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Abstract: New technologies and media, and the ubiquity and pervasive nature of its many devices are changing the nature of knowledge, discourse and learning. From teacher-centered to learner-centered, from a linear to a dynamic approach mobile learning (mLearning) has come to represent learning just-in-time, just-for-me, anytime, anywhere. This chapter reviews the emerging and expanding field of mLearning including the history, the key features, the pedagogy that supports such learning, current research and practices in schools, colleges and universities, and its challenges and potential.

Three aspects of mLearning are explored: (i) Learning within a classroom environment (focus on the technology); how readily available and easy-to-use portable devices create new opportunities for classroom learning, from handhelds, e-books, to classroom response systems, to reusable learning objects. (ii) Learning with portable technologies across contexts outside the classroom (focus on learner mobility), where PDAs and smart phones equipped with GPS systems offer field trips and museum visits by providing learners location-based, reconstruction of actual physical events that took place centuries ago. (iii) Learning with portable technologies in an increasingly mobile society (focus on accessibility); where, through the affordances of mLearning, at their convenience, students prepare for upcoming classes by accessing content before class or revisiting content afterwards.

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## Chapter 52: Mobile Technologies

Mobile Learning: Adopting a New Paradigm Towards Teaching and Learning

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### Abstract

New technologies and media, and the ubiquity and pervasive nature of its many devices are changing the nature of knowledge, discourse and learning. From teacher-centered to learner-centered, from a linear to a dynamic approach mobile learning (mLearning) has come to represent learning just-in-time, just-for-me, anytime, anywhere. This chapter reviews the emerging and expanding field of mLearning including the history, the key features, the pedagogy that supports such learning, current research and practices in schools, colleges and universities, and its challenges and potential.

Three aspects of mLearning are explored: (i) Learning within a classroom environment (focus on the technology); how readily available and easy-to-use portable devices create new opportunities for classroom learning, from handhelds, e-books, to classroom response systems, to reusable learning objects. (ii) Learning with portable technologies across contexts outside the classroom (focus on learner mobility), where PDAs and smart phones equipped with GPS systems offer field trips and museum visits by providing learners location-based, reconstruction of actual physical events that took place centuries ago. (iii) Learning with portable technologies in an increasingly mobile society (focus on accessibility); where, through the affordances of mLearning, at their convenience, students prepare for upcoming classes by accessing content before class or revisiting content afterwards.

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The chapter concludes with a discussion of appropriate assessment methods and ethics that are important for mLearning, as well as implications and direction for future research and practice.

Keywords: Mobile learning, situated-cognition, learner-centered, interactive, cell phones, anytime anywhere

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### Introduction

The Internet has revolutionized the way we teach, learn and retrieve information. There are already about one million courses on the Internet, 30,000 of them compiling with a scientific definition of online, 22,000 of these are listed on the telecampus portal, with many of them making didactic use of the World WideWeb (Neil, 2003, Fisher & Baird, 2007). The innovative application of technology to enhance the delivery of education often characterized as e-learning has opened up new ways and perspectives on how we can learn (Conole and Oliver, 2007). The convergence of mobile and social technologies, and the desire for on-demand information through laptops, personal digital assistants, smart phones, e-books, mobile music players (iPods) have permeated the manner and means of human communication. The age of instant messaging (IM), and social networking have come to represent a growing life style for many people. Learning is no longer device dependant but is about learning across contexts (Winters, 2007).

The predictability of the traditional way of learning where the teacher is the disseminator of knowledge and students are the receivers and emphasis is on the memorization of facts has given way to the need for a more dynamic and flexible way of learning. One in which learner's must practice greater levels of flexibility and adaptability. In the past access to information was limited dispensed by the expert few, this has quickly been replaced by access to an abundance of information so much so that it is almost impossible to find what is needed from the morass of irrelevance. This demands a higher degree of discernment on the part of the seeker (Finnis, 2003). Creating the need for learning to move a way from the process of conditioning and more towards the process of empowerment (Finnis, 2003). Mobile learning offers learners greater access to relevant information, reduced cognitive load, and increased access to people and systems. It may be argued that wireless, networked mobile devices can help shape culturally sensitive learning experiences and the means to cope with the growing

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amount of information. For example a myriad of resources are available on grammar, vocabulary and idioms a mobile device can enable the learner to choose from a web page, audio or video tutorial, or send a query for practice and guidance (Koole & Ally, 2006). Portability and access to information are significant attributes for this mode of learning.

### Defining “Mobile Learning”

Associated with “just in time, just enough and just for me” information delivery (Rosenberg, 2001) mLearning has come to represent flexible learning tied to a suite of options that can be adapted to individual learning needs (Peters, 2007). Traxler (2007) equates many of its traits to words such as ‘personal’, ‘spontaneous’, ‘informal’, ‘pervasive’, ‘situated’, ‘context-aware’ and ‘portable’. The underlying emphasis is on learning experiences along with ‘ownership’, ‘informality’, ‘mobility’ and ‘context’ (Traxler, 2007). The pervasive and ubiquitous mode of delivery is changing our nature of learning and discourse. Quinn (2007) describes mobile learning as the intersection of mobile computing and e-learning: the application of small, portable and wireless communication devices plus learning facilitated and supported through the use of information and communications technology. He defines it as “learning independent of time and place and facilitated by portable computers capable of providing rich, interactivity, total connectivity and powerful processing.”

### The History of Mobile Learning

“At the heart of every technological breakthrough is the challenge to make learning more relevant and engaging” (Najmi & Lee, 2010, p.97). To understand the rise and decline of technologies that were supposed to revolutionize learning in education, it is necessary to look at the past. Mobile learning is viewed more of an “evolution” than a

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revolution naturally, transitioning from face-to-face learning to distance learning, and distance learning to mobile learning.

The use of technology in learning can be traced as far back to the Abacus (Sharp, 2005, p. 3), or to Pascal's calculating machine from 1642 (Provenzo, Brett, & McCloskey, 1999). Prior to the Revolutionary War education was limited to the privileged few however in 1862 Congress passed the Morrill Act allowing new colleges to open which paved the way for public institutions that we know today. Distance education began in the 1880s when correspondence education via post allowed students to study from home (Moore and Kearsley, 2005). In World War II the U.S. army used two-way radios for communication the post-war period used the technology to develop commercial mobile-radio-telephones (Goggin, 2006). The Servicemen's Readjustment Act 1944 or the "G.I Bill" further opened up the opportunities for first generation college students to pursue higher education. During this period the use of motion film for classroom instruction (Rochester, N.Y, 1910), radio broadcasts of the Little Red Schoolhouse (Chicago, 1920), and the early use of instructional television in classrooms (Hagerstown, MD and Samoan Islands, 1950) had varying degrees of success and proved that technology alone was not sufficient to solve learning problems (Cuban, 1986). The launching of Sputnik, an unmanned Soviet satellite, in 1957 stirred national interest in educational reform. Major national efforts were made to reform education (Molnar, 1997).

The 1960s and 1970s further saw the adoption of the Open University and gave learners greater access and autonomy evolving into the next generation of distance learning. During this period the cellular telephony system went through several rounds of innovation. In 1972, Alan Kay at Xerox, Palo Alto Research Center envisioned a personal and portable computing device for children, one that would be engaging and allow them to work with something "real." The Dynabook is considered by many

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11 researchers to be the conceptual prototype for modern mobile computing devices (p. 4).  
12 As computer technology became smaller and less expensive, microcomputers were born.  
13 By the late seventies personal computers were everywhere and viewed as a necessity for  
14 schools and universities. With many universities requiring incoming freshmen to own a  
15 computer. Seymour Papert at MIT developed LOGO a programming language, to  
16 encourage rigorous thinking about mathematics. His approach to student-centered  
17 learning was to teach computer literacy by allowing students to control the computer  
18 through programming (Molnar, 1997).  
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24 It would be another decade before the first portable computer appeared on the  
25 market. In 1981, the Osborne 1 was introduced and it was a commercial success. It was  
26 the start of the budget friendly PCs followed by walkmans, battery powered personal  
27 digital assistants (PDAs), portable games, and cell/smart phones. Trinder (2005) noted  
28 with Personal Digital Assistants (PDAs) users were unwilling to accept longer boot times  
29 as they were used frequently to retrieve information and as such, the devices were  
30 expected to respond at all times. It was not uncommon for users to be owners of pagers,  
31 PDAs and cell phones for work purposes even though this was often cumbersome. The  
32 Internet and World Wide Web further revolutionized how communication occurred  
33 through email, instant messaging (SMS), Internet browsing, virtual classes and e-learning  
34 using synchronous and asynchronous learning (Moore & Kearsley, 2005).  
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43 Numerous studies started to emerge that reported mLearning technologies were  
44 expanding and becoming commonplace in a variety of learning environments (Lavoie,  
45 2007). In the April (2000) issue of *Computers and Education* Sharples discussed the  
46 potential of new designs in personal mobile technologies. He envisions the convergence  
47 of educational thinking and technological development to enhance lifelong learning  
48 programs and continuing adult educational opportunities. Furthermore, Peneul (2006)  
49 put forth the concept of one-to-one computing initiatives, which sought to provide laptop  
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computers, and Internet access to students at home and school. The idea was to improve academic achievement through technology, increase equity of access to digital resources, prepare students more rigorously with real-life skills and improve the quality of instruction (pp. 329-330).

In an effort to adopt and integrate mLearning into mainstream courses several educational institutions such as Duke University (2006) and Abilene Christian University (2008) distributed iPods and iPhones to all incoming freshmen. The idea was to improve access and mobility for course material allowing for learning to take place anytime, anywhere. Today, mobile learning is fast becoming a distinct sector of modern education with the user base diversifying across every sector of education. It is gradually moving from small-scale, short-term trials to larger more sustained and blended deployment. With devices get smaller and faster, the cell-phone is by far the most popular device to be owned.

### Key Features

Understanding the common characteristics that relate to this style of learning can help to clarify what is meant by mLearning. The following features contribute to a rich mobile learning experience.

Table 1: Features of mLearning (Wagner, 2005)

Ubiquity:	It is readily available anytime, anywhere. Information can be retrieved when and wherever it is.
Access:	Content is widely available and easily distributed by means of a wireless-network.
Richness:	Information is available in multiple formats integrates seamlessly. Pages load quickly? Animations play in a smooth manner? Streaming media (media that is consumed—read, heard, viewed—flows at a sufficiently consistent speed.
Flexibility:	Content is viewable on a variety of devices and can be played on other devices with comparable quality.
Security:	The shared content is protected from being intercepted by unintended recipients.
Interactivity:	The user interacts freely with the display and the content.

Sharples (2006) identifies key attributes of mobile learning as follows.



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- It enables knowledge building learning takes place in different contexts (cross curricular).
- It provides the ability to gather data unique to the current location, environment, and time both (real and simulated).
- Learners construct their own understanding (customized to their path of investigation).
- It changes the pattern of learning or the work activity (it supports interactivity)
- Mobile learning applications are mediating tools and can be used in conjunction with other learning tools.
- Its context goes beyond time and space in which learning becomes part of a greater whole, a process.
- Mobile learning raises ethical issues of privacy and ownership.

The implications for learning in this manner are profound. The widespread use and pervasiveness of mobile devices promotes familiarity, learners are more open to learning through such means. Since, the learner owns the mobile device a sense of ownership is created which is directly transferable to learning (Sharples, 2006; Najmi & Lee, 2010). Mobile learning tends to influence the learner's emotions, attitudes, and motivation and so offers many different opportunities for learning and knowledge acquisition (Sharples, 2006).

### **Theoretical Underpinnings**

The theoretical foundations of learning have moved at a rapid pace over the last two decades from behavioral to cognitive to constructivist. The convergence of the advances in theory and the affordances of technology provide the opportunities for mLearning. Through its unique nature mLearning is influenced by many different theories of learning (behaviorist, constructivist, situated, collaborative, activity, informal

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and lifelong learning), and so offers many possibilities of development (Naismith, Vavoula & Sharples, 2004). Sharples (2002) proposes a theory of mobile learning, drawing on Dewey's philosophy of Pragmatic Technology and Pask's Conversation Theory as foundations for the process of coming to know in a world mediated by mobile technology (Sharples, Taylor & Vavoula, 2005).

We look at mLearning from the Constructivist premise of teaching and learning where knowledge is actively constructed and socially re-constructed by the learner (Jonassen, 1991; Mautner, 1996; Duffy & Cunningham, 1996). Drawing upon foundations of situated cognition (Brown, Collins, & Duguid, 1989) and socially-shared cognition (Resnick, Levine, & Teasley, 1991) learning takes place within authentic settings and is defined in the context of the task and roles of the participants. Problems are often ill structured and require examination from multiple perspectives, through collaboration and reflection, integrated with scaffolding for support and assessment. Vygotsky (1978) refers to scaffolding as the zone of proximal development [ZPD], where learning takes place through higher-level psychological processes, on an interpersonal level through social interaction bound to a specific time and place (Gergen, 1995; Vygotsky, 1978), and then on an individual level, through individual internalization. Learning develops through multiple contributions by learners as an active, ever-evolving process (Vygotsky, 1978, p. 86). Mobile learning is well suited to context-aware applications simply because mobile devices support different contexts, and the learner can draw on them while building on existing skills to enhance the learning activity. Learners can adapt their learning according to their every day practices, prior expectations and preferences. Emphasis is on authentic learning experiences, personalization, adaptation, engagement, self-evaluation and reflection by the learner (Stead, 2006) the teacher is the guide or facilitator. These types of learning experiences are exceptionally well-suited to mobile learning and can be achieved both in the

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classroom as part of the formal curriculum, outside the classroom as a supplement to curriculum or as self-directed formal or informal endeavors.

### **Mobile Learning in the Classroom**

#### Learning Within A Classroom Environment (Focus On The Technology)

As the connection between media and youth grows and new content delivery channels emerge the line between traditional and alternate styles of learning continues to blur. Readily available, easy-to-use portable devices create new opportunities for classroom learning, from personal digital assistants (PDAs), tablet PCs, classroom response systems, reusable learning objects, cell/smart phones, and e-books. Mobile Learning offers innovative ways to meet student expectations and improve the quality of learning. Educational content in the classroom offers numerous options for delivery of content through pushing, posting, messaging, response and feedback, and file-exchange (Song, 2007). PDAs and tablet PCs support interactive learning and offer powerful tools for collecting data. Students download, store and utilize information or access information via the Internet. Learners use the web-based resources for revision, reference and information handling. They are encouraged to reflect and add a brief explanation on what they read with just in time comments. They may then publish it to the devices of other students or the teacher. Synchronous messages are aggregated using a display board or presentation tool within the classroom and can be used for group discussion. These are used to conduct research, take notes, for word processing, and project presentations (Pinkwart, Hoppe, Milrad, & Perez, 2003).

Audio response systems (clickers) increase the degree of interactivity and support co-operative learning activities. Modern clicker units are “two-way,” the clicker not only sends a signal but also indicates whether it was received. They allow question/response sequences, assess student preparation and enable instructors to gather student responses quickly and effectively. Often questions can be added according to student need or a

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question from a student can be addressed to the whole class. Common features of questions are to start and focus discussion, assess student preparation, ensure accountability, determine level of student thought, and use for formative assessment. Clickers work well when the questions content and structure are designed to reflect specific learning goals. Many institutions i.e., MIT, University of Massachusetts-Amherst, Harvard, Yale, Vanderbilt and Duke have implemented the use of clickers in physics and biology lecture courses (West, 2005). Crouch and Mazur (2001) noted increased student mastery of conceptual reasoning and quantitative problem solving in their calculus-algebra based, large introductory physics course. Students were required to prepare class material ahead of time. Heightened discussion and interactivity among students and the instructional content were observed. Overall, clickers were seen to support the pedagogy of active learning and to positively impact student attention, retention, actively engage learners during class, and improve learning outcomes (Beatty, 2004; Caldwell, 2007).

### *Smart Phones and mLearning*

As technology changes and new devices continue to emerge, the distinction between the different kinds of mobile devices become ever more blurred. Furthermore, the smart phone with its multi-function capability of email, texting, Internet browsing, photo and audio/video capabilities allows learners to access, create and share information effortlessly. From experiencing history to learning language mobile phones create opportunities for learning that surpasses, time, place and boundaries i.e., students access audio/video content and reading materials from the Universities learning management system to prepare and gain subject matter content ahead of lecture time (Rismark, Solvberg, Stromme, & Hokstad, 2007).

In China, it was found that the use of mobile learning helped to increase interactivity of classes and thus student engagement through a system that allowed

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students to customize their means of content-reception based on when and where they tuned into the broadcast. The students could also use their smart phones to tune in to live broadcasts of classroom activities and ask questions, make suggestions. The students changed from passive learners to engaged learners (Wang, Shen, Novak, & Pan 2009).

In Singapore, a primary school science curriculum was transformed for delivery by mobile technologies (smartphones). With mobilized lessons, students learned science in a personal, deep and engaging way and developed positive attitudes toward mobile learning. These mobilized lessons began as paper-based lesson designs then transformed to make use of mobile technologies. This transformation moved the lessons from a content- teacher-centered infrastructure to a student-centered infrastructure ... to foster personalized learning and self-directed learning (Looi, et al, 2010).

### Mobile Learning Outside the Classroom

Thornton and Houser (2005) reported regarding mLearning and its use in a Japanese University. In this study the investigators evaluated outcomes measures for classroom material using mobile phones, both via email and using WAP technology (Wireless Application Protocol) for web enabled phones. The researchers observed improvements in test scores ranging from between 35% and 75%, using pre-post test measures over paper materials alone. The students' reactions to this new learning opportunity were positive, although more so for the PDA trials than for the cell phone. The researchers noted that since the cell phone is so well established in Japan, distributing educational material through them is a relatively effortless process. They stress that interactivity in content seemed a superior teaching method when compared to using static web pages alone for conveying material.

The use of mLearning to aid the learning of languages has been the subject of several studies. Chen and Chung (2008) as well as Chen and Hsu (2008) examined

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personalized mobile learning systems to support learning English. Such a system would provide adaptable, personalized learning programs and deliver news articles in English to reinforce and enhance vocabulary. Kukulska-Hulme and Sheild (2008) and explored ways in which mobile devices could be employed to enrich language learning. These included the opportunity for collaboration as well as individual learning activities and call for different pedagogical approaches to be explored. Kukulska-Hulme (2009, 2010) conceptualize mobile assisted language learning to meet the needs of 21st Century learners and envisions learning activities placed on a continuum that has teacher-driven language provision at one end, and entirely learner-driven provision at the other end.

In addition to these examples of using mLearning for language learning, Evans (2008) studied the effectiveness of using podcasts with first-year undergraduate students in Business and Management at a London university. In this study podcasts were used as a revision tool after the traditional lecture course concluded but before the final examination. The results indicated that the students believed that podcasts were more effective than their textbooks and more efficient than their own notes in helping them learn. Petrova (2010) attempted to identify the factors that students perceived as drivers of, or inhibitors to, the success of the mLearning scenario, and investigated the implementation of a mobile learning requirements framework in evaluating the experiment outcomes. The results indicated that mobility support, information density and information relevance are the main success factors, while service cost is likely to be the major detractor.

Curriculum-oriented formal learning in the school learning, and non-curriculum oriented informal learning i.e., learning at museums, galleries or zoos, are converging to curriculum-oriented informal learning in which the goals of learning are explicitly defined by the learner but linked with the curriculum. Students will be engaged in informal learning with a curriculum-orientation such as learning at museums, but have

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the object of learning linked to the curriculum. This type of learning will be more organized and measurable so that teachers would find it easier to adopt in formal learning settings. It would be linked to curriculum and students would willing to participate because it is more fun to be working in an informal learning environment setting such as in a museum or outdoors. “However, before introducing the mobile devices as a learning support tool for learners, we need to ensure the key ingredients of a good learning environment from a curriculum perspective: well-designed content that links to curriculum, frequent and in-depth collaboration with peers, and scaffolding” (Mann & Reimann, 2007, p. 153). Curriculum-oriented informal learning, mobile learning with the context setting that is linked to the curriculum, through the use of mobile devices will be the ultimate convergence of formal and informal learning.

Computers and other aspects of Information and Communication Technologies (ICTs) allow children and young people a wide variety of activities and experiences that can support learning, yet many of these experiences do not take place in traditional educational settings. Many of these may not be considered ‘educational’ according to the conventional understanding of the term. This learning both complements and supplements learning occurring in schools. “The learning exemplified in out-of-school informal learning is very relevant to learning how to become a modern kind of worker and the formal education system needs to find ways to intersect with this kind of learning as a valid curriculum aim” (Sefton-Green, 2004, p. 30). People will continually need to enhance their knowledge and skills in order to address immediate problems and to participate in a process of continuous vocational and professional development. The new educational imperative is to empower people to manage their own learning in a variety of contexts throughout their lifetimes (Bentley, 1998).

### *Case Studies*

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Waycott et al. (2005) describe the use of an activity theory framework to analyze the ways that distance part time learners and mobile workers adapted and appropriated mobile devices for their activities and in turn how their use of these new tools changed the ways that they carried out their learning or their work. It revealed a two-way process in which users adapt the tools used according to their everyday practice and preferences in order to carry out their activities; and how, in turn, the tools themselves also modify the activities in which the users engage. They use three case studies to illustrate these processes: distance learners' use of e-books on PDAs to supplement their access to other static media such as books and computers, use of mobile devices by workers in the energy industry to access information when away from the office, and the use of mobile devices in an art gallery. They also discuss information access needs that are apparent in each of these learning contexts, and highlight the pertinent issues in the use of mobile technologies to support lifelong learners' information needs. They also explored the possibilities of informal learning in science settings and areas difficult to study because of the complexity and the difficulty of defining informal learning. They considered the learning as a continuum from the formal settings. The main focus of their work was how mobile devices could support informal learning in science and research (Scanlon et al., 2005).

Some of the studies undertaken have involved the use of mobile devices as part of museum and gallery tours at the Tate Modern, San Francisco Exploratorium, and as support to walking history tours (Scanlon, et al., 2005; Fleck, 2002; Hsi, 2003). These studies show that while the device can be helpful in learning they can also be a distraction and, in the worst case, a detriment to the learning when the technology does not perform as expected. An interesting comment by those using the devices on city streets was a concern about being mugged.



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De Crom and Jagger (2005) wrote about the use of PDAs in support of ecotourism. In these studies it was reported that 95% of participants had a positive experience. The PDAs eliminated the need to carry books to identify birds and provided a convenient way to take notes. “The PDA was a tool and not the experience” (p.31).

Mobile learning doesn’t need to be tied to a formal curriculum; it can be used to help people in everyday life by having information available at one’s convenience at the time of need. The “Mobile Learning Tools for Children with Life-threatening Allergies” project initiated research into a new application area: supporting learning and information-giving to help anaphylactic children and their families’ live safer and more flexible lives (Vavoula & Lonsdale, 2007).

Mobile technologies enable learning outside traditional learning environments, thus facilitating learning in real-world contexts. However, mobile learning experiences should not be viewed in isolation of other learning experiences. Each learning episode builds on previous learning, and is the basis for future learning. The outcomes of a learning experience can, and should, be used in subsequent learning experiences. Mobile technologies have the integral ability to support the mobility of learning outcome artifacts (collections of data, personal notes, etc.); the challenge is to also support the continuation of learning across different locations and contexts, both formal and informal (Vavoula & Lonsdale, 2007).

McFarlane and Triggs (2009), researchers from the University of Bristol, on a commission from the British Educational Communications and Technology Agency (Becta), performed a two-year investigation of the educational impact of one-to-one personal access to mobile learning devices at both the primary and secondary stages. This study found that learners associated the use of handheld devices with learning, in school and out of school and saw the devices as supporting effective learning. This perception was not dependent on level of use and persisted over time; it was not a novelty

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effect. Teachers played a key role in pupils' uptake and use of devices, both in school and out of school. When teachers made regular use of devices in class, a majority of learners also used the devices, both under direction and autonomously, in and out of class, for school-related purposes and non-school- related purposes.

McFarlane and Triggs (p.4) found attributes of the device associated with effective learning and valued by students include that it:

- facilitates individual, co-operative and interactive work in class
- enables the sharing of ideas and responses and the building of knowledge
- increases participation in whole-class settings
- enables learners to revisit areas for consolidation and reflection out of the classroom – this helps to increase understanding
- provides opportunities for autonomy and independence
- provides work and resources in one place, and to hand
- gives the ability to transfer work between digital devices and to and from other areas such as shared drives and learning platforms
- alleviates pressure on the computer rooms and makes learning more flexible.

### Assessment and Evaluation in mLearning

Mobile Learning takes learning beyond the walls of the classroom -- literally connecting the user to a world of information (Breck, 2006; Inkpen, 2001; Rogers & Price, 2007; Sharples, 2000). Outside the classroom, learners are able to continue their learning in spaces that meet their individual needs. Within classroom learning, the rigidity of the learning environment is softened by allowing the learner to stay connected in the learning space. Mobile devices carry media-rich content and provide greater interaction with educational material increasing the possibilities for students to collect

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and contribute new content. This has implications for teaching and learning, evaluation and assessment.

Miller (1956) states humans have limited short-term memory capacity; therefore, information should be organized into pieces to facilitate processing: five to nine meaningful units can help learning. “Chunking” information for display on mobile devices can help to compensate for the limited capacity of human, short-term memory as it directs the learners’ focus and supports learning. Since information is presented in pieces, learners need to be able to integrate the pieces and incorporate details of the lesson for better understanding. Hence, learning materials for mobile learning devices should be presented in electronic format and be reusable, e.g., learning objects to help accommodate different learning styles and learner characteristics (McGreal, 2004). A lesson should include a number of learning objects sequenced to form an instructional event and should be accessible from a database for instant access by learners, intelligent agents and instructors (Ally, 2004b).

Feedback should be immediate and regularly obtained at several stages, both formally and informally, through reflective skills, discussion and peer reviews. Buchanan (2000) reported that “repeated answering” was an effective format-assessment strategy under circumstances that no answer was given and some reference or supplementary material was provided as immediate feedback. Such characteristics allow learners to repeatedly participate in practice, reflection, and the revising process. Additionally, the use of questionnaires, focus groups, snap polls are other strategies for ascertaining the level of learning that occurs (Wang, 2010). The interface of the mobile learning system should be appropriate for individual learners so as to enhance motivation and learning. Cognitive psychologists view learning to involve the use of memory, motivation, thinking, and reflection ( Craik & Lockhart, 1972).

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Most learners have little experience with this kind of delivery mode and related instructional strategies, and even less about self-evaluating their own learning or the ability to self-assess how well he or she has done and to transfer knowledge and skills across disciplines. The lack of external feedback can have learner's question their goals and achievements. Hence, teachers need to identify and cater to specific student needs, foster reflection, help with the management of learning, monitor performance and employ strategies for the consolidation of learning and assessment.

Sharples (2009) suggests "distinction" of the activity and its goal can substantially improve outcome. He provides a framework for educators to help them distinguish between tasks, which can help in the evaluation of the learning activity, which is presented in Table 2.

Table 2: Initiation and management of learning (adapted from Livingston, 2001)

	<b>External Management</b>	<b>Learner Management</b>
<b>External Initiation</b>	Formal Learning	Resource based learning
<b>Learner Initiation</b>	Voluntary Learning	Informal learning

Choice of method depends on how the result will be used. For example evaluation as part of education research will be concerned with understanding how fundamental processes of learning can be mediated, enhanced and transformed. Evaluation to inform design will focus on intervention and enhancement, examining how a combination of technologies and activities can best be developed to address problems and provide new learning opportunities (Sharples, 2009). A useful way to approach the evaluation, for any stakeholder, is to address usability (will it work?), effectiveness (is it enhancing learning?) and satisfaction (is it liked?).

### **Ethics**

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With greater mobility comes the challenge of privacy and ethics. Mobile devices have the propensity to invade privacy hence guidelines need to be set and enforced. An evaluation must address both the specific aspects of ethical research and broader issues of the rights of students, at different ages, to escape from continual monitoring and to be free to play and explore without continual pressure to learn. Ethical constructs delineate all individuals who participate in a mobile learning activity do so with equal chances of success. Schools and universities face the issue that some instructors maybe better trained and more effective in their teaching which may result in an uneven inconsistent mode of instruction within the same institution. Similarly, some learners may not learn as well in a mobile environment as they may require more spatial or hands-on instruction. Other concerns are of “netiquette” the proper protocol that should be maintained when interacting with others. All these are concerns that emerge when using mobile learning (Singer, 1993).

### Summary/Discussion/Future Implications

The convergence and pervasiveness of technology has created the need to consider alternative ways of learning. If the world of working and living relies on collaboration, creativity, definition and framing of problems, dealing with uncertainty, change and distributed cognition – then education needs to prepare students for meaningful and productive lives in such a world. Education from a lifelong learning perspective should help learners enhance their abilities to learn, engage in meaningful activities, exploit the power of media, and promote new civic discourses, as a major role for new technologies is not to deliver predigested information but to provide for social debate and discussion (Bruner, 1996). “We are beginning to see significant adoption of these [mobile] technologies in further and higher education, in schools and the community, and in training and updating. They are having an impact on teaching,

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learning, and on the connections between formal and informal learning, work and leisure” (Kukulska-Hulme, 2005, p. 1).

“During the past few years there have been tremendous strides in the advancement of technology with the rise of mobile devices leading to an era characterized by the instant access and mobility of information. Mobile devices such as cellular phones, personal audio players, personal digital assistants, and portable computers have reshaped and redefined the ways in which information is constructed, accessed, and communicated among individuals and societies. As these mobile devices converge and wireless connectivity becomes more prevalent, remarkable technical capabilities are offered and profound innovative learning possibilities are now made feasible” (Avraamidou, 2008, p. 347-348). Mobile technologies are becoming more embedded, ubiquitous, and networked, with enhanced capabilities for rich social interactions, context awareness, and Internet connectivity. Such technologies can have a great impact on learning. Learning will move more and more outside of the classroom and into the learner’s environments, both real and virtual, thus becoming more situated, personal, collaborative and lifelong. The challenge will be to discover how to use mobile technologies to transform learning into a seamless part of daily life to the point where it is not recognized as learning at all” (Naismith et. al., 2004)

In Muyinda’s (2007) opinion, the future of mobile learning forecast is bright. The capabilities of PDAs, mobile and smart phones are on the move to higher ends. Integrated context-aware capabilities will transform everyday activities. The entire Internet will become both personal and portable. Such technologies will have a great impact on learning. Learning will move more and more outside the classroom and into the learner’s environment. As the already hectic pace of our lives increases we will need to find faster and more inventive ways to utilize previously unproductive time and chart out ways to

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deal with issues that emerge with this lifestyle i.e., cognitive overload among others (Geddes, 2004).

The information age has an increased degree of uncertainty that requires greater levels of flexibility and adaptability in order to survive and thrive. In this age individuals must be prepared for two to three career changes in their lifetime. Hence, workers will be more involved in the planning and decision-making processes. Individuals will need to develop the discernment required to make sense of the mass of facts, figures claims and counter-claims that surround them. Success will be measured in terms of creativity, innovation and forward thinking (Pink, 2006). Education will need to change from being a process of conditioning to one of empowerment.

As we go forward into the 21st Century lifelong learning is essential for maintaining a competitive edge in the global economy, for personal growth, and to function in an increasingly technical environment. “The image of mobile learning in education is slowly crystallizing into a picture of a learner enabled to not only use new technologies, but also to perform new activities with them; and of an educator who can not only put lots of learning ‘stuff’ in a mobile gadget and hand it to their students, but also to plan new learning experiences for them. Mobile devices can help to form steady bridges between technologies, contexts, experiences and learning spaces” and to balance the needs and demands of living and learning in such times (Vavoula, Sharples, Rudman, Lonsdale, & Meek, 2007, p. 37).

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