

# Mobile What? The Educational Potential of Mobile Technologies.

Thomas Fox McManus, Ph.D.  
Assistant Professor of Educational Technology  
Saginaw Valley State University  
7600 Bay Rd.  
University Center MI, 48710  
(517)790-4060  
[mcmanus@svsu.edu](mailto:mcmanus@svsu.edu)  
<http://www.svsu.edu/~mcmanus>

**Abstract:** Each new technology brings with it a certain potential for teaching and learning. This potential is based, in part, on the unique characteristics and capabilities of the technology. What can a learner or instructor do with the technology that they cannot do as well with any other? The advent of mobile technologies has sparked a trend, occasionally called m-Learning, or Mobile Learning, which is being touted as the next thing in learning. In this article we present a picture of what mobile technologies and environments may look like in the next few years. We examine the theoretical implications of mobility and ubiquity, the primary characteristics that separate these mobile technologies from other learning technologies. And we discuss the search for a pedagogical model for the creation of collaborative mobile learning environments.

## What is Mobile Learning?

Mobile learning is effectively a sub-category of the larger concept of e-Learning. According to Clark Quinn mobile learning is “the intersection of mobile computing and e-learning: accessible resources wherever you are, strong search capabilities, rich interaction, powerful support for effective learning, and performance-based assessment – e-learning independent of location in time and space” (Quinn, 2000). The difference between e-learning and m-learning is an addition of capabilities and limitations, more evolutionary than revolutionary. Briefly defined, mobile learning is the combination of mobile technologies and appropriate pedagogy to allow learners to interact with learning environments, and other learners, at any time from any location. To expand upon this definition, it is first necessary to describe the sorts of technologies and pedagogies used.

## Mobile Technologies

Mobile technologies include any system or device that allows a learner to access information or to communicate without the limitations of power cables or network wires. The term could encompass such technologies as radios, portable cassette players, calculators, dictation devices, or alphanumeric pagers. In most cases though, at the current time, the term mobile technologies usually refers to one or more of wirelessly networked laptops, WAP enabled mobile phones, or handheld computers. Future developments of mobile technologies are likely to include convergence, or the combination of several functions in to a single device, eventually leading to a pervasive or ubiquitous computing environment.

Wireless networking, which allows computers and peripherals to share data without being in physical contact, uses electromagnetic airwaves (radio and infrared) to communicate information from one point to another (WLANA, 2001), is becoming more common in educational settings. Handheld Computers are another new technology that is beginning to be seen in educational settings. Handheld computers, sometimes referred to as Personal Digital Assistants (PDAs), are small devices designed to fit in one’s hand or pocket. While many companies produce these devices, there are three widely used operating systems (OS) which act as almost generic names; the Palm OS, the PocketPC (formerly WindowsCE) OS, and the EPOC OS. While most handhelds are capable of interfacing with a desktop computer through a synchronization cradle, many of the newer handhelds are being offered with built-in or add-on wireless connectivity. This allows them to connect to the Internet at anytime, greatly enhancing their utility as an educational tool. Mobile phones, and their attendant technologies such as WAP (Wireless Application Protocol, SMS (Short Messaging Service), and mobile Internet connectivity are the other class of mobile technologies that are being used in learning environments. The next generation of messaging services,

MMS (Multimedia Messaging Service) will extend the capabilities of these devices by adding media to the messages. This system has yet to be proven in wide scale use.

### **The Future of Mobile Technology**

The current trend towards a single device being capable of handling multiple functions and media types is called convergence. This trend is already visible in the recent release of smartphones such as the Nokia Communicator ([www.nokia.com](http://www.nokia.com)) or the Handspring Treo ([www.handspring.com](http://www.handspring.com)), which combine the functionality of mobile phones, WAP, and SMS with the data processing capability of an Internet connected handheld computer. The idea behind convergence is that phone, computer, audio, video, and Internet can all be combined into one easily portable device. The prototype CyPhone, developed at Finland's University of Oulu (<http://www.ee.oulu.fi/projects/CyPhone/>), is just one example of such a device. Many futurists predict an era of what is called "ubiquitous computing" where computers are everywhere, in everything, constantly interacting in the larger digital world. Computer will cease to be discrete devices, their capabilities being integrated into most technologies. Ubiquitous computing means a fundamentally different way of interacting with the tools and appliances of our daily lives; and of their interacting with each other (Burbules, 2000). In educational terms this has the potential for tremendous impact. As students become more accustomed to this digital world they will expect, and demand, to see it reflected in the schools.

### **Unique Characteristics of Mobile Technology**

In discussing the merits and capabilities of any technology for use in education it is essential to determine its unique characteristics (Kozma, 1991). The unique characteristics of mobile technologies differ with each type of technology you examine. For instance wireless laptops, PDAs, and mobile phones all have significantly different processor, input, and display capabilities. But they also have certain things in common. The most notable of these, and most important for mobile learning, is their mobility.

This begs the question of what characteristics of mobility may have some effect on learning or teaching. The UniWAP Project (UniWAP, 2002) is looking at the added value of mobility in higher education. They have described three aspects of mobility that impact education: convenience, expediency, and immediacy. Convenience, in their work, deals with the fact that mobile technologies allow a person to engage in educational activities from anywhere they happen to be, even while moving. They point out that while this characteristic seems to have little pedagogical relevance, it does effect how the technology is used. Expediency describes the capability of a learner or teacher to be mobile in some particular place or context that is relevant to the content being studied or taught. Immediacy describes the capability of mobile technologies to allow us to access learning environments or to engage in learning activities at any time, from anyplace, not just when we are sitting at a desk bound computer.

There are other characteristics that can be used to describe mobile learning technologies. Elliot Solloway of the HI-CE project ([www.hi-ce.org](http://www.hi-ce.org)) often touts the affordability of inexpensive handheld computer, as compared to laptops, or desktop systems currently used in K12 schools. He asks what it means for schools when every student has access to computing technology in the learning environment. While this is a good point it is not always true. At the time of writing, it is possible to buy a handheld computer for under \$200, well under the cost of any other computer system with the equivalent versatility. But the more capable devices, those with wireless access and multimedia capabilities can cost more than \$600. While still cheaper than even the low-end laptops, this price is equivalent to that of a low-end desktop computer. Perhaps the most intriguing characteristic of mobile technologies is the current trend towards ubiquity. The idea of a person having constant access to a computing device has several theoretical implications.

### **Mobile Pedagogy**

When looking at the use of mobile technologies for learning it is important to determine a pedagogical paradigm that suits the characteristics and capabilities of the technology and the content. The use of modern technologies in education has always allowed the learner to place a certain amount of the cognitive load onto the computer (Scardamalia, Bereiter, Brett, Burtis, Calhoun, & Lea, 1992). Spreadsheets, for example, allow students and scholars to concentrate their limited cognitive resources on drawing conclusions from data rather than spending the cognitive energy performing complex statistical calculations. New wireless and handheld technologies have the potential to increase this effect many times. What will it mean when a

learner, whether in a classroom or in the field, has access to the near unlimited information of the Internet, voice and data connections to any number of experts or collaborators, and the data storage and processing power of a modern mainframe; all in the palm of her hand? What will the “effects with” such a technology be? How can we, as educators, design learning environments to take full advantage of these synergistic effects? Distributed Cognition, Situated Learning, and Cognitive Apprenticeship are some of the learning models that researchers are looking at as the basis for a mobile and ubiquitous pedagogy.

Distributed Cognition (Salomon, 1993) looks at the interaction of learners with each other and with the technology itself. Distributed Cognition emphasizes how cognitive efforts are distributed across not only artifacts and internal and external representations, but across individuals and groups as well. In doing so, it dissolves the traditional divisions between the inside/outside boundary of the individual, the technology, and the group. If a learner always has a mobile learning device with him or her, the learner and the device begin to interact, in essence becoming more than the sum of their parts as the learner offloads some of the cognitive effort onto the device, enabling the learner to free up more cognitive resources for learning. If the same device enables the learner to keep in touch with a larger community of learners then the cognition can be distributed over the entire community, as well as their devices, allowing for larger scale social construction of knowledge.

Situated Learning theory (Cognition and Technology Group at Vanderbilt, 1993) is based on the idea that learning that takes place in an authentic context is more likely to transfer than learning that happens in an artificial environment. The Cognitive Apprenticeship model (Järvelä, 1996) is also stresses the idea of situating learning in a realistic context. This means creating learning environments that either mimic the authentic environment where the skills and information learned will be used, or creating a learning environment that actual incorporates the authentic environment. Technology allows for either of these goals to meet more easily. Because mobility allows for learners to go to the authentic environments for their learning, it may be possible to design mobile learning environments that follow the tenets of Situated Learning theory and the Cognitive Apprenticeship model to help support the students’ learning. This could lead to the development of location or context dependent learning. That is learning that is greatly enhanced when it happens in a particular location or context. Imagine scientific field work or visits to historical landmarks as the context and think of how a mobile device could allow learners to access pertinent information, remediation, evaluation, or suggested further study as the learner comes in proximity to a location.

### **Research Findings**

Most published articles dealing with the use of mobile technologies incorporate training or K12 and Higher Education been anecdotal rather than research oriented. There have been a few more scholarly examinations of mobile learning, but the field is still very new and in-depth scholarly research takes time to perform and disseminate. Earlier studies looking at the use of laptops, though not specifically looking at laptops with wireless connectivity, showed some benefits and trends which may be reflected, or even increased when those laptops are freed from their stationary connections to the Internet. Some studies noted a shift toward more student-centered classroom environments (Stevenson, 1998; Rockman, 1998), increased student motivation (Gardner 1994, Rockman, 1998), and improved school attendance over students not using laptops (Stevenson, 1998). According to Rockman (1998), a majority of teachers in laptop schools reported an increase in both project-based instruction and cooperative learning. Fisher and Stolarchuk (1998), in a study involving the use of laptops in middle school science classrooms, found that emphasis on the process of inquiry positively impacted student learning and attitudes. Roschelle and Pea (2002) examined the way mobile devices change the way people collaborate and the creation of shared knowledge spaces. Perhaps the largest study to date is the Palm Education Pioneers (PEP) Program (Crawford, Vahey, Lewis, & Toyama, 2002). The report is based on data collected from more than 100 schools around the US who received PEP grants. Teachers using the PDAs gave evaluations of the use of PDAs as instructional tools, with responses over 90% positive. Portability and ease of access were cited as benefits, as were the integration of the handhelds into a variety of instructional activities, the increase in student motivation, and the use of collaborative and inquiry based instructional methods. It must be noted that this research was funded by a handheld manufacturer. Nonetheless, the findings are encouraging for the acceptance of the technology into the traditional classroom.

## Conclusions

Distance Education has always been about allowing learners access instructional environments that they could not otherwise access. Mobile Learning is another answer to the same need. But it also provides the opportunity for learners to access those environments at any time or from any place. This extra opportunity for ubiquitous access is the value that mobile learning adds to the educational mix. Mobile learning has the necessary characteristics to become a basic element in the structure of learning and education. The increase in access and the flexibility associated with mobile learning will move students from passive to active roles. They will be able to tailor the content and framework of the qualifications they require, and determine the mode, pace and delivery of study that is best suited to their own personal circumstances. While mobile learning research is still in its infancy, it is obvious that the trend towards ubiquitous computing needs to be matched with a sound theoretical model for educators to make the most of the new technologies.

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