UNIT 10  M-LEARNING

Structure
10.0  Introduction
10.1  Learning Outcomes
10.2  M-Learning: Concepts
  10.2.1  M-Learning: Definitions
  10.2.2  Strengths and Limitations
  10.2.3  Some Examples
10.3  Designing M-Learning
10.4  Technology of M-Learning
10.5  Towards a Theory of M-Learning
10.6  Cost and Impact of M-Learning
10.7  Let's Sum Up
10.8  Keywords
10.9  References and Further Readings
10.10 Feedback to Check Your Progress Questions

10.0  INTRODUCTION

Consider the following statistics, current to January 2009:

- Total circulation of all daily newspapers worldwide = about 480 million
- Total number of cars on the road = about 800 million
- Total cable and satellite television subscriptions = 850 million

Numbers increase for newer technologies:

- Desktops, laptops and netbooks currently in use = 1 billion
- Fixed land line telephone connections = about 1.2 billion
- E-mail users = about 1.3 billion
- Internet users = about 1.4 billion
- Credit card users = about 1.7 billion

Now consider this statistic: 4 billion people subscribed to mobile phone subscriptions in the same time period (Ahonen, 2009).

Certainly the world has gone mobile! The mobile penetration is about 61 per cent of the total population of the world. “In the developing world, mobile phones have revolutionized telecommunication and have reached an estimated average 49.5 per cent penetration rate at the end of 2008 — from close to zero only ten years ago” (ITU, 2009). In Africa mobile penetration has risen from just one in 50 people at the beginning of this century to more than one-quarter of the continent’s population today. Africa’s mobile penetration of 28 per cent compares to 38 per cent in Asia, 72 per cent in the Americas, 79 per cent in Oceania and 111 per cent in Europe (ITU, 2009). It is almost certain that these figures would be outdated by the time this unit is printed! This indicates the potential of the mobile technology to provide greater access to people in remote and geographically disadvantaged locations. “In regions with difficult geography or poor economic conditions, mobile networks can be designed and implemented in far quicker and cost-efficient ways than fixed networks” (Dholakia and Dholakia, 2004).
“Mobile phone use in DE will not only benefit learners in Asia, but can be exported to other developing and developed areas around the globe. Mobile phone diffusion in Asia particularly is spreading at a dramatic rate with the advent of cheaper handsets and better services” (Motlik, 2008), and, therefore, mobile technologies should be the preferred mode of teaching and learning support. Keegan (2002, 2005) declared that the future of distance education is wireless as there had never been a technology that has penetrated the world with the depth and rapidity of mobile telephony. He claims that the challenge for distance educators is to accept this fact and to now develop pedagogical environments for mobile devices. It is in this context, the present unit shall discuss m-learning at a very basic level to give you an overview of its potential to provide teaching and learning support.

10.1 LEARNING OUTCOMES

After working through this unit, you are expected to be able to:

- Define m-learning;
- Describe different types of technology used in m-learning;
- Discuss issues related to design and delivery of m-learning;
- Enumerate advantages and disadvantages of m-learning; and
- Give examples of use of m-learning in various educational and training settings.

10.2 MOBILE LEARNING: CONCEPTS

Educators’ tryst with technology has a long history. Thus, the field of education has seen many innovations and innovative use of common technologies for teaching and learning, including the use of television, radio, computer and the Internet. Despite Thomas A. Edison’s 1922 prediction “that the motion picture is destined to revolutionize our educational system and that in a few years it will supplant largely, if not entirely, the use of textbooks”, despite the volume of research documenting “no significant difference” in student outcomes between alternate modes of education delivery (see www.nosignificantdifference.org) and despite the debate over the question “Do media influence learning?”, technology use has dominated educational discourse in the 20th century. In the beginning of the 21st century, the use of mobile telephony in education gave birth to a new wave called “mobile learning” (“m-learning”). The popularity of mobile learning can be appreciated from the large number of publications and conferences on the subject since 2001. According to Kim et al. (2004), “Mobile wireless technology provides efficient and effective communication and network connectivity for teachers and students in K–12 education because it does not require any wires.” As mobile technology is pervasive, users no longer need to worry about access to the computer lab for technology activities, software assignments or Internet access, and its operational simplicity makes it the next killer application.

10.2.1 M-Learning: Definitions

“The term ‘mLearning’ has lately emerged to be associated with the use of mobile technology in education. It seems, however, that it is used in commercial purposes rather than as an educational concept. We wonder if the term is a commercial trick to market technology and educational services or if it an emerging concept that educationalists take seriously” (Sariola et al., 2001).
Interestingly learning cannot be mobile, but learners are mobile and they use mobile technologies (Keegan, 2002). If serving the mobile learners is the focus of m-learning, then distance education institutions have always been doing this — serving learners anytime, anywhere. For some, m-learning is e-learning delivered through mobile devices, and Keegan (2002) takes this point when he represented m-learning through a diagram showing links to other materials, the World Wide Web, interactions among students, interactions between the student and the teacher, provision of learning materials and student support services. Thus, for Keegan, mobile learning is provision of teaching and learning on a mobile device. “Mobile learning (m-learning) is defined as the provision of education and training on mobile devices: Personal Digital Assistants (PDAs), smartphones and mobile phones” (Keegan, 2006). Ally (2004) defined m-learning as the delivery of electronic learning materials on mobile computing devices to allow access from anywhere and at anytime. According to Quinn (2000) m-learning can be defined as learning that takes place with the help of portable electronic tools. Stone (2004) defines m-learning as a special type of e-learning, bound by a number of special properties and the capability of devices, bandwidth and other characteristics of the network technologies being used. Geddes (2004) defines it as the acquisition of any knowledge and skill through the use of mobile technology, anywhere, anytime, which results in an alteration in behaviour. However, Laouris and Eteokleous (2005) claim that a precise educational definition of m-learning is yet to be achieved.

A portable device that supports learning may be freely moved, but learner is mostly stationary, even though they are using a mobile device. Although the device is mobile and portable, the learning as an event cannot be described as mobile (Ahonen et al., 2004). According to Laouris and Eteokleous (2005) the definition of m-learning must view the learner as the one being mobile and not his or her devices. O’Malley et al. (2005) define mobile learning more broadly as “any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies.” Mobile wireless technology involves two areas — mobility and computing. “Mobility” in this context is defined as continuous accessibility to users, and “wireless” means communication using radio waves, infrared waves and microwaves instead of cables or wires in order to transport a signal to connect communication devices (Malladi and Agrawal, 2002). Kim et al. (2004) define “mobile wireless technology” as technology that provides continuous accessibility to users anytime, anywhere without using wire or cable to connect to networks (like the Internet), to transmit data or to communicate with others. Colazzo et al. (2003) state that mobile learning can be considered as any learning and teaching activity that is possible through mobile tools or in settings where mobile equipment is available. Traxler and Kukulska-Hulme (2005) define m-learning as a personal, unobtrusive, spontaneous, “anytime, anywhere” way to learn and to access educational tools and material that enlarges access to education for all.

Thus, mobile learning includes access to electronic materials and resources mediated by mobile devices for the exclusive purpose of teaching and learning support. Taken this view, m-learning is a sub-set of e-learning available through mobile technology to facilitate learning on the go. Koole (2009) has proposed a framework for understanding mobile learning. According to this framework, mobile learning falls within the intersection of learner, device and social aspects as represented in Figure 10.1. The labels in the illustration can be explained as follows:
Technology Primer

- **Device Aspect** — refers to size, weight, input or output capabilities, file storage and retrieval, processor speed of the equipment.
- **Learner Aspect** — refers to their prior knowledge, memory, context and transfer, discovery learning, emotions and motivations.
- **Social Aspect** — refers to conversations, co-operation and social interactions among users.
- **Social Technology (DS) intersection** — refers to device networking, system connectivity and collaboration tools.
- **Interaction Learning (LS) intersection** — refers to interaction, situated cognition and learning communities.
- **Device Usability (DL) intersection** — refers to portability, information availability, psychological comfort and satisfaction.
- **Mobile Learning (DLS)** — refers to information access and selection, mediation and knowledge navigation in mobile learning.

![Figure 10.1: Mobile Learning: A Framework (Source: Koole, 2009)](image)

### 10.2.2 Strengths and Limitations

Some key advantages of mobile learning include the following (Attewell, 2005):

- allows truly anywhere, anytime, personalised learning;
- can be used to enliven, or add variety to, conventional lessons or courses;
- can be used to remove some of the formality which non-traditional learners may find unattractive or frightening and can make learning fun;
- can help deliver and support literacy, numeracy and language learning;
- can help learners and teachers to recognise and build on existing basic literacy skills which allow young people to communicate in notational form via text messages;
M-Learning

- facilitates both individual and collaborative learning experiences;
- enables discrete learning in the sensitive area of literacy;
- can help to combat resistance to the use of ICT by providing a bridge between mobile phone literacy and PC literacy;
- has been observed to help young disconnected learners to remain more focused for longer periods; and
- can help to raise self-confidence and self-esteem by recognising uncelebrated skills, enabling non-threatening, personalised learning experiences and enabling peer-to-peer learning and support.

Analyses of 12 international case studies by Kukulska-Hulme and Traxler (2005) reveal the reasons of m-learning use in several different contexts.

Access
- improving access to assessment, learning materials and learning resources;
- increasing flexibility of learning for students; and
- compliance with special educational needs and disability legislation.

Changes in teaching and learning
- exploring the potential for collaborative learning, for increasing students’ appreciation of their own learning process and for consolidation of learning;
- guiding students to see a subject differently than they would have done without the use of mobile devices;
- identifying learners’ needs for just-in-time knowledge;
- exploring whether the time and task management facilities of mobile devices can help students to manage their studies;
- reducing cultural and communication barriers between staff and students by using channels that students like; and
- wanting to know how wireless or mobile technology alters attitudes, patterns of study and communication activity among students.

Alignment with institutional or business aims
- making wireless, mobile, interactive learning available to all students without incurring the expense of costly hardware;
- delivering communications, information and training to large numbers of people regardless of their location;
- blending mobile technologies into e-learning infrastructures to improve interactivity and connectivity for the learner; and
- harnessing the existing proliferation of mobile phone services and their many users.

Limitations
Most of the limitations of mobile learning are due to the small screen size of the mobile devices and their limited battery life. A study by Doolittle and Mariano (2008) found that learning while mobile was negatively affected in comparison to learning while stationary. They “found that students who learned about historical inquiry using a portable digital media player (e.g., iPod), while navigating a walking course that required attention to the path taken, performed significantly more poorly on measures of recall and transfer than students who learned while simply sitting at a desk” (p. 524). This is a serious drawback, and exclusive use of mobile device for any teaching and learning is therefore not recommended.
Maniar et al. (2008) reported that regardless of the screen size of a mobile device, students tended to have a positive overall opinion of m-learning, and watching a video significantly increased their knowledge of the subject area. However, compared to students who used devices with 2.28-inch to 3.78-inch screens, students who used a device with a 1.65-inch screen had a significantly lower subjective opinion of the screen quality and learned a significantly lower amount. This finding indicates that if an m-learning environment that relies heavily on video-based material is displayed on a device with a 1.65-inch screen, such as an average mobile telephone, then the effectiveness of the learning experience may be inhibited. Zawacki-Richter et al. (2007) reported that 62 per cent of respondents agreed that screens are currently too small to present complex learning material, and limited battery life of mobile devices was regarded as a problem for extensive use by 59 per cent of respondents. Despite these limitations, 50 per cent of the respondents believed that screen size is not as important as mobile devices should rather be used for communication and interaction purposes rather than for content distribution. Because of the small screen size in mobile devices, the interface should be built in such a way to convey the message using the smallest amount of text, and proper navigation must be built into the system to allow learners to move between screens and sections of the lesson (Ally, 2004).

Despite these small limitations, mobile devices should be seen as an opportunity to deliver just-in-time learning and support to learners in remote areas. As Sharples (2003) suggests, rather than seeing mobiles as disruptive devices, educators should seek to exploit the potential of the technologies children bring with them and find ways to put them into good use for the benefit of learning practice.

10.2.3 Some Examples

Learnosity — Using mobile phones for language learning

Second year Junior Certificate students (average age of 14) participating in the pilot project were supplied with a mobile telephone for the duration of the initiative. The school chosen to participate in the trial demonstrated how the project could succeed under extreme circumstances, without the cushioning of a school well-equipped with technology.

There are several components to the Learnosity system that, taken together, make it unique. These are as follows:

- The use of mobile phones with the interactive voice response (IVR) system.
- Questions are selected at random from a question bank.
- Students can re-record and repeat the process as required.
- Answers are recorded as WAV (compressed audio) files and saved to a server from which they can either be marked online through a Web site or saved and marked as a podcast.
- Students can hear not only their own, but exemplary answers as well.
- Feedback is given in the form of a printout or e-mail which can be saved to an e-portfolio if available.
- New vocabulary can be delivered by SMS text each day for use in class or written work.
- Text-chat with peers through Google Talk. In the pilot this was done with PCs but it could be via PDAs. Teachers can mediate in real time and assess later with the scripts also recorded and saved for self assessment.
- Access to an online dictionary supports further language development.
Outcomes

• 67 per cent students reported that they had made significant progress with oral Irish language in the six weeks of the pilot. There are plans for further trials in six schools, task-based and role-play conference calls and potentially, biometric voice recognition. However, wireless access in schools can be a barrier in remote areas.

(Source: http://www.learnosity.com/go/clients/ncca-ireland/phase1-results)

Mobile Learning and Teaching with PDAs

(Dewsbury College, Thomas Danby College and Bishop Burton College)

Personal Digital Assistants (PDAs) have been used at Bishop Burton College across the curriculum in workshop training and fieldwork, while Dewsbury College has trialled the use of PDAs in outreach centres with an NVQ Level 3 course in early years childcare and education. At Thomas Danby College, the focus has been on supporting basic skills and English for speakers of other languages (ESOL).

PDAs have been shown to be valuable in stimulating learners in environments that do not usually offer access to technology. They can support dynamic group activities without internet connectivity by the use of beaming, but like all new technologies, it is essential that they are not put to unsuitable uses such as conveying large quantities of information in text format. Some learners may not be able to use small screen devices successfully. Accessibility issues should always be considered and alternative routes provided.

(Source: http://www.elearning.ac.uk/innoprac/practitioner/resources/dewsbury.pdf)

JAVA midlets for Teaching Actuarial Sciences

Java based small applications that can be stored in a mobile phone were used in several courses in the Actuarial Sciences degree of the University of Málaga. This project was carried out by a multidisciplinary group of teachers who were engaged in developing learning resources in electronic format. They followed a flexible blended strategy that includes the traditional classroom, e-learning and m-learning elements. Thus, the students can customize their learning processes using the contents and the way of access they are more comfortable with or consider more effective.

The results of the study revealed that mobile phones may also be used as small computers and thus, their use in higher education as a new tutoring and communication medium can be very useful. The high degree of adaptivity and personalization of these devices can be educationally beneficial to students, especially in courses with insufficiently motivated ones. However, the limited capacity of the current mobile phones, small memory and little screens, makes it necessary to design small applications. The Java J2ME platform proved a better way of delivering content than the WAP one for educational purposes in this project. The students prefered the off-line execution of micro-modules (that are compiled into Java midlets) than the access on line to WAP pages, arguing that the first method avoids the payment of connection costs.

(Source: http://www.formatex.org/micte2006/pdf/2095-2099.pdf)
More examples on mobile learning can be found through a simple search on Google. One site that gives case studies is http://www.m-learning.org/case-studies/

Check Your Progress 10.1

Notes: a) Write your answers in the space given below.
    b) Compare your answers with those given at the end of this unit.

1) Define m-learning in your own words.

2) Identify four strengths of m-learning.

3) What are the three important aspects of mobile learning?

10.3 DESIGNING M-LEARNING

Although Grasso and Roselli (2005) recommended a set of guidelines for development of content for mobile learning, they also suggested rationalising because mobile devices have limited capacity and there is a risk of overloading the content giving rise to loading and storing problems. Park (2005) presented an adaptive approach to mobile learning management system that provides content adaptive to a learner’s learning style. Accordingly, a learner is provided with the type of learning content adaptive to his or her learning style on the process of the individual learning. Bae et al. (2005) demonstrated that the use of an Attention-Relevance-Confidence-Satisfaction (ARCS) model in designing content is useful to learners at the school level. Tsai et al. (2005) presented a six-stage model for design and development of mobile learning, as follows:

Stage 1 — Analysis of the learners’ needs and mobile situation
Stage 2 — Integration of mobile technology-based instruction with a learning environment that uses digitised information

Stage 3 — Design of mobile instructional strategies

Stage 4 — Design and development of mobile learning content

Stage 5 — Implementation of instructional activities

Stage 6 — Evaluation of mobile learning effect

Ismail and Idrus (2009) reported the use of a SMS physics lesson at the Universiti Sains Malaysia. They suggested the following educational design considerations in the use of mobile phones:

- present course materials in a systematic and chronological way;
- present a “daily” chunk of information, including learning tips, laws, rules, simple formula, definitions, rhetoric, quiz, points to ponder, glossary, everyday examples, etc.;
- make materials available in diverse formats either to use text, image, audio or video according to the systems they are using, whether GPRS or 3G;
- ensure content is experientially real to students in the sense that they can engage in personally meaningful activity and learning;
- ensure students have capability to return the message for further action;
- incorporate SMS with electronic portal for archival purposes;
- incorporate interaction (via forum) in the electronic portal;
- create student groups via the hand phone;
- develop an easy interface; and
- utilise capabilities of hand phone such as saved messages etc.

Mishra (2009) suggested that while designing the m-learning system for teaching and learning, it is important to identify the learners need. Such needs can be categorized into static and dynamic information, and interactive and non-interactive type (See Table 10.1).

<table>
<thead>
<tr>
<th>Non-interactive (broadcast type)</th>
<th>Static information</th>
<th>Dynamic information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Last date of submission of assignments</td>
<td>Tips, news, etc.</td>
</tr>
<tr>
<td></td>
<td>Last date of filling examination forms</td>
<td>Podcast lectures</td>
</tr>
<tr>
<td></td>
<td>Cancellation of a counselling session</td>
<td>Video</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interactive (student query type)</th>
<th>Static information</th>
<th>Dynamic information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Eligibility in a programme of study</td>
<td>Teleconference</td>
</tr>
<tr>
<td></td>
<td>Grade in assignment and term end examination</td>
<td>Chatting, discussion</td>
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<tr>
<td></td>
<td></td>
<td>Games</td>
</tr>
</tbody>
</table>

Design and development of m-learning applications are important, and in this context the research and development in this area is not comparable to the developments in the field of e-learning. Today, many open source Learning Management Systems (LMS) such as Moodle, ATutor, etc. among others deliver online learning. The same is not true for m-learning. Thus, most projects and institutions start from the basics and develop their own systems. Rather than focusing on the teaching and learning, the projects focus on technology developments. However, it is possible to deliver Moodle
courses on mobile through the use of Mobile Moodle (MOMO), a JAVA-based application that allows Moodle clients to access a MOMO add-on to the Moodle learning management system (see www.mobilmoodle.org). Android (see www.android.com) is a free, open source mobile platform that includes an operating system and other software for development of Internet-like applications on mobile phones. The Tribal Group (see www.m-learning.org) in the UK has developed a set of software tools for development of lessons for mobile, SMS quizzes, a discussion board and a student tracking system. The design and development of mobile learning applications require a systematic approach and should be considered from a theoretical perspective as well a technological one.

Check Your Progress 10.2

Notes:  
a) Write your answer in the space given below.

b) Compare your answer with the one given at the end of this unit.

While designing m-learning applications what are the types of information you will consider to include in the services?

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10.4 TECHNOLOGY OF M-LEARNING

It is generally accepted that devices such as mobile phones, PDAs and MP3 players fit into the category of mobile devices (Mellow, 2005; Andronico et al., 2003). However, laptop and notebook computers are sometimes not considered as mobile devices. “While they are capable of working without plugging into a power source and can utilize wireless networks, they are not devices that people can carry everywhere and quickly access at any time due to their size, configuration, and the time required to boot up and shut down” (Caudill, 2007).

Attewell (2005) categorises technologies used in m-learning into five categories:

1) delivery options;
2) platform options;
3) media options;
4) development languages; and
5) transport options.

To this list we may add another category — device options. A clarifying concept map of technologies used in m-learning is given in Figure 10.2.
Klopfer et al. (2002) identified five properties of mobile devices that produce unique educational affordances:

1) **Portability** — The small size and weight of mobile devices means they can be taken to different sites or moved around within a site.

2) **Social interactivity** — Data exchange and collaboration with other learners can happen in both synchronous and asynchronous mode.

3) **Context sensitivity** — Mobile devices can both gather and respond to real or simulated data unique to the current location, environment and time.

4) **Connectivity** — A shared network can be created by connecting mobile devices to data collection devices, other devices or to a common network.

5) **Individuality** — Scaffolding for difficult activities can be customised for individual learners.

![Figure 10.2: Mobile Learning Technologies (Adapted from Attewell, 2005)](image)

Keegan (2006) describes a range of mobile technologies used for administrative support as well as for teaching and learning through the use of SMS (for support, for quizzes and for assignment advice); personal or peer tutoring through mobile devices; instructional delivery through podcasting over mobile devices; and content delivery through appropriate design of the learning materials to suit different mobile devices. Now let's consider some commonly used technologies:

### Hand-held Computers

Hand-held is a generic term used for PDAs, palmtops and laptop computers. The Palm Education Pioneer (PEP) programme was one of the earliest comprehensive mobile learning initiative covering 102 classroom teachers in K–12 schools in the United States. The final evaluation of the programme revealed an overwhelmingly positive response about the use of hand-held computers in classrooms. Approximately 90 per cent of PEP teachers stated that hand-holds are an effective instructional tool and hand-holds have the potential to have a positive impact on students' learning. Teachers found that use of hand-held computers in the classroom increased student motivation and improved collaboration and communication. However, key drawbacks included inappropriate use of technology, management issues related to...
synchronisation and equipment damage. A personal use strategy rather than shared strategy was more likely to increase students’ time spent on schoolwork outside of school time (Vahey and Crawford, 2002).

Vogel et al. (2007) reported that students who already engaged in use of mobile devices found that use of a PDA enhanced their learning experiences. Moreover, those students who received support through mobile devices also reported increased performance enhancement. It has also been reported that PDAs are effective in improving knowledge creation during experiential learning (Lai et al., 2007) among fifth-grade students.

Mahamad et al. (2008) present a case of implementation of m-learning for primary schools in Malaysia by using open source technology. The case study focused on learning mathematics using hand-held devices among primary school students aged 11 and 12 years. Main users for this system included students, teachers and the administrator. This application suggests a new mobile learning environment with a mobile graph for tracking the students’ progress and performance.

**Short Message Service**

Short message service has the widest application in teaching and learning, as it is available in most basic mobile devices available in the market, and it can be used for both teaching and learning support. Viljoen et al. (2005) from the University of Pretoria experimented with the use of different types of SMSs to support learners and found that learners liked the academic instructions most, followed by mini lectures, interactive quiz, interactive student questions and instructional lecturer response, indicating learners wanted direct and short help messages. Cavus and Ibrahim (2009) reported an increase of more than 65 per cent in post-test score of learning new English words through SMS teaching. Jones and Edwards (2009) used text SMS to support student learning, and their study revealed many students perceived the SMS communication to have had a positive impact on their management of study time. Jones and Edwards argued that mobile text-based communication has the potential to support the development of time management skills, an important component of self-regulatory learning.

Traxler and Dearden (2005) in the context of sub-Saharan Africa presented a detailed report on potential applications of SMS in school empowerment, as the capital cost is negligible and the running cost is nominal. They emphasised SMS can be used for delivering distance learning programmes as follows:

- to provide study material, giving week-by-week support, maintaining momentum, contact, morale and continuity;
- to provide content support such as hints, tips, outlines, lists, summaries and revision;
- to provide reminders for assessment, contact, broadcast, discussion, video and meetings;
- to discuss in the form of feedback, seminars and queries;
- to provide encouragement and motivation; and
- to provide urgent alert messages about errata, cancellations and changes.

**Podcasting**

Lee and Chan (2007) argue that podcasting can be used to deliver a form of m-learning that offers a higher degree of lifestyle integration than many
current “state of the art” m-learning applications. Haaparanta et al. (2007) present the use of podcasting by teachers in schools using mobile phones.

Video use

Uses of video in m-learning have also been demonstrated by Doolittle and Mariano (2008) and Maniar et al. (2008). The use of mobile technology as a gaming device (for recreation and entertainment) makes it highly potential tool for educational usage despite the fact that these devices have very small screen size and therefore may require special developmental efforts. Small nuggets of video and animation can be used for teaching specific skills just in time.

10.5 TOWARDS A THEORY OF M-LEARNING

According to Naismith et al. (2004) use of mobile technology in education can be categorised into six main themes:

1) Behaviourist — activities that promote learning as a change in observable actions (drill and feedback model).
2) Constructivist — activities in which learners actively construct new ideas or concepts based on both their previous and current knowledge (participatory and interactive model).
3) Situated — activities that promote learning within an authentic context and culture (authentic and contextual model).
4) Collaborative — activities that promote learning through social interaction (conversational and shared model).
5) Informal and lifelong — activities that support learning outside a dedicated learning environment and formal curriculum (personalised, outside formal application model).
6) Learning and teaching support — activities that assist in the co-ordination of learners and resources for learning activities (learning support model for academic, administrative and technical purposes).

From a developing country perspective, features such as limited or no dependence on permanent electricity supply, easy maintenance, easy-to-use audio and text interfaces, affordability and accessibility are the most important considerations for using mobile phones as potential learning tools. Based on the use pattern, Traxler (2007) has categorised mobile learning as:

- Technology-driven mobile learning — Some specific technological innovation is deployed in an academic setting to demonstrate technical feasibility and pedagogic possibility.
- Miniature but portable e-learning — Mobile, wireless and hand-held technologies are used to re-enact approaches and solutions already used in “conventional” e-learning, to provide access to some virtual learning environment (VLE) using mobile technologies as flexible replacements for desktop technologies.
- Connected classroom learning — The same technologies are used in classroom settings to support collaborative learning, perhaps connected to other classroom technologies such as interactive whiteboards.
- Informal, personalised, situated mobile learning — The same technologies are enhanced with additional functionality (for example, location-
awareness or video-capture) and deployed to deliver educational experiences that would otherwise be difficult or impossible.

- **Mobile training or performance support** — The technologies are used to improve the productivity and efficiency of mobile workers by delivering information and support just-in-time and in context for their immediate priorities.

- **Remote, rural or development mobile learning** — The technologies are used to address environmental and infrastructural challenges to deliver and support education where “conventional” e-learning technologies would fail, often troubling accepted developmental or evolutionary paradigms.

Without theoretical underpinnings, technological innovation would not be sustainable. So, in this section, we make an attempt look into the theoretical implications of m-learning, and the theoretical models that are used in the design, development and delivery of m-learning. Three standard schools of thought — behaviourism, cognitivism and constructivism — play significant roles in the use of mobile technology for teaching and learning. Collaborative learning, situated learning and social constructions of learning are dominant approaches apart from the behaviouristic approach of using quiz and provision for immediate feedback. Arrigo et al. (2004) presented an innovative mobile platform for computer-supported collaborative learning based on third-generation mobile telephones. Students in the system can collect and share live data immediately, anywhere and at any time, enabling them to play an active role in the knowledge-building process. Nyiri (2002) notes that knowledge is information in context, and since mobile devices enable the delivery of context-specific information, they are well placed to enable learning and the construction of knowledge.

Sharples et al. (2005) present a framework for theorising about mobile learning to inform the design of new environments and technologies to support mobile learning. Using the activity theory approach, they analyse learning as a cultural-historical activity system, mediated by tools that both constrain and support the learners in their goals of transforming their knowledge and skills. They identify two separate perspectives as layers: (1) semiotics and (2) technology. The semiotic layer describes learning as a semiotic system in which the learner’s object-oriented actions are mediated by cultural tools and signs. The technological layer represents learning as an engagement with technology, in which tools such as computers and mobile phones function as interactive agents in the process of coming to know in a networked and connected world. Shih (2005) presents a modified ARCS model for designing m-learning that can be considered an instructional design approach. The learning cycle in the Shih’s model as shown in Figure 10.3 includes:

- sending a multimedia message to mobile phones to trigger and motivate learners;
- searching the Web for related information by using hyperlinks (URLs) embedded in the message received;
- discussing with learning peers by text, voice, picture or video messaging;
- producing a digital story that tells what they learn through an audio or video diary (a moblogging journal); and
- applying what they learn in a simulated environment such as online educational gaming.
One of the major reasons m-learning does not work at the present level of development is a lack of teaching and learning models using mobile devices. Not enough has been done to experiment with m-learning using the various learning theories and instructional design models available. Keough (2005) presents “mobigogy” as distinct from “pedagogy” and “andragogy” for application in mobile technologies. Accordingly, mobigogy is a teaching and learning paradigm for the mobile technologies that is continuous, learner directed and believes in education as democracy. Mobigogy enables network thinking, dynamic learning in supported communities, sharing experiences and learning from others in an object-oriented, just-in-time knowledge model.

**Personal Learning:** Mobile devices are becoming personal possession of individual learners. It is something that today’s youth do not want to leave for a movement. They are engaged with the mobile device in an intricate manner for different activities that the tool provide. For mobile learning to be possible, we must exploit this behaviour of the learner to deliver content through mobile device to reach anytime and anywhere by giving bite-sized information just in time approach.
**Didactic Content:** The dominant model of education is information transfer, and mobile technology can deliver information fast in different sizes ranging from Short Message Service (SMS) to delivery of podcast and eBooks in PDF and multimedia files. Mobile technology enabled by Voice XML can also provide speech-to-text and text-to-speech facility to provide content. These contents may be notes and presentation, eBooks, multimedia, websites and LMS delivered through PDA, and smart phones.

**Discursive Interaction:** Most educators believe that interaction is essential for learning to happen and sustain for a long time. In e-learning, we use discussion forum, email, etc. for interaction between student and teacher, and student and student. We also use the concept of ‘e-moderation’. Similarly, we can think of using interaction through mobile in both synchronous and asynchronous manner. So, while we can use SMS and MMS for asynchronous interaction, using the web interface in a suitable mobile, we can also make Computer Mediated Communication (CMC) possible through mobile devices. Today, mobile devices are available with pre-installed social network facilities that can be integrated around teaching and learning activities.

**Generic Academic Support:** Mobile devices can be used to develop study skills, personal information management, and time management skills. Phone based applications can be used for these purpose to develop lifelong learners. Mobile with in-build dictionary, maps are some other applications that can also provide academic support to the learners.

**Subject Specific Support:** Mobile devices can be GPS enabled, and can also have local map features. These can be appropriately used to teach specific subjects such as Geography. Learners may be asked to map the local area, and share and discuss he demographic patterns of a locality through the use of mobile phones. Similarly, language learning can be contextualised with the use of mobile phones.

**Guidance and Counselling:** A telephone is a highly useful medium for providing timely guidance and counselling to those who need. We can sue mobile technologies to extend the support services available to the learners into 24X7. While this support can also be academic, it is more useful for non-academic and para-academic support and guidance anytime. Learners can receive information about a range of services through phone call or interactive SMS. Mobile technology can also be used to give career guidance, counselling to cope up with stress, and other psychological issues of adolescence, etc.

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**Check Your Progress 10.3**

**Notes:**

a) Write your answers in the space given below.

b) Compare your answers with those given at the end of this unit.

1) Write the five properties of mobile devices that provides unique educational affordances.

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2) List the six areas where mobile devices can be applied in education.

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10.6 COST AND IMPACT OF M-LEARNING

Cost is probably the most difficult aspect of mobile learning, for post-secondary institutions and particularly at the school level in the developing countries. Traxler (2003) identified elements of a theoretical basis for estimating and predicting the effectiveness, efficiency and economics of mobile learning as:

- content development costs;
- teaching costs;
- software development costs;
- hardware costs; and
- usage costs, e.g., phone charges.

However, no in-depth analysis of these costs has yet been done. Experiences in the field of e-learning and distance learning show that the cost of m-learning is high at the present because of technological development, though m-learning has the potential to be much less costly due to economies of scale. Rekkedal and Dye (2009) accepted that cost-efficiency considerations prohibited them to develop parallel versions of courses for mobile learning. They recommend that “courses must be developed, presented, and distributed in a manner that allows both mobile and non-mobile distance learners to participate in the same course, using the same course materials that can be accessed from standard and mobile technologies.”

Impacts

Many benefits accrue when hand-held computers are used (Juniu, 2003). The most important benefit to the learners and teachers is the opportunity to take the learning experience outside of the confines of the classroom. Perry (2003) states that wireless technologies, notably PDAs, are proving to benefit “family learning” as learners are able to use them for various literacy tasks, including note-taking and reading e-books, and then take the PDAs home to continue working on them with their parents. Barker et al. (2005) described three significant impacts of mobile technologies as “portability,” “collaboration” and increased “motivation” of the learners. So, m-learning has the potential to change teaching and learning practices. Use of mobile devices in education and training would increase communication and collaboration and provide authentic learning experiences to the students through field trips and group work. However, real impact of m-learning has not yet been seen as most applications are in project stage and are yet to be integrated into the mainstream of educational institutions. Learners are the biggest stakeholders in m-learning projects, and it should be a top priority to ascertain their needs to have positive impact later. Kim and Ong (2005)
identified six factors affecting user satisfaction in m-learning, as follows:

1) relevant content;
2) service commitment of the m-learning provider;
3) usability of the system;
4) content accuracy and assurance;
5) system assurance and performance; and
6) community membership.

Thus, any m-learning provider should have a service policy and commitment, provide access to relevant learning materials developed on the basis of needs analysis and encourage the development of a community of learners.

10.7 LET US SUM UP

The growth of mobile phones and its access to people have propelled the imagination of educators the world over to use mobile technology for teaching and learning support. We defined m-learning through a detailed discussion in this unit. Simply put, it is the use of mobile devices for teaching and learning. While the ‘learner’ and the ‘technology’ are mobile, what is important in m-learning is learning that is personal, unobtrusive and anytime, anywhere. We discussed the strengths and weaknesses of m-learning. Access has been identified as a major strength, whereas many do consider the small screen-size as an impediment. You also learned design issues in m-learning, including the importance of identifying the nature of information/content required by the learners. We also discussed about various technologies used in m-learning. These are handheld computers, smart phones, Portable Digital assistants, Short Message Services, Podcasting, Video, etc. Towards the end of the unit, we discussed possible developments of a theory of mobile learning and identified five areas of use on m-learning that may lead towards development of a theory of its own. These are: personal learning, didactic content, discursive interaction, generic academic support, subject specific support, and guidance and counselling.

10.8 KEYWORDS

M-Learning: is access to electronic materials and resources mediated by mobile devices exclusively for the purpose of teaching and learning support.

Personal Digital Assistants (PDAs): is a handheld device that combines the feature of a mobile phone, computer, fax, and can provide access to the Internet.

Podcasting: A series of media file (usually audio) released episodically for download and use in mobile devices.

Shot Message Service: A form of text messaging using mobile phones/devices. It may also include multimedia files as attachment (often referred as MMS)
Scenario

Tabitha has been studying the influence of changing climate patterns on animal migrations. As part of her senior project, she has been monitoring hummingbirds, which have been seen in increasing numbers locally in past years. Tabitha is observing two sites in her neighborhood where they have been seen and one where they have not.

She sets up motion-sensitive cameras at each of the three sites—one at the local botanic garden, a second near a honeysuckle bank in an undeveloped wooded area, and a third near heavy perennial plantings on the back side of the community center. The cameras are set to record video of anything that moves, so she aims them high enough to ensure human traffic will not set them off. Whenever video is recorded, a message with a URL to access the video is sent to her smartphone. She consequently spends her free moments during the day—waiting for class to start or standing in line at lunch—viewing video on the screen of her mobile, trying to decide if there has been hummingbird activity. She also visits the camera locations daily, recording information on temperature and humidity.

She uses her smartphone to upload these observations to a database and to compare the day’s weather data with that of previous years.

Her first sighting comes five days into the study. She is scanning the video on her way to class when she sees a streak across the screen that she is sure is a hummingbird. Excited, she checks the data from the previous four years and notes her sighting is two days earlier than the average.

For her, the most exciting moment of her project comes after hummingbirds have been present for more than a week at two of her sites. A male hummingbird soars right in front of her as she checks temperature readings at the wooded location, her third site. Excited, she pulls out her mobile to check the hummingbird habitat maps. She thinks the bird is a full half-mile northeast of where his species had been spotted previously. Tabitha will need to do further research, but she believes she might have evidence confirming that the migration patterns continue to shift.

2 How does it work?

The applications used in mobile learning generally focus on brief interactions of perhaps five minutes or less, using simple navigation and graphics to accommodate multiple screen sizes. Such applications enable the quick review of information rather than prolonged or deep learning—as such, they are better suited for activities such as a status check, a request for just-in-time information, or as a student response tool in the classroom.

M-learning projects, by contrast, can involve complex tasks that employ multiple applications to track down complex data sets or complete assignments that involve solving multidimensional problems. Some exercises contain collaborative elements or game play, employing a variety of tools like social networking, calendars, customized calculators, simulations, or augmented reality. M-learning endeavors frequently fall into categories like data collection or application of location-based information, such as checking a map to see whether project team members are nearby.

These m-learning activities can be used on a growing list of devices, though the prevalence on campus of smartphones with a data plan—which allow users to run applications on the phone’s operating system, browse the web, and send and receive e-mail—makes them attractive options for course projects that are supported with mobile technology. That said, the smartphone category represents a range of devices and software, and new classes of mobile tools are emerging, such as HP’s Slate and Apple’s iPad, that will likely introduce new options and opportunities.

3 Who’s doing it?

As an early m-learning adopter, Abilene Christian University has chosen to focus on Apple devices, distributing either an iPhone or iPod touch to each incoming freshman. Instructors can leverage applications from the Apple iTunes store for learning purposes including field activities, while a dedicated portal offers campus news and calendars to keep students engaged in the learning community. Also focusing on the Apple platform, Seton Hill University announced plans to offer an iPad to every full-time student in fall 2010, a technology chosen both for
its mobility and the promise of easy future access to e-textbooks. A joint outreach program undertaken by Carnegie Mellon University and the University of California, Berkeley, called Mobile and Immersive Learning for Literacy in Emerging Economies (MILLEE) seeks to support a group of English teachers in rural India with m-learning applications designed for grade-school students. The children access these activities via their mobile phones to work on English skills in the classroom as well as in the fields on days when they help with farm work.

4 Why is it significant?
As learning management systems adapt to the mobile platform, m-learning may become a common tool for exploration by tech-savvy faculty. The use of mobile devices seems a natural fit for distributed learning and field activities in that handheld technology can not only accompany the learner almost anywhere but also provide a platform that is rapidly evolving and always connected to data sources. Learning management systems may drive campuses to recognize the potential of this always-on, anyplace technology that lowers the physical boundaries to learning and extends the classroom. Ease of use offered by mobile devices supports lifelong learning, and because the devices themselves are integrated into everyday life, they facilitate authentic learning. Ultimately, it might be the ubiquity of these student-owned devices that ensures their use as teaching and learning tools. The rising popularity of smartphones should promote the development of cloud-based applications that work on multiple devices. While some m-learning applications may be provided by colleges and universities, mobile technology in the main provides an inexpensive layer of functionality to the institution, capitalizing on an infrastructure that is increasingly supported by cloud services and by the technology that students bring to campus.

5 What are the downsides?
Hardware for mobile learning represents a wide range of platforms, screen sizes, and functionality, and no clear standards exist for development that address all of the tools available. As a result, colleges and universities can find infrastructure issues tricky to resolve. The cost of smartphones and data plans is out of reach for some students, and adoption and ownership is uneven. While the screen size on many mobile devices enforces simplicity of design, the small screens and keys are difficult for some to use effectively, and the additional strain on battery life imposed by mobile apps can be frustrating. Because m-learning is an emerging market, there remains a dearth of applications designed specifically for learning, and repurposing existing lesson materials for the mobile platform might add to faculty workload. The eclectic mix of devices and mobile formats, which are generally subject to student and faculty choice, could delay m-learning development, and standards may be slow to emerge in an environment where manufacturers are often trying to decide whether to merge their mobile devices with slates, tablets, or e-readers. Finally, while the devices can go anywhere with students, they might not engage students for long periods of time, as mobile learning activities are subject to frequent interruptions.

6 Where is it going?
New kinds of devices are emerging, blurring the distinctions between phones, PDAs, e-readers, and other types of hardware. Future mobile technologies will be able to present textbooks, create data visualizations, aid library research, and foster contextual learning.

Regardless of the directions taken by mobile manufacturers, newer incarnations of these devices are sure to provide easier access and better support for multimedia creation and collaborative applications. Field learning from art appreciation to zoology may soon find support from mobile devices pulled from a student pocket and used on the spot to check data, snap a photo, record location data, make a blog entry, or enter a question on the class discussion board. This rapid access to data, available wherever and whenever questions arise, could change our learning landscape, altering the way we solve problems.

7 What are the implications for teaching and learning?
The cell phone is currently the most common platform for m-learning, lending itself to collaborative and project-based efforts that leverage its potential to support the communication requirements of a team. Where wireless networks are available, or where smartphones with data plans have access to cell networks, mobile lessons and exercises can leverage the ability to gather information from a variety of interdisciplinary sources in a wide array of formats while exploiting the value of location-based learning. In developing countries where mobile devices are available at a fraction of the cost of other computing hardware, m-learning has extended the infrastructure of distance education to outlying areas that have previously been poorly served. Regardless of the hardware employed, as demand requires that more applications be re-authored for mobile formats, institutions may find it necessary to overhaul data-sharing and content-delivery techniques to support the mobile platform.

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Technology Primer


### 10.10 FEEDBACK TO CHECK YOUR PROGRESS

**Questions**

1. Your definition of mobile learning should cover the use of mobile devices, teaching and learning support, and access to electronic resources.

2. Four strengths of mobile learning are:
   - Personalized learning, anytime, anywhere
   - Increases collaborative learning and social support
   - Increases access as mobile is becoming pervasive
   - Develop confidence by giving just-in-time skill training

3. The three important aspects of mobile learning are: device, learner and the social aspect. The device aspects refer to considerations such as size, weight, input capabilities, storage capacities etc. The learner aspect refers to students’ prior knowledge, context and motivation to use technology; and social aspects relate to conversations, collaborations and social interactions. Mobile learning should consider all these while being applied in education and training situations.
Check Your Progress 10.2

For mobile learning applications, we should consider information as interactive and non-interactive, as well as static and dynamic. Non-interactive and static type of information include: last date of submission of assignments, etc., while non-interactive and dynamic information may be delivery of content such as podcast, tips and news items. Interactive and static information may involve grades in a course, while interactive and dynamic information may involve use of mobile in a teleconference session, games, chatting, etc.

Check Your Progress 10.3

1) The five properties of mobile devices are:
   - portability
   - social interactivity
   - context sensitivity
   - connectivity
   - Individuality

2) Mobile technologies can be applied in education for the following six purposes:
   - Provision of personalize learning to individual learners
   - Didactic information transfer
   - Promote discussion
   - Provide generic academic support
   - Provide subject specific support
   - Guidance and counselling through telephone
Dear Learner,

While studying the units of this block, you may have found certain portions of the text difficult to comprehend. We wish to know your difficulties and suggestions, in order to improve the course. Therefore, we request you to fill out and send us this form as soon as you complete reading this block. Kindly use a separate sheet, if you find the space provided insufficient.

Please mail to:
Course Coordinator (MDE-418)
STRIDE, IGNOU, Maidan Garhi
New Delhi – 110068, India

Questionnaire

Enrolment No.  

1) How many hours did you need for studying the units?

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<th>Unit no.</th>
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<th>4</th>
<th>5</th>
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2) In the following table we have listed 4 kinds of difficulties that we thought you might have come across. Kindly tick (√) the type of difficulty and give the relevant page number in appropriate columns.

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<th>Presentation is not clear</th>
<th>Language is difficult</th>
<th>Diagram is not clear</th>
<th>Words/Terms are not explained</th>
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3) It is possible that you could not attempt some CYPs. In the following table some possible difficulties are listed. Kindly tick (√) the type of difficulty and the relevant unit and question numbers in appropriate columns.

<table>
<thead>
<tr>
<th>Unit No.</th>
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<th>Question Not-clearly posed</th>
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<td>Cannot answer on the basis of information</td>
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<td>Answer given (at the end of unit) not clear</td>
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4) Any other comment:-