"In-Your-Pocket" and "On-the-Fly:" Meeting the Needs of Today's New Generation of Online Learners with Mobile Learning Technology

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INTRODUCTION

Mobile devices are ubiquitous in today's business and social environments, and they are shaping the way that individuals learn, communicate, and share information. A given technology for those approaching and just entering adulthood, mobile devices have also become central to the business demographic, who have a need or expectation to be always connected, mobile, and online. Today's online learners require flexibility, and mobile devices are a solution to remove the barrier of a fixed time, place, and mode of learning. Tailoring online education to meet the needs of those who wish to learn "anywhere, anytime," however, will be an ongoing challenge.

The emergence of the "Net Generation" into the halls and cyberspace of higher education has challenged educators to better understand the makeup of a new generation of learners within our highly connected, technological society. As Canada's leading distance education and

e-learning institution, Athabasca University (AU) is exploring tools, techniques, and the learning preferences of this tech-savvy demographic who are now just crossing our threshold. This chapter outlines what mobile learning is, its benefits and challenges, and discusses several of the issues faced. We also provide examples of how Athabasca University has applied mobile learning and mobile technology to support online teaching and learning, and offer our "lessons learned" in practice.

WHAT IS MOBILE LEARNING?

Although mobile learning is considered to be a relatively new concept, it has experienced significant growth with the onset of the new millennium. Mobile technologies, such as mobile phones, personal digital assistants (PDAs, such as *Palm®, iPAQ®*); smartphones (integrated telephony, computing, and communication devices, such as *BlackBerry®, Treo™, iPhone™*); and portable media players (such as MP3 players, *iPod®*) have become embedded in our social and business milieu, transforming the way we work, live, and, indeed, learn. According to a recent Statistics Canada *Innovation Analysis Bulletin* (McDonald, 2006), over 16.6 million Canadian individuals subscribed to mobile communications services by the end of 2005, and from 1997 to 2004, Canadian households increased their total communications expenditures on wireless services by 253% and on Internet access by 600%.

   Mobile learning (*m-learning*) is the delivery of electronic learning materials with built-in learning strategies on portable computing devices, to allow access from anywhere and at any time (Ally, 2004). In the continuum of educational technology, m-learning is emerging to build on the advances of e-learning, or the use of Internet and learning management systems (Georgiev, Georgieva, & Smrikarov, 2004). Milrad (2003) concurs and describes the differences between m- and e-learning: e-learning is "learning supported by digital 'electronic' tools and media," whereas mobile learning is "e-learning using mobile devices and wireless transmission" (p. 151).

   Everywhere today, people are connected: they are checking email on their PDAs; they are text-messaging, listening to music, or playing games on their cellphones or *iPods®*; and they are surfing the Internet via a wireless connection for sports scores, stock prices, and even for dinner and flight reservations. The rise of mobile devices is allowing a broad range of consumers – from those owning a basic cellphone to

those on the periphery with cutting-edge smartphones – to connect in ways that foster learning and the exchange of ideas within a more universal social "mind," beyond the restrictions of age, gender, national identity, and socio-economic status.

MOBILE LEARNING AND THE NET GENERATION

Mobile learning allows individuals to connect with just the right content, using just the right technology, at just the right time. In today's egoistic society, learning, too, can be on demand and attuned to the specific interests of the individual.

The *Net Generation* (also known by the monikers Net Gen, Generation Y, Millennials, the Google Generation, iGeneration, Me Generation) describes a demographic born between 1980 and 1994 who are very tech-savvy, accustomed to multi-tasking, and expect to control what, when, and how they learn (Tapscott, 1998). This demographic poses a new challenge for educators, who must consciously be aware of being made technically obsolete by the younger generation. According to Richard Sweeney (cited in Carlson, 2005), a university librarian at the New Jersey Institute of Technology, "higher education was built for us [baby boomers and previous generations] under an industrial-age model" (p. A34); the Net Generation is far from this design. This new generation of learners is smart but impatient, creative, expecting results immediately, customizing the things they choose, very focused on themselves, and reliant on an "arsenal of electronic devices – the more portable the better" (Carlson, 2005, p. A34). They are more apt to learn and work in teams, are very achievement-oriented, are comfortable in image-rich environments, crave interactivity, and prefer to learn by doing rather than reflecting (Oblinger & Oblinger, 2005).

The e-book *Educating the Net Generation* (Oblinger & Oblinger, 2005) is a compilation of articles that explores this theme and discusses how higher education must better understand the Net Generation to remain relevant for today's and tomorrow's learners. One key to understanding the Net Generation, however, is recognizing that this demographic is not specifically about technology; rather, it is about the activities or experiences that technology enables (Roberts, 2005). Technology is merely a tool that may or may not support the various learning activities that are available, as part of one's individualized approach to learning, for selection from a cafeteria-style array of learning services.

Today's learners have what Oblinger and Oblinger (2005) describe as "multiple media literacy" (p. 2.14). As such, educators today must not only prepare students for future careers, but also prepare students for the "real world," where state-of-the-art technologies will be encountered on a regular basis. Alvin Toffler's book *The Third Wave* (1980) illustrates society's transition from a brute force economy (the Agricultural and Industrial Revolutions) to a brain force economy (the Information Revolution). Toffler's subsequent book, written a decade later and titled *Powershift: Knowledge, Wealth, and Violence at the Edge of the 21st Century* (1990), explores power, based on individualism, innovation, and information. In today's economy, workers are increasingly dependent on knowledge and technology. Levy (2005) further builds on Toffler's ideas with his concept of "the fourth revolution," a movement to develop the full potential of knowledge workers, in order to gain maximum return from human capital. Emphasis is placed on the knowledge container, the "knower" whereby the learner is in full control and learning is no longer linear. These learners have the freedom and power to select what they wish to learn – central characteristics of the Net Generation. A key issue to consider for educators of this new demographic, therefore, is how to measure quality, given the new demographics' preference for learner-centred, cafeteria-style educational choices to meet their learning needs. If the learner is in control and can choose what he or she wishes from a selection of educational materials, can quality be achieved? How will we credential and certify learning competence?

If one assumes that the learner is in full control, what influence does this have on preferences for mobile learning? Given our knowledge of the Net Generation, Wagner and Wilson (2005) argue that mobile learning – while enabling equal opportunity access, ubiquitous connectivity, multi-generational uses and users, services for the mobile worker, and services for the mobile learner – will benefit most those who can leverage their digital communication skills in a world that has been levelled by mobile technologies.

MOBILE LEARNING IN DISTANCE EDUCATION TODAY

Muirhead (2005), in his paper, "A Canadian Perspective on the Uncertain Future of Distance Education," sees distance education to be at a "critical juncture in its historical development," and views distance educators as no longer leaders in an environment of "technology-enhanced, hybrid,

flexible learning environments" (p. 239). The educational marketplace is increasingly literate and competent with information and communication technologies, a phenomenon that forces distance educators to adapt to a rapidly changing technological social and learning environment. Muirhead believes that "distance education must focus on how to reconceptualize itself and reconcile the increasing role of computer technology in everyday educational activities, with the growing adoption of distance-like educators" (p. 253). According to Clyde (2004), "the challenge is to identify the forms of education for which m-learning is particularly appropriate, the potential students who most need it and the best strategies for delivering mobile education" (p. 46).

In 1996, the University of Hagen and FernUniversität, Germany's Open University, developed a virtual university system, the first e-learning platform and university in Germany offering services via the Internet. Within the past five years, the University of Hagen has evolved this virtual university model to the *pocket university*, where m-learning is being investigated for teaching and learning (Bomsdorf, Feldmann, & Schlageter, 2003). As with Athabasca University, the University of Hagen's typical students are employed, study part-time, prefer to attend virtual events asynchronously, and need access to information and materials while travelling. For these students, efficient learning is key to educational success, and the flexibility to learn at a time and place which they choose is critical.

Researchers cited in this chapter are focusing on the tools, techniques, style, structure, user interface, and the multitude of formats available for mobile learning and mobile devices. As such, educators are discovering various advantages and disadvantages of mobile devices for education. While some benefits of mobile devices include portability, collaboration and sharing, anytime-anywhere flexibility, "just-in-time" learning, and advantages for learners with learning difficulties and disabilities, there are also disadvantages in using mobile devices for learning (Riva & Villani, 2005).

Central disadvantages of using mobile devices are the small display screen (Rekkedal & Dye, 2007), reduced storage capacity, and reliance on a battery-powered device. Waycott and Kukulska-Hulme's (2003) research found that using PDAs for reading and note taking was not ideal. For older learners, diminishing eyesight makes viewing small screens a challenge. In addition, the lack of a common platform among the various manufacturers and equipment available (e.g., smartphones, cellphones, PDAs), complicates the development of content. There are

also security issues inherent in using a wireless device and connecting to an "outside" environment. Also, as more users access a wireless network, bandwidth can be compromised, affecting the immediacy expected by today's learners. Some educators opine that mobile devices are not the be-all, end-all solution to addressing the needs of today's learners, and that performance improvement and optimized environmental conditions for learning should be the focus – rather than the technology itself (Rushby, 2005). Nonetheless, these emerging technologies appear to complement many of the characteristics of today's learners and of other media used for delivery of distance education programming.

    Next-generation learning environments are being designed to be highly interactive, meaningful, and learner-centred. Kirkley and Kirkley (2005) believe these elements are important, as educators consider how to use technological affordances to provide a learning environment that reflects the same cognitive authenticity as the domain area or environment being trained. In *Going Nomadic: Mobile Learning in Higher Education,* Alexander (2004) describes the emergence of *learning swarms,* wherein the socializing powers of mobility and wirelessness are influencing the way we look at traditional education methods and the traditional, physically sedentary campus. Alexander (2003) argues that "m-learning shifts the educational center of gravity towards students, raising fundamental and practical questions about learning for every instructor and campus" (p. 3). Knowing the intended learning audience allows for more options to engage them in the learning process. Chris Dede (2005) of Harvard University's Graduate School of Education argues that campuses which make strategic investments in "physical plant, technical infrastructure, and professional development will gain a considerable competitive advantage in both recruiting top students and teaching them effectively" (p. 15).

MOBILE LEARNING AND EDUCATIONAL OPPORTUNITIES

What does mobile learning mean to providers of higher education today? Removing barriers to enable learning anytime, anywhere for learners worldwide and increasing the equality of educational opportunities can be provided by using mobile devices, as several of the researchers and educators cited earlier in the chapter have noted. Dede suggests that new methods of teaching and research must be explored to better serve students. Various university mandate statements affirm several of the

themes relating to mobile learning discussed earlier, such as accessibility, flexibility, meeting the needs of the learner *and* the workplace, and a commitment to research, learning technologies, and individualized distance education methods (Athabasca University, 1999, 2002, 2005; University of Waterloo, 2002; Royal Roads University, 2004).

Although technology has regularly transformed the preparation and delivery of distance education materials (from print to television to online, to mention just a few technologies), institutional mandates give impetus to further work in the field of learning technologies and methods, and to the newest evolution of e-learning. The methods and outputs of print-based educational publishing have been replaced largely with a new digital paradigm. Faculty and subject matter experts now interact with increasingly specialized team members skilled in multimedia and digital communication. Gone is distance higher education's reliance on paper-based manuscripts, hard-copy texts, broadcast technologies, and traditional course packs. Institutions once at the vanguard of the distance education movement must now compete with newcomers to the e-learning environment, as well as with the traditional bricks-and-mortar institutions, in the new arena of online, individualized, and collaborative learning.

MOBILE LEARNING AT ATHABASCA UNIVERSITY

In what ways has Athabasca University addressed the needs of the new generation of learners with mobile learning and associated technologies? How is Athabasca University different from other educational providers, and how can the university capitalize on its rich history of distance education, individualized approaches to learning, and the removal of barriers to learning? In October 2006, Athabasca University illustrated its commitment to mobile learning by hosting *mLearn 2006,* the fifth world conference on mobile learning, in Banff, Alberta (see: http://www.mlearn2006.org/). Topics of discussion included building and implementing m-learning strategies in educational institutions, corporations, and government; m-learning theory and pedagogy; cost-effective management of m-learning processes, digital rights management, and m-learning management systems (mLMSs); emerging hardware and software for m-learning; creating interactive and collaborative m-learning environments; intelligent agents, learning objects, and metadata for m-learning; mass personalization and socialization; m-learning in

developing countries; and the evaluation, implementation, instructional design, student support, and quality of m-learning. Various case studies, papers, poster sessions, workshops, and speeches were presented by conference attendees from around the globe. Several Athabasca University projects have since applied e-learning and m-learning pedagogy to support learners, and are discussed below.

THE DIGITAL READING ROOM

The Digital Reading Room (DRR) at Athabasca University enables students to access library materials that have been selected by faculty for a particular course. The DRR is an interactive online reading room, offering digital files for course readings and supplementary materials. It can accommodate a range of formats, including online journal articles, electronic books, audio or video clips, web sites, and learning objects. In 2007, the DRR housed more than 20,780 resources, serving 235 courses (Tin, 2007). The resources available have been specially selected by faculty, are organized by course and by lesson for the convenience of students, and are accessible using *persistent links* (PURLs). The library's Web Access Management (WAM) function manages access to licensed resources, including password protection of copyrighted intellectual property (Magusin, Johnson, & Tin, 2003). The Athabasca University DRR can be accessed at http://library.athabascau.ca/drr/

The Mobile Deployment

Mobile access has been used to articulate the resources that are also suitable for m-learning, currently available in the Athabasca University DRR. This work has resulted in the implementation of a comprehensive mobile library web site that contains relevant digital reading files, application tools and software, and learning resources. These materials include

- mobile device-ready learning objects, including MP3 versions of journal articles, video clips, and e-books
- existing AU library electronic resources, organized for m-learning
- an m-library web site
- a comprehensive list of m-learning application tools
- A best-practice document for m-learning instructional design.

Figure 2 illustrates how the desktop version of the DRR has been adapted for mobile display.

FIGURE 1. Athabasca University DRR interface for MBA program (desktop display)
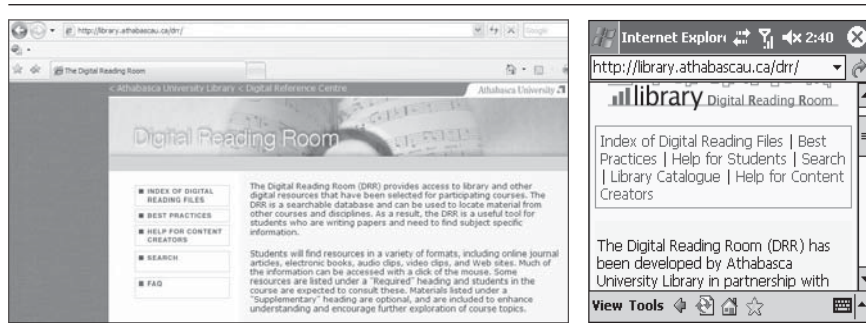
FIGURE 2. DRR desktop display (left) and mobile display (right)

Mobile ESL Project

E-learning, or using computers to study, is a well-established pedagogy in Canada. Athabasca University has taken e-learning one step further by using mobile phones to deliver interactive course materials. The AU Mobile English as a Second Language (ESL) Project provides English grammar lessons and interactive exercises to anyone with a mobile device (cellphone, PDA, or smartphone) and access to the Internet. Students can brush up on their English language skills while waiting for a bus, over their lunch break, or whenever they have time to review grammar. The AU Mobile Learning Project was sponsored by the Canadian Council on Learning, Alberta Science and Research Authority, Canada Foundation for Innovation, Athabasca University, Canadian Virtual University, and the National Adult Literacy Database.

The digital ESL content is based on Penguin's bestselling introductory English grammar lessons and exercises, which was released by the author as open-source material (O'Driscoll, 1988; 1990). Students have access to the basic tools of English grammar in an interactive modular format, accessible on mobile and fixed computing devices. The course content consists of 86 lessons and related exercises that teach the basics of the English language, ranging from the difference between *is* and *are* to verb tenses, countable nouns, and other aspects of basic grammar. These digital lessons have been adapted into reusable multimedia learning objects that are accessible to anyone on the Internet, either as stand-alone lessons, groups of lessons in units, or as full-course modules. The content materials are in a digitized format with interactive elements added to enhance flow and learner motivation. Specifically, the content has been rendered interactive by using a variety of multiple-

choice, short-answer, jumbled-sentence, matching/ordering and fill-in-the-blank exercises on the World Wide Web. The content is specifically formatted for output on small mobile devices. Figure 3 illustrates the mobile ESL content on a basic cellphone. This familiar learning context lends a sense of security to teachers and learners when using the mobile devices for learning. It adheres to the principle of introducing new technologies in a familiar context, as one would introduce new pedagogical approaches in traditional contexts. The course site has been developed to also auto-detect for desktop display; PDF and Microsoft® Word documents are provided for download or printout, should the learner prefer to use these document formats.

FIGURE 3. Mobile ESL display on a basic cellphone

Adult learners from three institutions – the Edmonton Mennonite Centre for Newcomers, the Chinese Evangelical Baptist Church, and Global Community College – assisted Athabasca University by pilot testing this project. The pilot testing indicated the following interesting results (Woodburn and Tin, 2007):

a) *Test Scores*: A slight improvement was shown after the students accessed and studied the grammar units on the mobile phone. The improvement was still noted the week following the pilot testing.

b) *Accessibility*: Almost all participants (90%) either "agree" or "strongly agree" that the mobile technology provided flexibility for them to learn anytime and anywhere.

c) *Quality of Learning*: Most participants (69%) thought that learning with mobile technology increased the quality of their learning experience.

d) *Taking More Mobile Lessons*: Most of the students (60%) chose either "5- Strongly Agree" or 4- Agree" when asked if they would like to take more lessons using mobile technology.

e) *Recommend to Friends*: Most (60%) agreed that this technology could be useful to others.

Mobile ESL learners have reported three main benefits from this project. First, students are provided with immediate feedback. As students work through the exercises one by one, they receive instant feedback on how they scored (after clicking *Submit*, they are told which questions they answered correctly or incorrectly); if they have answered incorrectly, they can try again and learn from their initial mistake. Second, this project allows for cross-referencing to other sites and resources. Mobile devices with constant wireless online access enable users to surf the World Wide Web and view related web sites on grammar that may assist them in their language learning. Last, this project increases motivation and opportunity for learning. Having the content online and right at students' fingertips, "one click away," means they can learn wherever they are, despite the constraints of busy work and personal schedules which take them from place to place. Moreover, as students achieve success and progress through the exercises, they may be motivated to learn more of the English language. The Athabasca University mobile ESL project can be accessed at http://eslau.ca

Athabasca University AirPac

The Athabasca University AirPac project is another example of mobile learning technology. AirPac is a software module of Innovative Interfaces

Inc. (III), an automated library system specially designed for compatibility with wireless mobile devices. AirPac runs on the library's server and sends out JavaServer Pages (JSP), formatted for mobile devices requesting information. AirPac allows mobile users with wireless Internet access to search and browse the library catalogue, check due dates, request materials, and view their patron records in real time. Library staff and patrons, including people with disabilities, can now access the online public catalogue via wireless LANs, WiFi, 802.11b, and Bluetooth. Digital information is reformatted "on-the-fly" for different browsers and screen resolutions. AirPac also recognizes that information needs to be formatted in Wireless Access Protocol (WAP). If the user submits a search from a wireless PDA (such as a mobile phone or handheld computer), AirPac formats a response for that type of device. For example, a mobile phone will receive a minimal display to accommodate the smaller screen area, while AirPAC will send a larger display to a PDA with more screen area available. Athabasca University's AirPac can be accessed at http://aupac. lib.athabascau.ca/airpac/.

The DRR and MP3 Technology

Moving Picture Experts Group Audio Layer III – more commonly known as MP3 – is a format that compresses digital audio file size, yet retains nearly the original quality of the audio. The DRR takes advantage of this new technology by offering MP3 audio-reading files for curriculum use. In particular, the DRR features the use of *MP3Producer*, a CD-ripping and MP3-encoding program (see http://www.softsia.com/MP3Producer-download-8ts0.htm). Using *MP3Producer*, a series of CD audio tracks were converted to MP3 files for use in French language lessons at Athabasca University. The resulting encoded files are more compact, suitable for playback on an *iPod®* or on a media player program on a mobile device.

In another Athabasca University example, pre-coded MP3 files were obtained with copyright permission and streamed for use in the Global Strategic Management (EGSM-646) course of Athabasca University's online MBA program. These Harvard University clips complement the study of several specific Harvard cases in the course. Students commented favourably on the learning value they provided; the video clips also provided the instructor with another medium for teaching course concepts. The MP3 files were converted into Realplayer's Real Media (rm) streaming format. They are available in both high-speed and low-speed versions, to accommodate bandwidth restrictions and thus remove another barrier for learning (see http://library.athabascau.ca/

drr/mba _template.php?course=mba&id=585). This type of technology is ideal for busy, time-pressed executive or adult learners engaged in graduate studies such as the MBA, undergraduate studies, or specific work-related training, while juggling family and business commitments, including travel. Although typically older than members of the Net Generation, Athabasca University students embrace many of the characteristics of this younger demographic, especially given their multiple-media exposure through the technologies and practices of business, the expectation of "digital connectedness" at all times, and the need to be highly efficient at multitasking. Today's office, like today's learning environment, increasingly knows no boundaries.

The Mobile DRR also features the use of text-to-speech (TTS) technology to convert machine-readable text into MP3 audio files. Using a software program called *River Past Talkative* (*RPT*; see http://www. riverpast.com/), a curriculum guide for a Master of Arts in Integrated Studies course, was converted from text into an audio-WAV file, providing a choice of natural human voices (see http://library.athabascau.ca/drr/view.php?course=mais&id=496&sub=0).

Once created, these audio files can be saved as MP3 files and listened to on a mobile device or portable MP3 player. The interface contains simple and readily accessible controls for different voices, including *AT&T® Natural Voices*™ (see http://www.naturalvoices.att.com). This program is also used to convert books and articles into MP3 audio books and audio articles for use in the mobile DRR. For an example, see http://library.athabascau.ca/drr/view.php?course=demo&id=418. To further enhance the audio books and articles with full-text display and content reading aloud, a software program called *MP3 Stream Creator* is used (see http://www.guangmingsoft .net/msc/).

IRRODL and MP3 Technology

The *International Review of Research in Open and Distance Learning* (www. irrodl.org) is a renowned, refereed, open-access e-journal that aims to disseminate research, theory, and best practices in open and distance learning worldwide. IRRODL is housed at Athabasca University's Open University Press web site. It is available free of charge to anyone with access to the Internet. IRRODL has pioneered the use of MP3 technologies for e-journal development (Killoh, Smith & Wasti, 2007). Individuals with *iPod*s®, mobile phones, and other mobile devices are able to access IRRODL's content anytime, anywhere. The inclusion of MP3 audio technology increases access for those with disabilities. IRRODL has featured

more than 40 MP3 audio articles for download and *iPod®*-casting. IRRODL uses NeoSpeech's *VoiceText®* technology to convert the written text into MP3 audio files. The MP3 version of IRRODL is available at http://www.irrodl .org/index.php/irrodl/index.

Podcasting

Podcasting is a term that describes the combination of a Rich Site Summary (RSS) feed and multimedia materials. It has become popular as multimedia-capable devices such as the Apple *iPod®* and other hand-held "smart" devices have become ubiquitous. Most podcasts are in MP3 audio format. The *iPod®* is not wireless-enabled, so it functions simply as an audio player. Using the DRR, Athabasca University researchers added multimedia clips of different formats and created a podcast RSS channel. Athabasca University has aimed at testing and exploring three different groups of multimedia clips: audio, video, and enhanced audio with pictures, and chaptering capabilities and their applications.

Podcasting works like a radio, but with better audio quality and no need to tune in at a specific show time. With a combination of *iTunes®* on the desktop and the mobile *iPod®*, students can retrieve materials when they connect the device at their desk, or listen to the materials on the road. *iPod®* is far superior to analog devices such as cassette tapes. Educational developers can add chapters in the clip, allowing learners to jump to the appropriate section. For some MPEG 4 audio files, pictures can also be encapsulated for each chapter. *iPod®* allows students to listen to audio lectures, anytime and anywhere. The subscription model streamlines the process for students to locate and retrieve newly available learning materials. As such, podcasting opens up a new and better way to deliver audio clips.

EFFECTIVENESS AND FUTURE OF MOBILE LEARNING

Is m-learning effective? Avellis and Scaramuzzi (2004) remind us that, although there is great potential for m-learning, there are relatively few successful implementations from which best practices can be studied. The "distinction between software and supporting learning is blurred because of the way the application runs, which affects its educational effectiveness, and the educational purpose, which underlies the design of the software... therefore, both aspects must be carefully considered" (p. 16). Further, Avellis and Scaramuzzi state that it is "difficult to develop a pre-defined

set of standards against which the educational value of the software can be defined, because it is not possible to define a unique and general instructional approach" (p. 16). One group of researchers has developed a set of "quality function deployment" tools to identify and classify four types of learning, using mobile devices and learning environments: context, presentation, management, and communication (Baber, Sharples, Vavoula, & Glew, 2004). These aspects are reflective of the functions considered important for mobile learning, such as the ability to "adapt functionality for learner characteristics and learning context; discover, access, evaluate, store, retrieve learning objects; monitor, utilise, evaluate learning outcomes; assist in the recovery of breakdowns and errors during and due to learning; support the learner's mobility" (p. 23).

Although mobile technology is still in its infancy, it holds unbounded promise and potential as a key medium for learning and training in the future. The challenge for higher educators and learning professionals, therefore, is to harness the burgeoning growth of this technology and transform it into educational formats that speak to today's new generation of online learners.

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