LUX: A Journal of Transdisciplinary Writing and Research from Claremont Graduate University

Volume 2 | Issue 1 Article 23

2013

Mobile Learning: Designing a Socio-Technical Model to Empower Learning in Higher Education

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Abstract

Mobile learning is a rapidly developing mode for teaching and learning to deliver content to learners. Additionally, mobile learning can aid both formal learning in traditional classrooms and informal settings outside classes. This paper explains how the mobility of learners can contribute to the process of acquiring knowledge, skills, and experiences, and further investigates how to design an effective model. This study also explores activities in which students can use mobile devices to facilitate their learning. Additionally, there are many factors that affect students' learning outcomes. In this paper, researcher investigates how to design an effective socio-technical model by integrating cultural difference to maximize the benefits of mobile learning. The potential outcome of doing this research is a mobile learning success model, which includes different aspects of using mobile learning in higher education.

With the proliferation of the Internet and mobile technology, mobile learning has been increasingly adopted by educational institutions. As such, mobile learning is a rapidly developing mode of teaching and learning. According to Quinn (2000), an early example of mobile learning is Electronic Learning (e-learning) through mobile computational devices, such as Personal Digital Assistants (PDAs), Windows CE machines, or even digital cell phones. Sharples, Taylor and Vavoula (2010) argue that mobile learning is not only learning that is facilitated by mobile technology, but also the process of learning through conversations and explorations across multiple contexts between learners and personal interactive technologies. Scholars have expanded the definition of mobile learning to focus on interaction and communication with others, including capturing information and sharing it among learning communities. In addition, features of mobility can facilitate teaching and learning wherever and whenever learners need it. As a result, learners can choose locations that they want to study at times convenient to them.

In the mobile age, research into mobile learning has been done in various contexts. Some researchers study mobile learning in K-12 and higher education settings (Faux, McFarlane, Roche and Facer, 2006; Verdejo, Celorrio, Lorenzo, Ruiz and Sastre, 2007; Whittlestone, Bullock, Pirkelbauer, May and Sánchez, 2008), while others study mobile learning for professional development and workplace settings (Smordal and Gregory, 2003; Schrader, Nguyen-Dobinsky, Kayser and Schrader, 2006; Derycke, Chevrin and Vantroys, 2007). These studies aim to investigate how learners who use mobile devices can enhance their ability to

acquire knowledge, skills, and experiences. Most of this research explores the concepts and factors influencing effective learning outcomes through creativity, collaboration, and communication (Sharples et al., 2010). However, there is a missing factor, culture, which should be added to the existing mobile learning model. Understanding this missing piece may improve the learning outcomes of students. Therefore, I would like to investigate how to design an effective socio-technical model by integrating cultural difference to maximize the benefits of mobile learning, focusing on higher education settings.

Mobile learning can aid formal learning in traditional classrooms by extending learning beyond class time. For example, learners can use their mobile phones to share pictures and videos with their classmates, and have personal conversations within a learning community. In traditional classrooms, students are involved in learning activities and discussing materials with peers and teachers via face-to-face communication. Learning assessments can measure the learning performance of students. However, it is more difficult to evaluate the effectiveness of mobile learning outside the classroom context if students access mobile learning in an informal context, because they can learn by themselves, with their peers, or from online societies (Kakihara and Sorensen, 2002).

Major research questions in the area include:

- What are the key factors needed in a mobile learning environment for designing an effective mobile learning model?
- Do cultural differences influence the students' effective learning outcomes?

Literature Review

Mobile technology plays an important role for academic institutions. Mobile devices become personal tools, helping people learn wherever they go, through formal training or informal support and conversation (Kukulska-Hulme, Traxler and Pettit, 2007). Students can learn from multimedia or multimodal learning, which traditional methods cannot address properly. For example, teachers sometimes just talk and use the whiteboard, but some students may learn better in different ways. They may need to use multiple devices to access web-based technology and use visual tools for learning. So, it is hard to provide active and experiential learning using traditional classroom-only methods. Therefore, mobile learning could be a good way to help students meet their preferred learning styles using more contemporary, effective, and efficient methods (Milrad and Jackson, 2008).

A challenge for mobile learning is the design of the information capturing procedure. Learners have their own learning preferences, so learners may use a mobile device differently depending on their learning behavior or learning culture. For example, learners may prefer to do one or more of the following as part of their learning process: take pictures, record videos, write notes, or create their own artifacts, such as blogs and e-portfolios. Due to the variety of available media, students can learn in different ways based on their preferred learning styles. Thus, it is essential to understand the context of use of mobile technology to facilitate students' learning as a key factor for designing a mobile learning model. Moreover, personal mobile technologies, such as handheld media devices, tablets, and smart phones tend to change quickly. This has consequences for the researchers of mobile learning who must deal with such uncertainties. Therefore, research design and methodology should be flexible and allow research practice to adapt to the need of learners.

Users and technologies are significant elements of the mobile learning system (See Figure 1). To obtain the greatest advantage from mobile learning, it is important to understand both external factors (e.g., competition, technology shifts) and internal factors (e.g., learning preferences, pedagogical approaches). For example, Williams (2009) only uses an internal factor. By measuring the performance of participants, he finds that mobile learning is less effective than face-to-face learning. However, this study investigates only Mode of Delivery (MOD) as the factor that influences the acceptance and use of mobile learning. Williams considers only mobile learning and compares it with face-to-face learning, but it would be more useful to study a blended learning approach in which mobile technologies supplement learning activities in traditional classroom settings.

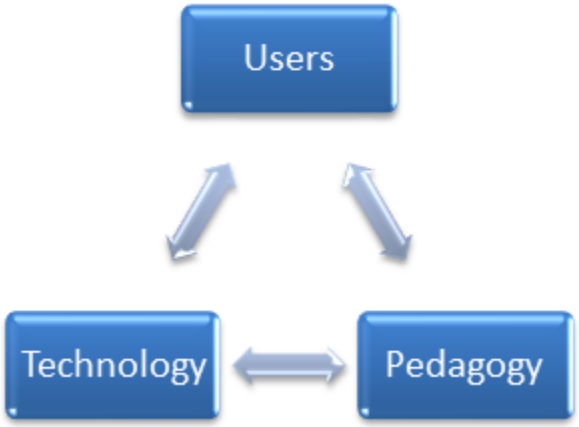

Figure 1. Significant elements of a mobile learning system

In addition, there are some other factors that need to be considered for teaching and learning. Fisher (2006) asserts that teachers and students can benefit from playful, active, and experiential learning wherein the opportunity to construct, enact, and revise their learning paths is settled. However, a performance-driven culture affects teachers and students, and their organization of teaching and learning. Therefore, culture should be considered as another major factor, which may have an effect on learning performance in the mobile learning environment.

Theoretical Framework

The theoretical foundations of mobile learning can be described in pedagogical and theoretical perspectives. This section discusses how various theories of learning and forms of pedagogy are involved with technologies. According to Dabbagh (2006), a range of learning literature, developed in the "Instructional Design Knowledge Base," is classified into three main schools of thought: behaviorism, cognitivism, and constructivism. Fundamentally, the major difference among these three concepts resides in how different people learn (Leidner & Jarvenpaa, 1995). Skinner (1963) describes behaviorism as a learning theory that only focuses on observable behaviors and discounts any independent activities of the mind. Behavior theorists define learning as the acquisition of new behaviors based on environmental conditions. On the other hand, cognitivism is a part of learning theories that are based on an information processing theory which deals with how people perceive, learn, remember, and think about information (Norman, 1980). This theory focuses on processing rather than behavior. The third theoretical

perspective is constructivism. Piaget (1973) asserts that people construct their own understanding and generate their own rules and mental models from their experience. Learning is simply the process of adjusting the mental models to accommodate new experiences.

All three theories have different assumptions about knowledge states and focus on different learning outcomes (Mowrer and Klein, 2001). Accordingly, an examination of these perspectives in the design of a mobile learning environment is important for gaining an inclusive understanding of the learning process. Drawing from the last school of thought, focusing on constructivism in the theories of learning, this mobile learning model is grounded in two theoretical frameworks: 1) Social constructivist theory, and 2) Activity theory.

1-Social Constructivist Theory

Social constructivism extends constructivism by including the role of other actors and culture in development into an active social process (Dewey, 1916; Vygotsky, 1978). In this sense, social constructivism considers the learner as an individual who is dynamically involved in collaborative learning (Vygotsky, 1978), and it also focuses on interaction over observation. The principle of this theory is that humans generate new knowledge from interactions between their ideas and experiences. Additionally, studies on motivation and increased use of student discussion in the classroom are grounded in the theories of social constructivism (Sivan, 1986; Alavi, 1994; Anderson et al., 2007). There are a variety of advantages that result from the implementation of discussion in the classroom. Participation in group discussion allows students to generalize and transfer their knowledge of classroom learning and build a strong foundation for communicating ideas (Reznitskaya et al., 2007).

An instructional strategy grounded in social constructivist theory is computer-supported collaborative learning (Alavi, 1994). This strategy gives students opportunities to practice 21st century skills in communication, knowledge sharing, critical thinking, and the use of relevant technologies in the classroom setting. For example, students can participate in online discussion forums. Teachers can use content management systems to collaborate with students to share resources and give feedback. Learning collaboration can also be enhanced through using wikis and blogs.

Mobile learning proposes new ways to extend schooling outside the classroom and into the interactions and communications of everyday life. Thus, in a mobile learning environment, a teacher can conduct class by allowing students to apply new information and experiences to their existing knowledge through conversation and collaboration with their classmates. Students can gain new knowledge from both formal and informal learning processes based on their learning style and learning culture (See Figure 2).

DOI: 10.5642/lux.201301.23

Figure 2. Social Constructivist Learning

2 Activity Theory

Activity theory is a paradigm by Vygotsky (1978) and his co-founder, Leont'ev (1978), originating from cultural and historical psychology. It provides a method of understanding and analyzing a phenomenon, and describing and presenting phenomena using a common language that is beyond individual or group preferences (Nardi, 1996). Additionally, activity theory focuses on understanding human activities and work practices as complex, socially situated phenomena and goes beyond paradigms of cognition, psychoanalysis, and behaviorism (Vygotsky, 1978).

Activity theory focuses activities as the unit of analysis (Vygotsky, 1978). An activity is viewed as a goal-directed or purposeful interaction of a subject with an object, mediated by a tool/artifact, then, transforming it into an outcome (Vygotsky, 1978). Furthermore, Engestrom (1987) identifies that an activity is mediated by an organization or community. The community may impose rules that affect activity. The subject works as part of the community to achieve the object. An activity normally also features a division of labor (Vygotsky, 1978; Engestrom, 1987) (See Figure 3).

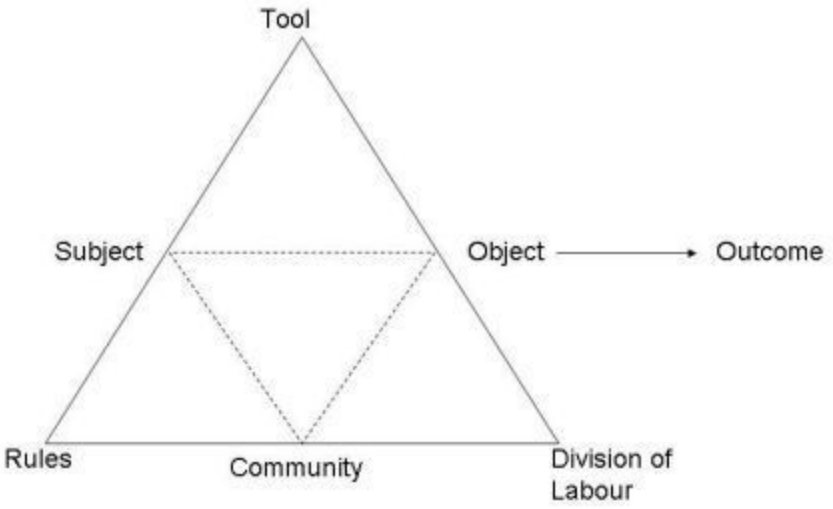

Figure 3. Activity theory (Vygotsky, 1978; Engestrom, 1987)

In the activity system according to Uden (2007), a subject can be an individual or a group, who is really an important actor to perform a particular activity. An object can be a material thing, which is either tangible or intangible. For example, a student (subject) learns about a particular problem (object) by using a mobile device, textbooks, and internet (tools) to complete her assignment (outcome). In this case, this student may be assigned to work in a group (rule) in which the success of her assignment can be influenced by her team/classmates (community) and the relationship between teacher and students in the classroom environment (division of labor).

The principles and components of activity theory have been used as analytical tools for many different areas; including human-computer interaction (Kuutti, 1996), interface design (Bodker, 1990), and education (Engestrom, 1987). Using activity theory in an educational setting provides several benefits for the classroom community. Students can use mobile technology as a tool to support their learning activities in order to reach their goals. Therefore, activity theory plays a vital role in designing a mobile learning model and in understanding a mobile learning environment. Designing learning based on activity theory is more appropriate for a student-centered approach which allows learners to fully participate in learning activities (Gifford and Enyedy, 1999). However, it may not be suited for a teacher-centered approach, in which teachers have a major role in conducting classes.

Activity theory provides a powerful channel for developing mobile learning for many reasons. First, it can be used as a lens to analyze learning processes and outcomes for the design of mobile learning. Second, it imparts the design of context-aware applications that is essential for mobile technologies. The theory helps structure analysis of the entire system focused on the activities (Nardi, 1996). As a result, using activity theory enables researchers to more deeply understand the context of use when designing a mobile learning model. Thus, it is important for researcher to determine whether a mobile learning platform (model/artifact) will be adopted. Both social constructivist theory and activity theory will be used as a basis for developing a new mobile learning model. Such a model can potentially explain all important factors that affect

DOI: 10.5642/lux.201301.23

students' learning outcomes when they utilize their mobile devices in learning. The effectiveness of the model will be evaluated based on its adoption.

Designing a Mobile Learning Model

There are a number of studies regarding mobile learning that disclose the impact of mobile learning adoption and implementation in the information age (Sharples et al., 2010; Faux et al., 2006; Fisher, 2006). Successfully building mobile learning applications depends on the subjects, learners, levels of learning, and contexts in which they are being used. Some studies of mobile learning indicate that it can offer convenience and increased information access (Ragus, 2006). In addition, Facer, Faux, and McFarlane (2005) argue that, although there are a number of mobile learning initiatives in the United Kingdom (UK), an underlying principle for the use of mobile devices in education has yet to be articulated. A limited number of research reports focus on the effectiveness of mobile learning in higher education (Milrad and Jackson, 2008; Whittlestone et al., 2008). This paper will propose a design of mobile learning model to support teachers or instructional designers to create educational values and provide students with a quality in mobile learning environment.

Kakihara and Sorensen's (2002) study explains that context is a central construct of mobile learning. The context is created by people in interaction with other people, with their surroundings and with everyday tools. Traditional classroom learning is founded as a stable context, by setting up a fixed location with common resources, a single teacher, and an agreed upon curriculum. Mobile learning removes all these things and enhances the interrelated aspects of mobility. The mobility helps students to expand learning space from formal learning taken in the classroom to informal learning taken in the workplaces they prefer. The "mobile" in mobile learning can be defined as both the mobility of learners and mobility of technology (Kakihara and Sorensen, 2002). Thus, mobile learning can occur while people on the move utilize mobile devices to facilitate informal learning during the gaps of daily life. Also, mobile learning means gaining knowledge from portable tools and resources that are available in a handy lightweight device.

A central undertaking in the design of technology for mobile learning is to promote enriched conversations within and across contexts. The mobile technologies are directly support conversation between teachers and students, and also provide communication channels among classmates. Moreover, the design of technology involves understanding how to select technologies and interactions to support seamless learning across contexts, and how to integrate mobile technologies within education to empower innovative practices. A proposed mobile learning model is described in Figure 4.

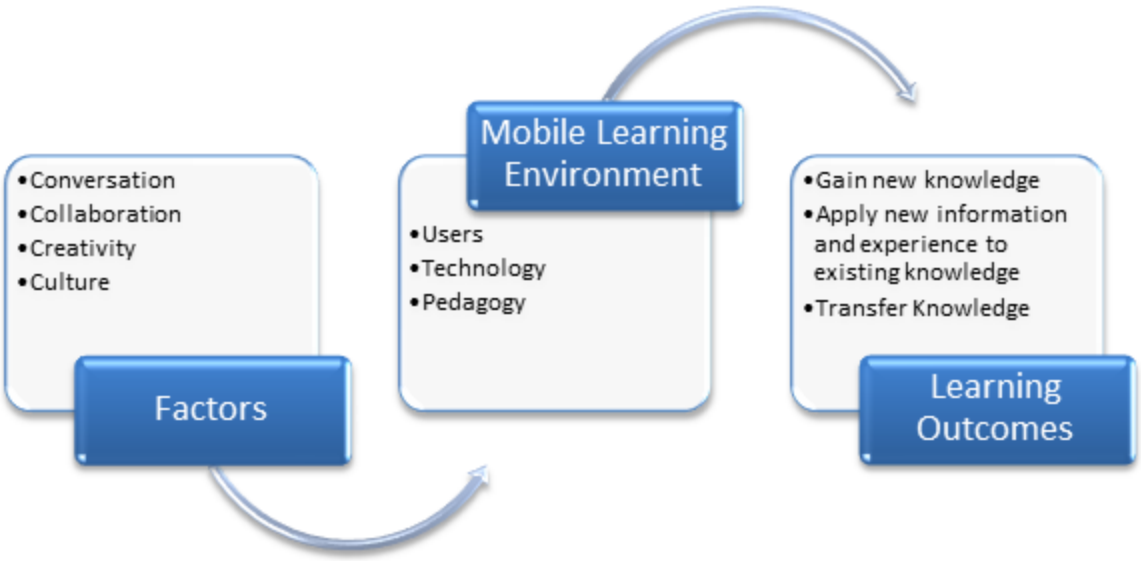

Figure 4. A proposed mobile learning model

Naismith and Corlett (2006) explore the success of mobile learning research, based on the mobile learning (mLearn) conference series during 2002-2005. They suggest that an effective design of mobile learning applications needs to: (1) create quick and simple interactions that can help the learner in responding to information in a timely manner, (2) prepare flexible materials that can be accessed across contexts and serve an individual's learning needs, (3) consider special capabilities of mobile devices that might add to the learner's experience, such as the use of audio and user anonymity, and (4) use mobile technology to facilitate learning, especially making use of the features in current mobile devices for voice communication, note-taking, photography, and time management Furthermore, Naismith and Corlett (2006) pinpoint five critical success factors for mobile learning projects. These important factors are access to technology, connectivity, integration, ownership, and institutional support. A description of each success factor follows:

- Access to technology: making mobile technology available where and when it is needed
- Connectivity: using mobile devices to connect to wireless networks, e.g., 3G, 4G, Wi-Fi, Bluetooth, and Personal Hotspots, to provide access to learning resources, and to allow students to capture material and to share it with others
- Integration: integrating mobile learning projects into the curriculum, the student experience, and daily life
- Ownership: owning the technology, or having ability to use or upgrade it anytime
- Institutional support: designing relevant resources in a mobile format, training staff and providing technical support and maintenance

The critical success factors mentioned above are significant for mobile learning environments. With regard to students' learning needs, it is necessary to provide open access to gigabytes of information in the mobile age. Thus, students can use appropriate mobile devices

DOI: 10.5642/lux.201301.23

for learning purposes in a blended learning environment, by using mobile learning as an addition with classroom sessions.

Discussion and Recommendation

A new mobile learning success model would be built based on two research theories: social constructivist theory and activity theory. There may be other theories that might be integrated in this research, such as socio-technical theory and the technology acceptance model (TAM). According to the socio-technical theory (Bostrom & Heinen, 1977), researchers propose that the achieved design system should aim to the joint optimization of the technical subsystem and social subsystem. Both the devices and tools of technical subsystem and the employee's skills and attitudes of social subsystem are critical factors of the organization. As a result, the design of mobile learning system needs to consider that all the subsystems are working in harmony. As well as the TAM, Davis (1989) suggests that perceived usefulness and perceived ease of use can determine an individual's intention to use a system. When users discover that the mobile learning system is useful and easy to use, they will feel more comfortable to use it. Ultimately, the intention to use the mobile learning system would lead to better students' learning outcomes.

The new model supported by this theoretical framework includes the impact factor "culture" and other aspects of using mobile learning in higher education. Culture difference is also an important factor as well as motivation, collaboration, and communication. As the mobile learning market becomes gradually global, understanding cultural difference and educational values could provide a significant competitive edge for universities or training organizations. Johari, Bentley, Tinney, and Chia (2005) recommend a new intercultural standard for creating the instructional of a course in which designers and learners can clearly convey the educational values to each other. These educational values are mainly influenced by (1) cultural norms, (2) the philosophy of learning, and (3) personal preferences for learning (Hofstede, 1986). When instructors know they will have intercultural students in their classes, they should create materials that are culturally neutral. This requires use of an easier sentence structure and avoiding slang and colloquialisms. Also, students who take intercultural courses should have an open mind to try new things and embrace new learning habits and adapt to them.

In this new mobile learning model, learning outcomes would be measured by assessing the quality of the new model, and analyzing learners' satisfaction. The satisfaction of learners can be measured by surveying learner attitudes towards the mobile technology and observing the enjoyment of mobile learning experiences. Consequently, this new mobile learning model will describe how students use mobile devices for their learning purposes in a blended learning environment. Although potential disadvantages exist in mobile learning devices, including small screens, limited storage capacities, and short battery life, these drawbacks are outweighed by the advantages that mobile learning can provide to three groups of users: individual students, faculty, and university administrators. If mobile learning allows students to easily access to information, then it will bring value to their learning experience. Additionally, results from research may assist faculty in designing their courses to use mobile learning to help students meet their learning objectives. Furthermore, research findings may enable university administrators to make effective decisions regarding the role of mobile learning, and also provide end-user training to motivate students to use mobile learning for their efficient learning outcomes.

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