mobile devices. However, the fast pace of technology has pushed us to a new era of 4G (fourth generation) wireless services. It brings about quicker and smoother speed for our entertainment, daily lives, business and learning. More and more people have realized the impact of mobile technologies in education. Hwang & Tsai (2011) carried out a survey focusing on mobile and ubiquitous learning research from 2001 to 2010 based on the articles published in six major SSCI journals. They found the number of articles has significantly increased during the past 10 years, especially in 2010. Another finding was the number of authors from different countries, and US authors contributed the most publications, followed by UK authors and Taiwanese authors. The government takes action involving in the development of m-learning. The U.S. government is seeking to reduce costs by encouraging schools to transition from paper-based to digital textbooks within next five years (Hefling, 2012).

The purpose of the review is to explain what mobile learning is, what implications mobile learning has in education and what challenges and trends mobile learning has in promoting teaching and learning. Comparing to other formats of learning style, such as e-learning, social networking, and virtual community and games, m-learning also has its specific advantages when applying in education. This review will state the characteristics, advantages and limitations of m-learning applied in education in detail on the basis of my own learning experience and also the literature. From the review, many recent concerns about mobile learning will also be concluded. They are not only the current hot issues, but also implications for future studies.

There are many definitions of mobile learning. Vinu, Sherimon and Krishnan (2011) proposed that mobile learning is the union of mobile computing technologies and e-learning. This type of learning environment enables the learners to access the learning materials from anywhere at any time. Wilson and Bolliger (2013) stated m-learning refers to any sort of learning that occurs with a mobile device, when the learner is not tethered or fixed to a predetermined location. The definitions are more relative to the common meanings of m-learning. Keskin and Metcalf (2011) proposed the different definitions of mobile learning in many theories, including Behaviorist Learning, Cognitivist learning, Constructive learning, Situated learning, Problem-based learning, Context awareness learning, Social-culture theory, Collaborative learning and Conversational learning in their literature review. The characteristics, the relationship among distance learning and e-learning and the limitations of m-learning have been frequently mentioned.

Nowadays, the wide application of m-learning has attracted more and more researches on m-learning. From the recent research on m-learning, it can be found different focuses on application

of education. For instance, the relationship among traditional learning, e-learning and m-learning has been discussed. Meanwhile, the possibility of m-learning involving in education has been proved. As the stakeholders involving in different kinds of learning style, the role and responsibility of each stakeholder has also been talked about. The strategies and pedagogies in learning have also been included in these researches. And also how the different learning objects apply mobile learning in their learning has been mentioned.

2. Methodology of Review

The research studies chosen for the literature review concentrate in the meanings and implications of m-learning, challenges and trends of m-learning applied in education. The literature comes from lib.usm.edu and scholar.google.com. The main format of the literature is paper from 2011 to 2014. The journals of Computers and Education and The Chronicle of Higher Education have many papers relevant to m-learning. The main keywords for searching the literature is mobile learning and m-learning. Through searching, I find the papers mainly focus on the empirical study. This kind of study can help transfer the m-learning theory or hypothesis to the application in education.

3. Overview of Research Studies

3.1 Methodologies and Educational Settings

The literature relevant to mobile learning for the review includes twenty-one studies. Nine of the literature used both quantitative and qualitative methods (Cheon, J., Lee, S., Crooks, S.M., & Song, J., 2012; Gikas, J., & Grant, M.M., 2013; Hwang, G.-J., & Chang, H.-F., 2011; Hwang, G. J., & Tsai, C. C., 2011; Hwang, G.-J., Wu, P.-H., & Ke, H.-R., 2011; Jones, A.C., Scanlon, E., & Clough, G., 2013; Ng, W. & Nicholas, H., 2013; Sandberg, J., Maris, M.&De Geus, K., 2011; Wu, Wen-Hsiung., Huang, Sih-Han., Jim Wu, Yen-Chun., Chen, Chun-Yu., Wu, Wen-Hsiung., Kao, Hao-Yun., & Lin, Che-Hung., 2012). They proposed a hypothesis, conducted survey with questions, collected and analyzed data, and gave the qualitative conclusion according to the results.

There are six studies mainly focusing on m-learning application in high education (Cheon, J., Lee, S., Crooks, S.M., & Song, J., 2012; Gikas, J., & Grant, M.M., 2013; Keller, J., 2011; Park, Y., 2011; Wilson, M., & Bolliger, D.U., 2013; Young, J. R., 2011).

There are also two reviews for mobile learning. One is “Research trend in mobile and ubiquitous learning: a review of publications in selected journal from 2001 to 2010” (Hwang, G. J., & Tsai, C. C., 2011) and another is “Review of trends from mobile learning studies: A meta-analysis”(Wu, Wen-Hsiung., Huang, Sih-Han., Jim Wu, Yen-Chun., Chen, Chun-Yu., Wu, Wen-Hsiung., Kao, Hao-Yun., & Lin, Che-Hung., 2012).

The studies are all set in educational settings from K12 to higher education and also the adult education. The educational settings are divided into formal and informal learning environment.

3.2 Purposes of and Participants in Research Studies

The twenty-one literature has the similar purpose of explaining the meanings and applying mobile learning in education. The participants for empirical studies are students from K12 (Ng, W. & Nicholas, H., 2013; Sandberg, J., Maris, M. & De Geus, K., 2011) to high education and adult learners (Jones & Scanlon, 2013).

4. Findings of the Review

4.1 Characteristics, limitations of mobile learning

Various definitions appeared since the beginning of twenty-first century. Recently, the definitions discusses are more relative to the common meanings of m-learning. The characteristics, the relationship among distance learning and e-learning and the limitation of m-learning have been frequently mentioned.

Ubiquitous/spontaneous, portable size of mobile tools, blended, private, interactive, collaborative and instant information: are supposed to be the basic characteristics of mobile learning by Ozdamli and Cavus (2011). These characteristics can be easily realized in an m-learning setting. And they are the differences from other styles of learning. Some definitions directly proposed the relationship among these similar learning styles. From the definitions, m-learning cannot be without the support of mobile device and wireless service. In my opinion, the mobile characteristic is the most different factor from other types of learning. There are many learning applications which can be available from app store or play store for mobile devices. For my master's program learning, Blackboard learning system can also be logged in on my iPad. It is really helpful when I check the emails and new threads in discussion forum. Some online tools for instance piZap, a kind of graphic editing and designing tool, also have their mobile application for users to use in their mobile devices. All the characteristics also well explain the advantages of mobile learning. Some potential benefits such as cost savings, ubiquitous communications, study aids, and location-based services are also mentioned frequently.

The limitations also come with the advantages of application of m-learning. Comparing the past concerns of the size, cost and limited battery life of mobile devices, and the limited internet connection, Wilson and Bolliger (2013) proposed although there are service providers for the free platforms for m-learning, there is not a standard for operating different platforms. They also mentioned learners cannot print from their mobile devices and need consistent technical support. There are concerns about the instructors. To help design a suitable environment for learners' m-learning, the instructors will spend more time and energy on pedagogical reasoning in their planning and teaching (S ølvberg & Rismark, 2012). The concerns on learners, instructors and other stakeholders in mobile learning are the most complex and difficult problems. However, with the common spread of m-learning, many solutions have been proposed to solve the problems and well assisted learning and teaching. From my learning experience, I also found that many websites provide their mobile version for mobile devices users to view. However, the layout is strange comparing to that in the personal computer. As instructional designers, we need to concern about these differences. For example, when I design a tutorial for piZap, I think I need to design different versions for computers and mobile devices users. For piZap has different interfaces for computers and mobile devices, the locations of the menus including functions and tools are different, learners cannot find one function or tool in the menu.

4.2 Application of mobile learning for different stakeholders

In mobile learning the human factors refers to the stakeholders in learning system. The stakeholders contain students, instructors, administrators and service provider and others who may be involving in mobile learning. Meine, Dunn and Abbey (2012) proposed the concerns of online stakeholders, including 14 faculty concerns, 9 administrative concerns, 4 mutual concerns and 4

student concerns. The concerns are the pressure from office time and spare time, the attraction of the course content, the frequent communication with each other, the cost of devices for learning, the comparison between online learning and face-to-face learning, the technological problem for flowing learning and test integrity and how to evaluate the faculty and students, etc. All the concerns relate to the objective and subjective problems in online settings. Although mobile learning has its characteristics, most of the concerns can be transferred to mobile learning. Different roles in mobile learning have different concerns. The concerns may come from the other stakeholders, such as the evaluation and communication for each other and the rules set by an improper object. Other concerns may be from the cost and technological problems. These problems constitute the limitation of mobile learning. The limitations are mentioned in nearly all the researches. Hwang, Wu and Ke (2011) proposed the useful strategies designed for teachers adding the load for them. Wilson and Bolliger (2013) listed the drawbacks of mobile learning and tried to find proper methods. Ng and Nicholas (2013) found the disappointment of the result from students, teachers and coordinator. Parents also involved in mobile learning. They had to afford the necessary mobile devices for students' learning. Students they didn't think using PDAs can improve their learning. Teachers had to spend more time preparing learning materials for students in advance. Principal must consider all the aspects of education and coordinator didn't think they can control the process of teaching and learning. They believed to delegate responsibilities with trust among members of the management team and between management and the teachers as well as the teachers and the students. The research had exposed an unexpected outcome. They found the conflict among all the stakeholders.

Among the literature, learners as one of the stakeholders were paid more attention than other stakeholders. It has been common sense that all the learning styles have the same objective that is to support or promote learners' learning, so does mobile learning. From the perspectives of constructionism, learners have been set to the center position of instruction. The learner-centered principle leads much reform in instruction, for the aim of education is to equip students with knowledge and literacy to live better. Many researchers have realized the principle. They involved their research into different stages of students, including the primary and middle school, higher education, and adult education. The Hwang's team in the year 2010 to 2011 carried out many researches in primary and middle school. They considered mobile learning as a good learning strategy to help students learn science course. They designed software or learning system equipped in students' mobile devices in a hybrid learning settings, including classroom learning and authentic settings learning. And their researches are consistent. From their series of papers, it can be found that the current research was close to the last research, but it had been modified and promoted. They focus on the field of primary and middle school science course and have got many outcomes.

Comparing to primary and middle school researches, researches on higher education are fewer. Park (2011) proposed m-learning in higher education was still in the early stages of development. For instance, while many universities provided free Apps, their contents were primarily non-instructional such as news, event calendars, and maps. However, the availability of mobile devices does not guarantee their use in education; we must first assess students' readiness for mobile

learning (Keller, 2011). Young (2011) thought mobile device applications can be used as learning aids that students can access from virtually anywhere. Cheon and Crooks (2012) proposed a conceptual model based on the theory of planned behavior (TPB). They tried to explain how college students' beliefs influence their intention to adopt mobile learning.

For adult education, there are researches focusing on the informal learning. Jones and Scanlon (2013) believed mobile technologies could support learning across different contexts for informal and semiformal learning settings. They carried out two cases. Participants in the first case were 14–15 year olds to use web based software to support science inquiry learning in a semiformal context. The second case study focused on informal adult learners using their own mobile technologies to learn about landscape. However, there was no software equipped with their mobile devices to support the second case. Application in the adult education is fewer, for most adult education is considered to be an informal learning.

4.3 Strategies and pedagogies for mobile learning

The main contents of the research are strategies and pedagogies for mobile learning. Researchers carried out researches on different topics, including acceptance, attitudes, effectiveness, efficiency, etc. They often firstly proposed theories, systems or frameworks, and then applied the pedagogical methods and learning strategies in authentic learning settings. One of the representations of recent research is the research carried out in Taiwan. The team of Hwang focused on assisting the primary school students involving in m-learning. Their research process was firstly setting a framework, then selecting a proper course and finally analyzing the pre-test and post-test data to gain conclusions. They also referred to the detailed assistance for learning, for example the design of assessment (Hwang & Chang, 2011) and learning strategies (Hwang, Wu, & Ke, 2011). Another similar research was the mobile English learning (Sandberg, Maris & De Geus, 2011). The researchers divided fifth grade students to three groups to learn English words in different settings. However, there are also some researches which just proposed a theory or hypothesis (Ng & Nicholas, 2013). Taking the technology for the language teacher for example (Horkly, 2013), the researcher in the case just proposed a model which may be applied to the ELT (English Language Teaching) and took some examples for explaining each stage of SAMR (substitution, augmentation, modifications and redefinition). All the learning tasks involved in the examples were just the hypothesis and suggestions. There are also many researches mentioning higher education (Gikas & Grant, 2013) for different major, such as nurse education (Robb & Shellenbarger, 2012), health education (Wilson & Bolliger, 2013), etc.

These studies generally focused on the application research. They had explicit application fields and the research objects. There were authentic learning activities. The researchers with the courses' instructors designed the learning activities, equipped students the necessary mobile technology and devices, carried out tests and tracked the whole learning process. They tried to involve their researches in students' daily learning. Therefore, the researchers are meaningful. Once the experiment is proved to be effective and efficient, the research can be directly applied in students' learning. The researchers kept closely with the survey school instructors and students. They knew them so well that they could design proper learning materials, meet their learning or teaching needs and carry out meaningful learning activities. Therefore, the research doesn't mean

a survey, just a support and promotion to instruction.

4.4 Formal and informal learning of mobile learning

Although online learning, mobile learning and other similar learning styles have applied in instruction for a long time, there are still many people who cannot accept them as a formal learning, for they considered the formal learning was the traditional learning style, face-to-face learning. The question of the application of mobile learning in formal or informal learning is also in a debate. Some researchers considered mobile learning as independence learning or complementary to others. Others believed it to be a hybrid and blended learning mixed with mobile learning. Jones and Scanlon (2013) carried out two cases. One was for middle school students in hybrid learning settings. Another was for adults as a semiformal learning settings. They compared the different contexts for informal and semiformal learning settings. How to identify the differences between formal, semiformal and informal learning and what position the mobile learning should be set need to be illustrated by much practice of mobile learning involving in instruction.

5. Discussion and Implications

5.1 Discussion

From the literature review, there are some common research themes recently. The first is the concentration on acceptance and effectiveness of m-learning is still more than other contents. To test the acceptance and effectiveness, the research is often based on some hypothesis of theoretical framework (Cheon, Lee, Crooks & Song, 2012), following an authentic m-learning activity and data analysis. The second theme focuses on the different kinds of learners. There are researches carried out in the primary and middle school students and undergraduate and graduate students. And also there are researches mentioning the adult learners. For different stages of students, m-learning is applied in different courses, such as science, native culture, language learning, nurse education, etc. The third theme is the detailed strategies and pedagogies. This kind of recent research is to design systems, technology, pedagogical methodologies and learning strategies in the detailed m-learning process to assist learners' learning. The fourth theme of the research may be the hybrid learning settings, from formal and informal learning to classroom learning, distance learning, and field study. For instance, the design of assessment (Hwang & Chang, 2011) and learning strategies (Hwang, Wu, & Ke, 2011) were conducted in both classroom and mobile learning setting. Another similar research was the mobile English learning (Sandberg, Maris & De Geus, 2011). The researchers divided fifth grade students to three groups to learn English words in different settings.

5.2 Implications and Future Trends

From the definitions of mobile learning, in my opinion, mobile learning is one kind of e-learning. The specific characteristic is the keyword of mobile. Mobile learning has nearly the same characteristics as e-learning. The difference may be that the platform mobile learning conducts in is the mobile device and the platform for e-learning is a computer. Of course, the premise is the designer provides the different learning versions for both e-learning and mobile learning. It is meaningless to discuss the differences among many formats, such as e-learning, m-learning, social networking and virtual community and games and distinguish the learning settings for them. For instructional designers, we should well know each learning format's advantages, limitations and

its possible application settings. Based on the knowledge, just take good use of each learning format. In fact, in real instructional setting, the hybrid learning is common. Mobile learning is a part or a small field in instructional technology. Recently comparing to m-learning, e-learning, virtual social community for learning, a lot of similar researches have been carried out and sometimes they are mixed researches. For instance, recent online learning is nearly the blended learning, including both synchronous and asynchronous communication. Mobile learning can be integrated into classroom learning and also supplement e-learning.

To well apply mobile learning in education, firstly, the acceptance and attitude of different stakeholders are the most important. If they cannot accept and even resist this learning format. The design of mobile learning cannot even be implemented. From the review, many concerns for different stakeholders can lead to rejecting mobile learning. Another concern for applying mobile learning in education may be the literacies of pedagogy design and technologies supporting mobile learning. There are many limitations about the technology of delivery and expense of mobile device and wireless. However, the excessive emphasis on technology can lead to neglect the pedagogy in a mobile learning setting. The technology can help us solve the availability in different media. Platforms and systems may change according to different media, but what may not change is the instructional design. That's the business of pedagogy. What is more interesting and valuable for application in education may be the strategy and pedagogy of integration mobile learning into instruction to promote teaching and learning.

From the review, I also learnt quantitative and qualitative methods for mobile learning studies. More and more research data was gathered and analyzed. Many results were concluded from the data. It is the best evidence for the conclusion or the hypothesis. It fits to the problem-solving process, from proposing a problem to analyzing the problem to solving the problem. In the future data analysis methods become important for researchers. Mastering research methodology is the basic literacy to carry out a survey. However, the sample of data must be considered covering certain amount. In most of these studies, the results from the data analysis mostly supported the hypothesis, framework or theories. Scientific research can prove hypothesis to falsification and verification. However, most of the research results proved the hypotheses to verification. Although during the research process there may be some limitations in the design or technology, all the limitations are good suggestions for the future research. Through the research it is well proved that mobile learning can be widely applied in instruction. Another implication for me is the continuous study on one theme. The team of Hwang from Taiwan continued to focus on assisting the primary school students involving in m-learning. It took a long time for them to gain the conclusion. Also the teamwork is vital in the research outcomes, for a survey contains much work including the whole design, preparation, implementation of learning activities, gathering and analyzing data, communication with students, instructors and administrators, etc.

Undoubtedly, there are challenges for application of mobile learning. Many factors include the different stakeholders' acceptance and attitude, the technological support, the expense of mobile devices and wireless, and other factors which are weaker than other format of learning. However, more and more wide application of mobile learning is the fact in reality. For future studies, firstly, how to overcome the difficulties and solve these limitations of mobile learning is

more important and meaningful. Another trend for further studies may be the concerns on the instructional design of mobile learning. When the application of mobile learning has become more and more popular, the whole design is necessary. Just as recent studies, the strategies and pedagogies will also gain more attention. With the rapid pace of technology, the principle of promoting teaching and learning with integration different formats of learning supported by different kinds of technology will be unchangeable.

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