

# Mobile Learning: A New Paradigm in Electronic Learning

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## Abstract

*As mobile phone becomes popular in the society and many people can afford the cost, the demand of mobility is extended to teaching and learning purposes. One recent and significant change in learning environment is the demand of mobility. This paper will introduce a proposed framework of mobile learning. It consists of four functional levels: (1) mobile learning applications, (2) mobile user infrastructure, (3) mobile protocol and (4) mobile network infrastructure. The framework can simplify the design and development so that different parties (e.g. vendors, service providers, designers, developers) can address individual levels. A single party can build on the top of the functionalities provided by others. The functions of these four levels will be described with some examples. Moreover, practically knowledge management and learning community are two major issues in the mobile learning. In fact, they are the two states of changes in the learning paradigm, and will be discussed in the paper.*

## 1: Introduction

When wireless and mobile networks are developing, mobile learning follows soon. How must wireless technologies change to support this learning style? Electronic learning continues to grow phenomenally but most e-learning development involves wired infrastructures. It is believed that emerging wireless and mobile networks will provide new applications in mobile learning [2].

It is estimated the total number of mobile phone users worldwide is over 300 million, double the number of Internet users [5]. One of the recent and significant changes in learning environment is the demand of mobility. Mobile phone becomes popular in the society and most of the people can afford the cost. In addition, the exponential growth of wireless and mobile networks has brought vast changes in mobile devices, protocol development, standardization and network implementation, and user acceptance.

Mobile learning is primarily delivered over the wireless network. It can adapt quickly to meet changing

learning needs. It is possible for learners to find and learn what they want to at a pace and place that suit them. Mobile learners can collaborate with instructors and other learners so as to learn better. Mobile learning can deliver learning materials in multimedia formats in a fast and cost-effective way to teach learners in need.

## 2: Mobile learning framework

It is predicted the next phase of electronic learning development will be focused in mobile learning. Mobile learning is the point at which mobile computing and electronic learning intersect to produce an anytime, anywhere learning experience. The following is the proposed framework for mobile learning.

Mobile learning applications
Mobile user infrastructure (browser, handheld devices)
Mobile protocol (adoption of content with WAP)
Mobile network infrastructure (cellular systems, satellites, etc)

Figure 1. Mobile learning framework

This framework for mobile learning defines several functional levels, simplifying the design and development so that different parties (e.g. vendors, providers, designers) can address individual levels. By using this framework, a single entity is not forced to do everything to build mobile learning systems, but can build on the top of the functionalities provided by others. The framework is divided into four levels. In the mobile learning applications level, many new applications are becoming possible, and many existing electronic learning applications can be modified for a mobile environment. In the mobile user infrastructure level, the design of new mobile learning applications should consider the capabilities of the user mobile devices. In the mobile protocol level, the aim is to hide the underlying network's details from applications while providing a uniform and easy-to-use interface. In the mobile network infrastructure level, service quality primarily depends on network resources and capabilities. These four levels will be described in the following paragraphs in details.

## 2.1: Level 1 – Mobile learning applications

With an unlimited number of potential mobile learning applications, of particular interest are mobile learning activity management and proactive learning management. There are many types of learning activities outside classroom. For example, students may visit museums to observe some artifacts or collect some specimens in the field trip. Mobile learning activity management can track the location of a student and evaluate the needs of the student in a particular situation so that it is possible to arrange course material delivery accordingly, thus improving and enhancing the student's learning purposes [4].

For example, when a student is collecting an unknown specimen outdoor, the student may need certain information for help. The relevant information may be downloaded through the mobile device. In addition, the student can obtain just-in-time delivery about the weather and traffic when the student is moving from spot to spot during the field trip. Mobile learning activity management's success depends on cost, wireless infrastructure reliability, and learners' level of comfort with the new technology.

The system helps learners to learn without the involvement of another person. In the mobile learning environment, learners experience in the real application that guides the user through a series of actions that help them complete learning tasks. Examples include knowledge-based databases used to troubleshoot typical learning problems, and study-flow maps that guide routine actions. The system provides performance support on demand, and supplies the steps required to accomplish a learning task.

With proactive learning management, applications collect information on learners' needs and then signal the learning system to provide information and knowledge. It is believed that customization controlled by the instructor can improve the effectiveness of communication [6]. An instructor can customize the teaching content to the learner. This can be accomplished by collecting information about the learner when he is accessing and interacting the mobile devices. The programming can initiate a dialogue to ask questions and the learner responds. It can be used real-time to customize the form and content of the communication. It can highlight particular aspects of the teaching content that would be interesting to the learner given his goals and interests.

For example, an application may collect information on what students have done in a field trip. After the field trip, the students can be instructed to perform some activities, based on such information. Instructors can use this kind of information to better manage lecture contents in the future. Such detailed information lets them target the curriculum to learners who may need a particular kind of skills and knowledge in the coming lessons.

## 2.2: Level 2 – Mobile user infrastructure

Mobile devices and wireless networks can provide texts, video on demand, and information services. Learners would require such technology as appropriate mobile devices, and high-bandwidth wireless networks. Connectivity is important because disconnection caused by handovers seriously affect the quality of information services. Learners require several functional components to realize these applications. First of all, a mobile device with sufficient memory, an appropriate display, and communications functionalities is necessary. The personal digital assistant (PDA) with a wireless modem, and a mobile phone with computing functions can be used. These devices are designed for either communication or computing. In the near future, these functions should be combined into intelligent mobile devices.

When these devices gain more functions and improve in storage and processing power, an operating system to manage resources is required. A general-purpose operating system is not suitable for these devices because of the real-time requirements, processing power, limited memory, and small screen size. An operating system with a small footprint and reduced storage requirements is necessary. Now many operating systems vendors have attracted developers of applications for handheld and smaller devices (e.g. Microsoft Windows CE, Pocket PC, Symbian, Palm OS, etc) [1].

## 2.3: Level 3 – Mobile protocol

Mobile protocol connects different applications, tools, networks, and technologies to provide a common user interface. Achieving application independence from device and wireless technologies is important. Protocol is a layer for connecting mobile learning applications with different mobile networks and operating systems without noticing mobility awareness. It adjusts to fluctuation in bandwidth and resulting delays, and changes in learner location in the applications. It can give applications better response times and reliability. The typical optimization techniques include header compression, delayed acknowledgments, and concatenation of several smaller packets into one to reduce wireless network traffic.

The World Wide Web Consortium (W3C) specifications and the WAP specifications can enable a wide range of mobile networking applications. WAP uses a common set of applications and protocols and it can facilitate interoperability among different wireless networks, devices, and applications. A microbrowser as the client software can supports text, graphics, and standard Web content. In addition, in the future, Web content should be accessible from PCs, to TVs, to PDAs, to cellular phones. Therefore, the W3C has developed several extensions of existing Internet standards so that mobile devices can fully access the Web. The Extensible Markup Language (XML) is applied for richer semantic information. The improved cascading style sheets and Extensible Stylesheet Language can further separate

content from presentation. It is a document object model defining a language-independent API that applications can use to access and modify HTML, XML and WML documents' structure, content, and style.

## 2.4: Level 4 – Mobile networking infrastructure

Other than mobile devices and protocols, mobile learning applications should depend on networking support. Transmission rate and coverage are the two most important factors. Because many mobile learning applications require small messages, they may use the short messaging service of the European GSM or other networks. Developers are now standardizing the third generation of wireless networks that can support a bandwidth of several megabits/second [10]. Another important factor is multicasting support in which communications among a selected group of learners is necessary for group-oriented applications such as discussion. Wireless and mobile networks should consider support for multicasting [11]. In general, mobile learning requires wireless quality of service that affects the performance of mobile learning applications in terms of delay, loss, and other quality attributes. Location management is also required and it is an integral part of many mobile learning applications especially those involving location or learner searches. Furthermore, reliable and survivable wireless networks are necessary. Learners can access mobile learning applications, even under varying degrees of network failure. Finally, roaming across multiple heterogeneous networks can allow learners to access mobile learning applications from anywhere, even when the coverage of a single wireless network is spotty.

## 3: Knowledge management and learning community

Mobile learning is proving to be increasingly useful and powerful, pushing and inspiring developments for the Web and mobile networks. These areas include content, information, and knowledge management; community building; publishing and journalism; teaching, learning, and collaboration; and course management systems. Mobile learning has the following characteristics.

- Mobile learning is dynamic. It is today's content not old news. On-line experts and best sources for emergencies are available.
- Mobile learning operates in real time. Learners get what they need, when they need it.
- Mobile learning is collaborative. Because people learn from one another. It connects learners with experts, colleagues, and professional peers.
- Mobile learning is individual. Every learner selects activities from a personal menu of learning opportunities most relevant to his/her background at that very moment.
- Mobile learning is comprehensive. It provides learning events from many sources, enabling learners to select a favored format or learning method or

training provider.

- Mobile learning builds learning communities whose members forge.

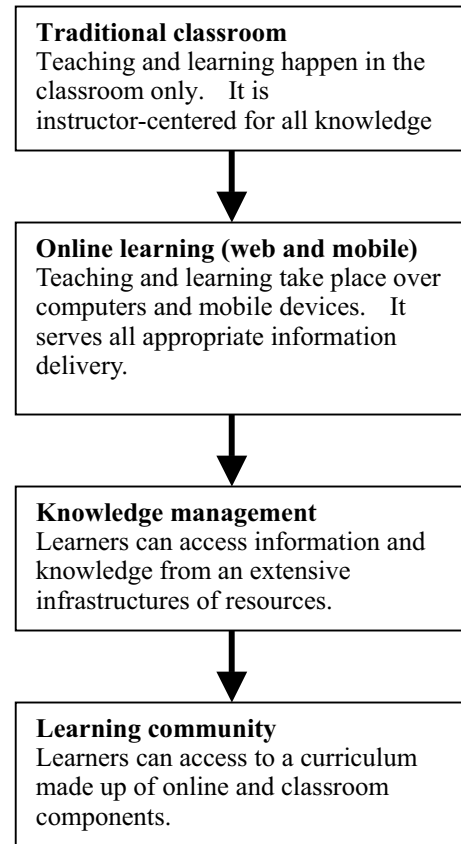


Figure 2. The change of learning paradigms

The power of mobile learning is its ability to immediately put form to thought. You can get ideas of others and in seconds share it with the world. You get feedback, refinement, stories, and so forth. Also, mobile learners are easily linked and cross-linked to form learning communities. Innovative teachers can encourage students to maintain class and personal mobile web sites. Enthusiasm grows as learners take ownership of the content. They write, edit, review, and publish content. Teachers make articles available to read on the wireless networks. In the future, learners may learn by assembling personal digital portfolios.

All learning is social. In the past, people learnt what works by conversing with one another informally. Mobile learning gives learners freedom, unstructured time, and encouragement to learn this way. Learning styles and multiple intelligences are given. Howard Gardner [3] says that differences in learning style "challenge an educational system that assumes that everyone can learn the same materials in the same way." Mobile learning does not determine the right method to present this particular lesson to this individual. But it does increase the chances of success by providing multiple paths for learning. Its credo is learner-focus, learner-centric, and learner

obsession.

Has technology changed anything about teaching and learning? (see figure 2) When computer was used for education, in one form or another, for more than 30 years, the trend was to reproduce a classroom online. There are virtual or online lessons, modules and quizzes. In fact, most innovations imitate the approaches they replace. However, most kinds of computer-based training (CBT) were an afterthought of traditional teaching and learning. In the past, there were technical problems in incompatibility issues. For example, you have a piece learning software that does not suit your purpose and work with facilities. But it does not stop the hype, which was almost always followed by disappointment.

The introduction of the information technologies including Internet and wireless networks creates a common, user-friendly, and universally accessible platform that gets rid of compatibility issues virtually. Web learning and mobile learning should not only focus on providing access to information and expertise. The instructor-centric model is being replaced by a learner-centric view and it extends beyond just classroom and online learning to embrace a far richer architecture of online resources. In fact, when we focus on the organization of information, and when we use tools (mobile learning and web sites) to make this knowledge accessible, we are dealing with knowledge management.

Knowledge management includes the capability to collect, archive, manage, evaluate, and distribute information across the learning community. It uses technology but depends mainly on human interaction to succeed. When a learner is searching for some information or knowledge, there is a central human component. It is the need to know something. Now, mobile learning technologies for searching, document management, and collaboration are creating knowledge networks across learners in the learning community.

In a learning community, learners have a pragmatic approach and they like to learn what they need for completing certain tasks. Each learner has a personal style or set of preferences and learn at his/her own pace. Not everyone learns in the same way. Their interest in learning new things varies widely. They want to be in charge of their learning rather than yielding to an instructor. Transfer of learning in a learning community is largely a function of the quality and strength of personal relationships.

We should provide ways for learners to find each other and communicate on a regular basis. We learn from one another more often than we do from any other source, and that will never change. Mobile learning extends the reach of teaching and learning beyond the physical limitations of classroom and instructional resources. Knowledge management brings instantaneous and real-time information and expertise to everyone, everywhere. Together, they define mobile learning in ways that make it more acceptable and more a part of learning culture than an adjunct to it. It is the key to the success of mobile learning.

In the mobile learning community, when a learner needs information, the learner can get it by working with others. From this perspective, learning is less about taking in new information than it is about connecting with people who help put that information in context and suggest new ways of understanding it. This social aspect is central to the way people learn in the mobile learning community. In fact, it is the central feature of a learning culture.

The success lies in the community in which people share their experiences. People learn and adjust their approaches not just by getting facts but by getting relevant information from others. If we attempt to substitute technology for community, it will cause isolation of the very human system that will accelerate their learning. The myriad technologies can enhance our learning, but in a culture that does not allow people to learn in context, technology adds nothing. Technology cannot completely replace a learning culture. It is only a tool to use in the community of learning. The use of technology does not stimulate more learning, but it does reflect how active a learning culture might be. In this way, mobile learning technology is a mirror of an organization's culture with regard to learning, not a stimulus for reshaping it.

Electronic communication has brought on a shift from the *place-based community* to an *online learning community* where new online personas and identities have emerged. It is likely that more time is spent processing information internally rather than interacting in face-to-face settings. However, without face-to-face interaction, how does community building occur in online groups? Is it possible to build a community without it? How can the foundation of community that is premised on ideals like ethics, goals, liabilities and social norms be laid when we cannot see each other? The absence of mutual support and group participation can stifle online learning. However, by taking simple humanistic approaches such as discovering common interests, discussing personal issues, and exhibiting flexibility on the part of instructors, a more effective online learning experience will subsequently emerge. It will lead to a stronger and more vital mobile learning community.

#### 4: Conclusion

The logic for mobile learning is compelling. Change is constant and there is an ongoing need to keep learners educated and up to date. People tend to be focused on constantly improving their skills, so an environment with a comprehensive mobile learning programme is attractive to them. The cost-effectiveness of mobile learning is also important. Traditional classroom-based learning has a high cost in getting people to and from venues, much of which mobile learning cuts out [7 and 8]. Mobile learning is seen as more accountable and measurable because it gets the right training to the right people as quickly as possible, and measures the results to ensure it is achieving its goals.

However, it is shortsighted to think mobile learning will substitute traditional classroom-based learning. In the traditional classroom, people can get to know each other and develop contacts. Mobile communication has brought on a shift from the place-fixed learning environment to a mobile one. Because more time is spent processing information internally rather than interacting in face-to-face settings, this medium naturally suits more introverted people. However, without face-to-face interaction and mentoring, mobile learning can become very dry [9]. Learners need to access instructors and other learners to ask questions and receive guidance. An ideal medium requires to be achieved: learners can do parts of a course through mobile learning but come together in a classroom environment at strategic points.

The best mobile learning systems should use both instructional and informational approaches. We should focus on information as well as instruction, and look for opportunities to incorporate a knowledge management perspective. Technology is a critical enabler of mobile learning, but main challenges are more likely to be in content, strategy, and transformational change. At the end of the day, learning is a people-to-people activity. It helps people find the expertise they need, when they need it.

Traditional classrooms should not be replaced by mobile learning. Development of new skills and approaches will be required to maximize the pedagogical effectiveness of mobile learning. Knowledge is the most serious resource for future social and economic development. Online education (including mobile learning) is an answer to solving some problems of education today. It is empowering tools for the new generation of learners who can help themselves to navigate the growing complexities of our knowledge society.

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