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**Abstract:** This article opens with a discussion of how and why mobile learning (m-learning) is purported to be the next step in the evolution of distance education, before looking at various perspectives on what m-learning constitutes. It critically examines the degree to which 'true' m-learning has been achieved, by offering pedagogical value beyond the mere use of mobile devices to deliver e-learning content. The authors argue that podcasting, in combination with a variety of portable MPEG Layer 3 (MP3) capable devices that are increasingly ubiquitous, 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, despite not being as technically complex. They present an example of a study in which podcasting was used to deliver supplementary listening material to distance learners undertaking an information technology subject. An end-of-semester survey yielded extremely positive feedback about uptake levels and the perceived effectiveness of the podcasts in aiding the students' learning of the subject matter. However, it also produced interesting results on the ways the students made use of the podcasts, which deviated from the researchers' original intentions for 'anytime, anywhere, any device' learning. The results are discussed in the light of possible influencing factors, supported by follow-up interview data. The study may have broader implications for the still nascent field of m-learning.

# **Pervasive, lifestyle-integrated mobile learning for distance learners: an analysis and unexpected results from a podcasting study**

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This article opens with a discussion of how and why mobile learning (m-learning) is purported to be the next step in the evolution of distance education, before looking at various perspectives on what m-learning constitutes. It critically examines the degree to which ‘true’ m-learning has been achieved, by offering pedagogical value beyond the mere use of mobile devices to deliver e-learning content. The authors argue that podcasting, in combination with a variety of portable MPEG Layer 3 (MP3) capable devices that are increasingly ubiquitous, 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, despite not being as technically complex. They present an example of a study in which podcasting was used to deliver supplementary listening material to distance learners undertaking an information technology subject. An end-of-semester survey yielded extremely positive feedback about uptake levels and the perceived effectiveness of the podcasts in aiding the students’ learning of the subject matter. However, it also produced interesting results on the ways the students made use of the podcasts, which deviated from the researchers’ original intentions for ‘anytime, anywhere, any device’ learning. The results are discussed in the light of possible influencing factors, supported by follow-up interview data. The study may have broader implications for the still nascent field of m-learning.

**Keywords:** *Mobile learning; Podcasting; Multitasking*

## **Introduction**

Distance education has progressed and evolved from pencil and paper correspondence courses to the use of analogue audio-based (radio, audio cassette tape) and video-based (television, videotape, videoconferencing) educational technologies, and finally the use of the personal computer. This evolution has paralleled the societal evolution from the Industrial Age to the Information or Electronic Age (Keegan, 2002). The advent of computer networks and later the Internet paved the way for the delivery of e-learning. E-learning promised to allow learners to study at their own time and pace, with a reduction in or elimination of on-campus attendance requirements, as with traditional distance education, but with the ability to disseminate course materials and facilitate both learner-learner and learner-instructor interaction at speeds and levels of convenience that were previously unconceivable.

However, the flexibility afforded to learners continues to be limited by the need to undertake learning activities at a tightly delimited and/or predetermined physical location, using a fixed device. Traditional, desktop computer-based e-learning is leaving a large segment of learners ‘out in the cold’ (Yuen & Wang, 2004, p. 2248). There is a need ‘... to dramatically expand the accessibility of learning beyond the physical footprint of the PC. If we remember that over 50% of the workforce [in the United States] does not sit at a desk, but instead is standing, walking or moving around a factory, we see the potential of breaking the tether of the Ethernet wire’ (Masie, n. d., cited in Shepherd, 2001, sec. 2., para. 1).

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The rise in popularity of portable electronic devices such as laptop and handheld computers, tablet PCs, digital cameras, mobile phones and personal digital assistants (PDAs), with rich media capabilities, decreasing physical sizes and increasing storage capacities, is helping to fuel a transition to a 'Mobile Age'. Correspondingly, a specialised form of e-learning, dubbed mobile learning (m-learning) is gaining significant interest in most sectors of the education and training industry. At the dawn of the new millennium, at a time when wireless technology began to gain widespread adoption, Clark Quinn (2000, para. 5) painted the following picture of the possibilities of m-learning: 'Rich interactivity, total connectivity, and powerful processing. A small device that is always networked, allowing easy input through pens and/or speech or even a keyboard when necessary, and the ability to see high resolution images and hear quality sound.' M-learning is a natural match for distance education, since it has the potential to fit in with the unique work-style requirements of the mobile workforce, who form a large proportion of current and potential distance learners (Yuen & Wang, 2004). More can be done to help them make efficient use of their time, by harnessing the idle moments they have in their day waiting or travelling on public transport, allowing them to undertake learning in conjunction with other tasks, or when on the move for extended periods of time, such as during business trips. Many of them are 'continuously connected' by mobile phones, laptops and hand-held devices.

### **The current state of affairs in m-learning**

Many varied and overlapping definitions of m-learning exist in the literature. In fact, Laouris and Eteokleos (2005) claim that a precise educational definition of m-learning is yet to be achieved. For example, Geddes (2004) defines it as 'the acquisition of any knowledge and skill through using mobile technology, anywhere, anytime, that results in an alteration in behaviour'. In their own definitions, many other authors (e.g. Quinn, 2000; Harris, 2001; Keegan, 2002; Wood, 2003) have tended to place more emphasis on the mobility aspect and the types of devices used. These authors view m-learning as occurring away from the learner's usual environment for formal learning, such as the home, workplace or educational institution. By contrast, O'Malley *et al.* (2003) 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' (emphasis added, see Table 1).

[TABLE 1 ABOUT HERE]

While m-learning can be viewed as a specialised type of e-learning that uses a variety of mobile computational devices, just a few years ago, the advent of e-learning offered the same promise of 'anytime, anyplace' learning that forms the chief selling point of m-learning today. Is m-learning nothing more than the new flavour of the month? Does it actually have anything new to offer us in the way of improving and/or enhancing the way we teach and learn? As Kukulska-Hulme and Traxler (2005) remind us, 'to a certain extent, learning... in various locations requires nothing more than the motivation to do so wherever the opportunity arises – from books, electronic resources, places and people' (p. 1). They list seven attributes that mobile learning applications might possess: *spontaneity, personalisation, informality, context-sensitivity, portability, ubiquity* and *pervasiveness*, which are described in Table 2.

It is arguable that the qualities of *personalisation* and *informality* are functions of the instructional and media design, and can already be achieved without the use of mobile technology. While most purported m-learning applications offer *portability* and *ubiquity*, and therefore also opportunities for *spontaneous* use, simply by virtue of the devices they are consumed on, 'm-learning' that consists of desktop-based e-learning content and activities that are repackaged for mobile platforms offers little extra value from a pedagogical perspective. It fails to deliver the real potential of *pervasive* mobile learning that provides the ability to undertake learning activities not only while moving in the sense of travelling or being in transit, but also while being actively *in motion* carrying out other manual tasks such as performing household

chores, walking from place to place or exercising. This type of learning ‘on the move, while in motion’ occurs only when learning activities are able to integrate into our daily lives in a completely unobtrusive fashion:

I use my handheld devices for ‘stolen moments of learning’ so that I can eke out a little more productivity in my day by learning while standing in line at the bank or waiting for an appointment... Designing for short instances of self-directed learning will be a norm for these new devices. A kitchen-sink design philosophy will most certainly fail because it violates the new paradigm for instant access and short sessions that is familiar to frequent handheld device users. (Metcalf, 2002, p. 19)

This emphasises that in striving to achieve pervasive, lifestyle-integrated m-learning, the focus should be on providing short, bite-sized pieces to facilitate ‘educational moments’ (Harris, 2001) or ‘short... informal learning events’ (Lee, 2005). There also appears to be some agreement in the recent literature that m-learning will not replace e-learning, or for that matter, traditional modes of learning, but instead will extend and/or supplement it (cf. Metcalf, 2002; Yuen & Wang, 2004; Son, Lee & Park, 2004).

In the face of myriad promising opportunities, m-learning faces a number of barriers. Quinn (2000) suggests that these include:

1. the problem of managing learning through intermittent connections; and
2. the lack of cross-platform solutions to give all learners access to all materials independent of the devices they use.

The second issue is continuing to be addressed through interoperability/standardisation efforts like learning object standards, with the goal of being able to run any compliant content on any compliant system. In response to the first issue, a continuous connection to the Internet may not be requisite for spontaneous, personal, informal, portable, ubiquitous and pervasive m-learning. Trifonova & Ronchetti (2003) describe m-learning delivery mechanisms as a continuum, with the two extremes being ‘pure connection’ and ‘pure mobility’. ‘Pure connection’ refers to a situation whereby the mobile device is continuously connected to the Internet; ‘pure mobility’ is when no connection is available and so all needed data and applications must be downloaded to the device beforehand in anticipation of offline use. Devices are synchronised whenever and wherever connectivity is available. Through techniques such as ‘content hoarding’ (Trifonova & Ronchetti, 2006), learning content can be automatically selected, prepared and pre-fetched to a mobile device’s local memory in anticipation of a period of limited or no connectivity.

Admittedly, applications that are context-dependent require solutions closer to the ‘pure connection’ end of the continuum (Trifonova & Ronchetti, 2003). Reliable, permanent connections for mobile devices are becoming available in many countries, in particular within metropolitan areas; however, recent media reports suggest that in countries like Australia the growth of m-learning has been hampered by the practices of the major telecommunications providers. Australian e-learning and m-learning analyst Dr Marcus Bowles (2004), states (in Wilson, 2005) that network switching is important for m-learning to prevent dead spots and dropouts from interrupting real-time learning and assessment activities. However, the providers have caused mobile data transmissions to be confined to high-cost cellular networks, neglecting the viability of wireless networks and satellite technology. While there have been definite improvements in infrastructure, with carrier licensing still based on the traditional cellular network model, configuration and access are vendor-specific and cannot be designed for seamless, transparent switching between networks (M. Bowles, personal communication, 17 November 2006). Perhaps part of the answer to this lies in the technological developments in and increasing availability of wireless broadband technologies such as mobile WiMAX (Worldwide Interoperability for Microwave Access) and Third Generation (3G) mobile phone networks, which enable mobile devices to maintain continuous connections to the Internet, but the costs of using these technologies on a large scale for synchronous m-learning remain prohibitive.

Another major obstacle lies in the usability of mobile devices. In discussing the outcomes of a WAP (Wireless Applications Protocol) based m-learning project by an Asia-Pacific consortium formed by Insead, Nokia and Incus, Keegan (2002) pointed out that ‘most wireless devices... [had] small screens, low resolution, slow processing, and limited storage capabilities’ (p. 63) Although these limitations are fading as technology continues to develop, increasing the screen size compromises the level of portability and mobility, as with laptops and tablet PCs. Most e-learning content has been developed for larger screens that impose fewer restrictions on the types of learner-computer interactions that are possible. The lack of convenient input tools continues to push research towards exploration of new types of user interfaces like sound (e.g. text-to-speech, microphones and voice recognition) and mobile scanning tools (Trifonova & Ronchetti, 2003).

In response to the question of whether true m-learning has been achieved to date, Reimann (2005) maintains that ‘... with Internet access from our laptops, PDAs and mobile phones, thanks to iBurst, Blackberry and the likes, we [already have anytime, anywhere access to content]... [But] [a]re people learning anywhere, anytime? Probably not. They make use of the technology to access information, and in particular email, anywhere, but that's not the same as learning’ (para. 1). Similarly, authors such as Metcalf (2002; 2006) and van Barneveld and Shaw (2006) believe what we have now is more accurately termed as ‘mobile performance support’.

### **Educational podcasting and its benefits for distance learners**

In order for the vision of true mobile learning to come to fruition, continued technological development and consumer market entry of ad hoc networking and context-aware mobile devices may be needed (Reimann, 2005). These devices will be sensitive to their environment, able to cooperate with one another and ‘smart’ enough to sense ‘situationally appropriate’ (Carnegie Mellon University, 2001; Fogarty *et al.*, 2005) times to interact with the learner to supply content or otherwise intervene to facilitate learning. Meanwhile, although there is no silver bullet, the authors believe that the use of portable digital audio players is a step in the right direction. Unlike many other existing m-learning applications, listening to learn ‘frees eyes and hands’ (Clark & Walsh, 2004) and liberates learners from the need to fixate on a small screen. Short, ‘bite-sized’ audio clips can not only be used to fill the moments of ‘wasted’ or ‘dead-time’ amidst other day-to-day activities, but in many cases can also coincide with these activities for pervasive learning that is interwoven with and integrated into learners’ lifestyles. Moreover, MP3-capable mobile devices have tremendous levels of social appeal that work to their advantage (ibid, 2004).

Podcasting, a technology that allows users to receive new audio material on their desktop computers automatically by subscription, offers a low-cost, low-barrier solution for the timely delivery of content as it becomes available, ready for transfer to or synchronisation with a portable device. In this way, this approach is closer to the ‘pure mobility’ end of the m-learning spectrum. The subscription-based download of files is made possible by Really Simple Syndication (RSS), a technology originally designed to allow the syndication of text summaries of frequently updated websites like news sites and weblogs. RSS 2.0 (RSS Advisory Board, 2005) feeds permit the inclusion of *enclosures*, which in the case of podcasts are simply references to audio files, usually in MPEG Layer 3 (MP3) format. A podcast-aware aggregator or ‘podcatcher’ application on the user’s desktop is configured with the URL of the feed(s) to monitor for newly added enclosures.

RSS and podcasting have much to offer in the way of simplicity, convenience and time savings for busy distance learners since the user does not have to manually plough through a plethora of sites for relevant content; nor is there a need for the even more tedious process of continually monitoring these sites for updates. As new enclosures become available on subscribed feeds, the files they refer to are automatically downloaded, with no user intervention. By having a computer continuously online, bandwidth-intensive content can be ‘drilled in’ and made available when ready, so that the ‘click and wait’ situation common in streaming is effectively eliminated (Curry, 2004), even in bandwidth-constrained environments.

Being MP3 files, podcasts can be transferred to a variety of portable devices, including but not limited to dedicated MP3 players, mobile phones and personal digital assistants (PDAs). Returning to Kukulska-Hulme and Traxler's (2005) seven characteristics of m-learning, the use of podcasting in combination with portable MP3-capable devices appears to demonstrate all but one of these characteristics to a large degree, as can be seen in Table 2.

[TABLE 2 ABOUT HERE]

The remainder of this article is devoted to a case study in which podcasting was used to deliver supplementary learning material to a group of distance learners studying an information technology subject, with the initial assumption that these students would transfer the podcasts to portable devices and multitask listening to them with other activities in the interest of efficiency and time savings. A survey of the students' usage patterns yielded some unexpected results, which may have broader implications for the theory and practice of mobile learning.

### **Mobile learning, podcasting and distance learners: a case study**

#### *Background, purpose and aims*

In a recent study, the authors attempted to ascertain whether or not the use of podcasts could help mitigate the issues caused by isolation and promote inclusivity for distance education students, by taking advantage of the affective qualities of audio (Lee & Chan, submitted). They used podcasts that were structured as short, 3 to 5 minute talkback-radio style segments presented in a relaxed and informal style. It was hoped that the style and format of these podcasts would make listening to them more easily multitasked with other activities, using a variety of mobile devices. The ability to enjoy 'anytime, anyplace, any device' consumption with this level of convenience and lifestyle integration would ostensibly be of considerable benefit to distance learners with hectic personal and professional schedules. However, as seen in an end-of-semester survey, their reported usage patterns were not altogether consistent with this view. It is included here as an illustration of the possibilities and problems that may arise when trying to accomplish pervasive, lifestyle-integrated mobile learning.

The research aims of the study relevant to the present article include:

- To determine the *level of uptake* of the podcasts amongst the distance education student cohort and the factors that influenced this;
- To examine the *perceived effectiveness and impact* of the podcasts on the students' learning;
- To investigate the *ways in which the students preferred to obtain and consume* the podcasts.

#### *Context and participants*

The participants were from a class of on-campus and distance education students, including both undergraduates and postgraduates, enrolled in a Human-Computer Interaction (HCI) subject at Australia's largest distance education provider. The subject's core learning strategies are based around readings from a set textbook, web-based notes and other readings, as well as a series of online tutorial and practical exercises. In addition, students are urged to undertake wide reading of academic literature beyond that prescribed or suggested by the lecturer. The primary online communication method in the subject is an asynchronous discussion board, used to facilitate a continual class dialogue whereby students share their reading, experiences, ideas and questions with one another.

In Autumn 2006, the students studying the HCI subject in on-campus and distance education modes were provided with access to the same podcasts, with a new episode made available each week. The episodes were recorded and released progressively over the semester, and included the following, all of

which involved dialogues between two or more speakers (volunteer students) presented in a casual and light-hearted fashion for easy listening:

- Various 'topic trailers' providing a lead-in to and broad overview of each topic to prepare students for the core learning activities;
- Summary or 're-cap' material to provide revision and reinforcement;
- Assignment tips, hints and post-assignment feedback from the lecturer;
- An interview, conducted over the popular Voice-over Internet Protocol (VoIP) tool *Skype* (2007), with the UK-based author of the prescribed textbook for the subject.

The content was supplementary in nature. In the university's definition, this refers to materials that do not directly affect the assessment of a subject but aid learning and provide support in relation to the core learning materials. In other words, students who did not listen to the podcasts but diligently worked through the textbook, online materials and printed study guide would not miss out on content that might appear in the final examination. The students had the option of either downloading the MP3 files manually via hyperlinks on the online subject outline, accessible through a portal within the university's proprietary learning management system, or configuring their podcatchers to periodically check for new files and download them automatically.

### *Methods*

At the end of the semester, email invitations were issued to the distance education students in the HCI subject to participate in an online survey, which was advertised as being completely voluntary and anonymous. The survey consisted mainly of close-ended (multiple choice and Likert rating scale) items, although two open-ended items were also included, the responses to which are not relevant to the present article. Students were requested to respond regardless of whether they had downloaded or listened to the podcasts. The survey was kept open to collect responses for approximately 10 days, before simple descriptive statistics were performed on the responses to the close-ended items.

Following the survey, semi-structured interviews were carried out with a small random sample of students, for triangulation purposes as well as to gain richer and deeper insight into the students' usage patterns of the podcasts and the reasons behind their choices, which relates to the third research aim above. The interview recordings were transcribed and analysed using a simple content analysis (Patton, 1990) approach to identify, code and categorise primary patterns in the participants' discourse according to the major issues of interest that emerged from the survey.

### *Results*

A total of 39 distance education students (31 undergraduates and 8 postgraduates, aged between 19 and 54, mean age 30.9) were invited to participate. There was a response rate of 46% (18 students).

According to the survey results, all 18 respondents had access to a desktop or laptop computer able to play MP3 files, with 12 (67%) of them additionally having access to one or more MP3-capable portable devices. Reported uptake levels of the podcasts were excellent. Of the nine available podcasts, each respondent reported having downloaded a mean of 8.09 podcasts (standard deviation = 0.59), with all but one respondent downloading at least seven podcasts. The respondents listened to a mean of 7.61 of the podcasts (standard deviation = 0.64) in their entirety (from start to finish), with 15 (83%) of them listening to seven or more podcasts in their entirety. 16 (89%) of the respondents listened to at least three of the podcasts multiple times.

Tables 3 and 4 summarise the responses to the survey questions pertaining to the students' perceptions of the value, effectiveness and impact of the podcasts, as well as how, when and where they obtained and consumed the podcasts. Most respondents reported having little or no trouble both obtaining

(downloading) and consuming (listening to) the podcasts (Table 3, Questions 8j and 8k). The podcasts themselves were also seen not only as being useful and of educational value in the context of the subject, but also as being of entertainment value (Table 3, Questions 8a, 8b, 8c, 8m and 8r). The students' perceptions of the style, format and approach adopted, of the content and topics chosen and of the specific benefits gained from the exercise are detailed in Lee & Chan (submitted).

There were also some rather unexpected results. Despite the high levels of MP3 player ownership and the fact that the respondents were generally in agreement that they were more likely to listen to the podcasts because of the ability to do so on the move (Table 3, Question 8e), an overwhelmingly vast majority preferred to listen to the podcasts *using a desktop/laptop computer, at home and set aside dedicated time to do so* (Table 4, Questions 5, 6 and 7). Similarly, although the respondents were in clear agreement with the statement, 'Subscribing to the feed using an aggregator/podcatcher to allow automatic download of the podcasts makes it easier for me to obtain them' (Table 3, Question 8f), most of them favoured *manually downloading the MP3 files via a web browser* instead of taking advantage of the capabilities of RSS (Table 4, Question 3).

[TABLE 3 ABOUT HERE]

[TABLE 4 ABOUT HERE]

While the results obtained in relation to the uptake levels and perceived effectiveness/usefulness of the podcasts were extremely encouraging, the respondents' reported usage patterns are at odds with the vision of pervasive m-learning as portrayed by authors like Clark and Walsh (2004), Lee (2005) and Metcalf (2002), cited earlier. While one might justifiably question the pedagogical soundness of expecting students to engage in activities designed to encourage 'deep' learning while performing other tasks, or with a host of distractions around them, this was not at all the expectation with these informal, talkback-radio style podcasts. Because the survey did not probe the reasons why students made the choices they did as seen in Questions 5, 6 and 7 in Table 4, a series of follow-up interviews was conducted with 12 students studying the HCI subject. Discussion centred primarily around the reasons behind the students' preferences in terms of how, when and where they listened to the podcasts.

It was evident from most of the interviewees' responses that they did not multitask their listening of the podcasts with other tasks because they treated it as a learning activity that formed part of formal, deliberate study efforts demanding undivided attention and concentration within a designated study location (usually in the home). This was despite the fact that the podcasts were classed as supplementary in nature, and were deliberately designed so as to provide for easy, casual listening as opposed to lectures containing complex, information-dense instructional content:

I do all my study at home... Listening to the podcasts is part of my study and so happens in [my] dedicated study time.

I have time at home at night to listen and concentrate on the podcast[s] with less distractions.

Unlike music, podcasts tend to require more focus and concentration, so I prefer to be sitting down in front of my laptop.

[I]... want to hear the content clearly.

For the small number of students who did choose to multitask, the fact that the podcasts did not contain examinable material was a key factor in influencing this choice:

If they were for assessment then I would set aside time to listen to the podcasts, however as they are not for assessment purposes I listen to them while doing other tasks.

At a deeper level, the interview data revealed that the ways in which students used the podcasts to enhance their learning in line with their own learning styles, preferences and individual study strategies appeared to

have a significant bearing on when, where and how the podcasts were listened to. For example, a number of interviewees reported using the podcasts as pre-study listening material, either to provide a preview of the content to be studied in the prescribed readings, or to serve an affective function such as to motivate them and set the mood for their personal study time:

[I set aside dedicated time because I]... Usually [listen to the podcasts] before I commence reading the relevant material from the textbook for the given week...

Like pulling on your running shoes seems to mentally prepare you for exercise, so listening to podcasts helps... [me]... prep for... [my]... study session.

Another student's preferred strategy involved listening to each podcast multiple times, initially using a portable device, then subsequently on her home computer to facilitate more in-depth listening:

The first time I listen is usually a scan and that is done on an MP3 [player]... I can then re-listen [at home, on my PC], while I sit down with my books and material. That is why the podcasts are extremely useful to me in my learning, especially [for] one with a busy worklife... [Listening to the podcasts at home is beneficial because it is] quieter... [and allows for]... better concentration after the first 'quick' listen... I close my eyes and just listen away.

Last but not least, many of the interviewees expressed the view that they found it inconvenient – even cumbersome – to transfer the podcasts to a portable player, and did not find this to be worth the time savings to be gained from the ability to listen on the move:

... I can download when I am online and then listen to the podcast on the PC without having to transfer onto the iPod.

[I tend to listen to the podcasts on my laptop to avoid spending]... too much time messing with controls of [my] MP3 player. On my laptop I can just quickly switch over to iTunes or [Windows] Media Player and listen for 5 minutes.

... the podcasts aren't important to listen to more than once so I don't transfer them to my iPod to listen to on the road.

Further research is required to ascertain what influence, if any, the design of the podcasts, including their format and length, had on this view. For example, students may see benefit in transferring longer podcasts, such as full-length lectures, to a portable device.

### *Discussion and future work*

The issue of multitasking and its effect on m-learning certainly warrants further investigation, since the ability to engage in multiple tasks concurrently forms the core, essential motivation driving the development of the technologies upon which m-learning is based. A limitation of the present study is that it relied solely on students' retrospective self-reports of their podcast usage. The authors plan to conduct a subsequent study in which they will implement measures to capture and analyse the usage patterns *as they occur* through a combination of computer log files and journals/diaries maintained by the students.

Meanwhile, despite an extensive literature search, the authors have been unable to locate information on systematic research conducted into students' tendencies or abilities to multitask their listening of audio learning material with other activities. It appears that rhetoric, rather than empirical evidence, is often used as the basis for arguing that modern mobile technologies are a time-saver, allow students to multitask and promote a high level of lifestyle integration. The authors also attempted to find research on student use of older portable audio technologies such as personal stereos and portable CD players, as a means of understanding whether the issues that arose from the podcasting study were new, or simply old issues in a new guise. This search yielded only results of limited relevance, which do not focus directly on the effects of mobility and multitasking on student learning. In a study by Sumner (1990), commuter students living at a distance from their university campus rated listening to educational audio tapes while commuting as 'not helpful', although they did report to listening to the radio while commuting. The reasons behind this

were not covered by the study. Other learning activities that the commuter students found to be not helpful included reading, writing, using instructional materials and playing educational games; instead, they favoured engaging in collaborative activities with fellow commuter students during their travel time, such as discussion, brainstorming and providing encouragement for one another.

It is unclear at this stage whether the tendency of the students in the podcasting study to avoid multitasking was an issue of actual ability, in which they found difficulty in absorbing and processing information from multiple concurrent sources, or simply one of self-efficacy, which may have been a result of the way they were conditioned to learn in their prior tertiary studies. Another plausible explanation for the unexpected results is that the students simply might not have wanted their study to infringe on their personal (family, social, leisure) and professional (work) time, and so consciously chose to demarcate boundaries to keep these aspects of their lives separate. In relation to the former issue, in a study at Cornell University, Hembrooke and Gay (2003) found that students who were allowed to multitask using their laptops with listening to lectures suffered decrements on traditional, immediate measures of memory (recall and recognition questions) for the lecture content, as compared to those who were not allowed to do so. The viewing of relevant web content on the laptops did not predict better performance, and spending the majority of class time viewing class-related content did not result in higher scores on the memory tests. In fact, students who spent more time browsing class related pages fared poorer on recall questions, whereas those who spent more time browsing class unrelated pages scored better on these questions.

Cognitive Load Theory (CLT) (Chandler & Sweller, 1992; Sweller, van Merriënboer & Paas, 1998) provides one good candidate to serve as a sound theoretical framework for further investigation into of students' abilities to engage in the type of multitasking demanded of pervasive, lifestyle-integrated m-learning. According to CLT, the 'split attention' effect occurs when a learner must attend to multiple sources of information simultaneously, causing him/her to have to divide attention between tasks. Few, if any humans are capable of effectively dealing with many of the cognitive tasks demanding split attention, due to the cognitive load these efforts have on our limited working memory (Sweller, 1999). Even attempts to combine tasks that require passive and behaviourally active cognitive constructiveness may result in split attention overload (Gladstones & Regan, 1989; Fracker & Wickens, 1991; Pashler, 1994). This cognitive overloading, rather than deeply engaging attention, generates frustration or distraction. Recent research in the neuroscience domain is supportive of the presence and effects of the split attention principle. For example, experiments conducted at Johns Hopkins University (Shomstein & Yantis, 2004) produced results indicating that not only are attentional resources strictly limited, but when attention is allocated to one sensory modality, such as audition, this necessarily exacts a toll on the resources available to another modality, such as vision.

CLT tells us that split attention problems in multitasking may be eliminated through the development of automated schemata within long-term memory for one or more of the tasks through sustained practice in those tasks. In the study by Hembrooke and Gay (2003) described earlier, by categorising learners by browsing style, the researchers found that the negative correlation between the time spent on class-related sites and performance was mediated by the learner's ability to monitor or balance their browsing behaviours: 'The sustained distraction, regardless of content relevance appears to be the nemesis of the multitasker; if one is adroit at staccato-like browsing, processing multiple inputs simultaneously may not suffer to the same extent' (p. 59). Perhaps a similar principle applies to m-learning. If this is the case, some learners may be able to jump quickly and nimbly between the cognitive tasks involved in attending to audio learning material, and other tasks in their daily lives. Hembrooke and Gay further suggest that if, through time and practice, students can become more efficient browsers, or at least become more adept at self-monitoring their browsing behaviour, the typical performance decrement seen in multitasking conditions may be reduced. This highlights the importance of self-regulatory and other metacognitive skills (White, 1999) in multitasking situations, even more so in non-classroom based situations such as those that would be found in many types of m-learning.

In certain situations or with the available technology, it may in fact transpire that it is infeasible to manage split attention problems in order to achieve a high degree of lifestyle integration through multitasking learning with other activities. This does not mean that the goal of pervasive, lifestyle-integrated m-learning cannot be fulfilled; an alternative strategy is to attempt to avoid split attention as much as possible by designing m-learning that is linked to or coupled with, rather than replacing or occurring in parallel to, other tasks in learners' daily lives. This way, learning tasks can be attended to with focused attention and active engagement, rather than divided across several tasks, while still accomplishing the goal of having a high level of lifestyle integration. The use of mobile technologies presents exciting prospects for authentic learning and assessment that is directly linked to and/or situated within distance learners' work contexts. For example, the multimedia capabilities of modern portable devices can be used to deliver text, audio, images and video to members of a distributed workforce in small, 'bite-sized' pieces for just-in-time learning. Simulations can be built for quick, formative and/or diagnostic assessments that can be completed by learners at their convenience or in preparation for a real task in the workplace. The technology also opens new doors in the way of delivering learner-generated content. In addition to text, learners can capture voice, images and video in authentic settings to be shared with their peers and instructors, and receive assistance with and feedback on job tasks through opportunities for observation, correction and remediation.

## **Conclusion**

Mobile learning is being hailed by many as the next stage in the evolution of e-learning. While it is likely that m-learning will not fully replace traditional forms of learning, at least in the foreseeable future, it offers considerable potential to supplement and/or extend existing face-to-face, print-based distance learning and e-learning applications, particularly when it is able to incorporate all of the qualities listed in Table 2. The benefits of these features are substantial for distance learners with several competing priorities in their lives. However, at this stage, few or none of even the most technologically sophisticated m-learning applications are able to fully demonstrate these features without compromising at least some of them. In particular, the goal of totally pervasive and context-sensitive m-learning remains a vision rather than reality at the present time. As Kukulka-Hulme, Evans and Traxler (2005) caution, educators and technologists must be wary about claims that new technologies and devices can be used for learning anyplace, anytime – Pedagogical, technical, logistical, usability and social constraints must be given due consideration.

For now, the use of recorded audio, albeit a simple and mature medium for learning delivery, offers a step towards and insight into pervasive m-learning designed to take place 'on the move, in motion', since listening does not require visual fixation and therefore can coincide with other manual activities. The podcasting case study described in this article is presented as an example of the possibilities and problems in trying to achieve this level of lifestyle integration. It is clear that podcasting provides a flexible option for the delivery of content to, and consumption of material by, distance learners, and that it adds yet another modality of learning. However, there may be impediments to realising its full potential as a means of facilitating pervasive, lifestyle-integrated mobile learning.

While the sample size alone makes the study and its results far from conclusive and generalisable, they certainly prompt us to consider the challenges that may persist even following the development of tools and technologies that are theoretically able to make learning spontaneous, personalised, informal, contextual, portable, ubiquitous and pervasive. For example, if learning is to be multitasked with other activities, split attention problems must be avoided or managed. Individual learners' self-efficacy and perceptions of the devices and tasks involved, including their desire to see these technologies used in their learning – or otherwise – cannot be overlooked. All in all, educators cannot make assumptions based solely on extrapolations of how students' day-to-day uses of technology for other purposes will carry over into learning scenarios. The fact that learners use certain technologies for work, communication and entertainment does not necessarily mean that they will automatically use them in similar ways for effective

learning. The ability to be a successful m-learner, for example, may require the development of new meta-learning competencies, or at the very least a different mindset.

## References

- Bowles, M. S. (2004) *Relearning to e-learn: strategies for electronic learning and knowledge* (Carlton, University of Melbourne Press).
- Carnegie Mellon University (2001) *Situationally appropriate interaction*. Available online at: <http://www-2.cs.cmu.edu/~hudson/sai/> (accessed 21 June 2005).
- Chandler, P. & Sweller, J. (1992) The split-attention effect as a factor in the design of instruction, *British Journal of Educational Psychology*, 62(22), 233-246.
- Clark, D. & Walsh, S. (2004) *iPod-learning* (Brighton, Epic Group).
- Curry, A. (2004) *iPodder – A brief history*. Available online at: <http://www.ipodder.org/history> (accessed 23 April 2005).
- Fogarty, J., Hudson, S. E., Atkeson, C. G., Avrahami, D., Forlizzi, J., Kiesler S., Lee, J. C. & Yang, J. (2005) Predicting human interruptibility with sensors, *ACM Transactions on Computer-Human Interaction*, 12(1), 119-146.
- Fracker, M. L. & Wickens, C. D. (1991) Resources, confusions and compatibility in dual axing tracking: displays, controls, and dynamics, *Journal of Experimental Psychology: Human Perception and Performance*, 15(1), 80-96.
- Geddes, S. (2004) Mobile learning in the 21st century: benefit for learners, *The Knowledge Tree: An e-Journal of Learning Innovation*, 6. Available online at: <http://knowledgetree.flexiblelearning.net.au/edition06/download/geddes.pdf> (accessed 14 November 2006).
- Gladstones, W. H. & Regan, M. A. (1989) Division of attention: the single-channel hypothesis revisited, *Quarterly Journal of Experimental Psychology*, 4(A), 1-17.
- Harris, P. (2001, July) Going mobile, *Learning Circuits*. Available online at: <http://www.learningcircuits.org/2001/jul2001/harris.html> (accessed 14 November 2006).
- Hembrooke, H. & Gay, G. (2003) The laptop and the lecture: the effects of multitasking in learning environments, *Journal of Computing in Higher Education*, 15(1), 46-64.
- Keegan, D. (2002) *The future of learning: from eLearning to mLearning* (Hagan, FernUniversität).
- Kukulska-Hulme, A. & Traxler, J. (2005) *Mobile learning: a handbook for educators and trainers* (New York, Taylor and Francis).
- Kukulska-Hulme, A., Evans, D. & Traxler, J. (2005) *Landscape study in wireless and mobile learning in the post-16 sector* (Bristol, Joint Information Systems Committee). Available online at: [http://www.jisc.ac.uk/index.cfm?name=eli\\_outcomes](http://www.jisc.ac.uk/index.cfm?name=eli_outcomes) (accessed 24 November 2006).
- Laouris, Y. & Eteolkeos, N. (2005) We need an educationally relevant definition of mobile learning, paper presented at *mLEARN 2005*, Cape Town.
- Lee, M. J. W. (2005) Mobile learning: should we get a move on? *Training and Development in Australia*, 32(4), 8-11.
- Lee, M. J. W. & Chan, A. (submitted) Reducing the effects of isolation and promoting inclusivity for distance learners through podcasting.
- Metcalf, D. (2002, March) Stolen moments for learning, *eLearning Developers' Journal*, 18-20. Available online at: <http://www.elearningguild.com/pdf/2/March02-Metcalf-H.pdf> (accessed 21 June 2005).
- Metcalf, D. (2006) *mLearning: Mobile learning and performance in the palm of your hand* (Amherst, HRD Press).
- O'Malley, C. O., Vavoula, G., Glew, J. P., Taylor, J., Sharples, M. & Lefrere, P. (2003). *Guidelines for learning/teaching/tutoring in a mobile environment*. Available online at: [http://www.mobilelearn.org/download/results/public\\_deliverables/MOBILearn\\_D4.1\\_Final.pdf](http://www.mobilelearn.org/download/results/public_deliverables/MOBILearn_D4.1_Final.pdf) (accessed 15 November 2006).
- Pashler, H. (1994) Dual task interference in simple tasks: data and theory, *Psychological Bulletin*, 116(2), 220-244.
- Patton, M. Q. (1990) *Qualitative evaluation and research methods* (Newbury Park, Sage).
- Quinn, C. (2000) *mLearning: mobile, wireless, in-your-pocket learning*. Available online at: <http://www.linezine.com/2.1/features/cqmmwiyp.htm> (accessed 5 June 2005).
- Reimann, P. (2005) *Mobile learning, ready or not?* Available online at: [http://www.elnet.com.au/experts/mobile\\_learning](http://www.elnet.com.au/experts/mobile_learning) (accessed 18 November 2006).
- RSS Advisory Board (2005) *Really Simple Syndication: RSS 2.0.1 specification (revision 6)*. Available online at: <http://www.rssboard.org/rss-2-0-1-rv-6> (accessed 2 March 2006).
- Shepherd, C. (2001) *M is for maybe*. Available online at: <http://www.fastrak-consulting.co.uk/tactix/features/mlearning.htm> (accessed 10 November 2006).
- Shomstein, S. & Yantis, S. (2004) Control of attention shifts between vision and audition in human cortex, *Journal of Neuroscience*, 24(47), 10702-10706.
- Skype (2007) Available online at: <http://www.skype.com> (accessed 13 March 2007).
- Son, C., Lee, Y. & Park, S. (2004) Toward a new definition of m-learning. *Proceedings of E-Learn 2004*, Washington, DC, 2137-2140.
- Sumner, J. A. (1990) As assessment of adults' learning strategies while commuting, paper presented at the 5<sup>th</sup> *National Conference on the Adult Learner*, Columbia, SC.
- Sweller, J. (1999) *Instructional design in technical areas* (Camberwell, ACER Press).

- Sweller, J., van Merriënboer, J. J. G. & Paas, F. G. W. C. (1998). Cognitive architecture and instructional design, *Educational Psychology Review*, 10(3), 251-296.
- Trifonova, A. & Ronchetti, M. (2003) Where is mobile learning going? *Proceedings of E-Learn 2003*, Phoenix, 1794-1801.
- Trifonova, A. & Ronchetti, M. (2006) Hoarding content for mobile learning, *International Journal of Mobile Communications*, 4(4), 459-476.
- van Barneveld, A. & Shaw, S. (2006) Mobile learning: a review of implementations, *Proceedings of E-Learn 2006*, Honolulu, 980-985.
- White, C. J. (1999) The metacognitive knowledge of distance learners, *Open Learning*, 14(3), 37-46.
- Wilson, E. (2005, June 7) Why mobile e-learning fails to make a move, *Sydney Morning Herald*, Next, 5.
- Wood, K. (2003, March 18) Introduction to mobile learning, *Ferl*. Available online at:  
<http://ferl.becta.org.uk/display.cfm?page=65&catid=192&resid=5194> (accessed 5 July 2004) .
- Yuen, S. & Wang, S. (2004) M-learning: mobility in learning, *Proceedings of E-Learn 2004*, Washington, DC, 2248-2252.

Table 1. Types of mobile learning (O'Malley *et al.*, 2003)

Technology	Fixed	Mobile
Location		
At usual environment	Non-mobile learning	Mobile learning
Away from usual environment	Mobile learning	Mobile learning

Table 2. Desirable attributes of mobile learning (based on Kukulska-Hulme & Traxler, 2005, p. 2) and how the use of podcasting and portable MP3-capable devices can be used to achieve them

Attribute	Description	Possible manifestation in educational podcasting applications
Spontaneous	Access to learning activities and/or resources at the spur or the moment or whenever the opportunity arises.	Access to content is on-demand as content is automatically 'dripped in' as it becomes available. The learner can pick and choose what to listen to on the fly without the need to 'click and wait'. Moreover, the large storage capacities afforded by modern portable electronic devices allow learners to carry substantial 'libraries' of content for spontaneous access while on the move.
Personal	Learner-centred; uses the affective qualities of various media to personalise the learning experience.	Companion media devices are 'personal' as is the nature of audio and the spoken word as a communication medium.
Informal	Makes learning a relaxed and casual activity. In some cases the learning may be incidental though facilitated/assisted by the use of mobile technology.	Podcasts can leverage the affective qualities of the human voice in such a way as to provide a relaxed and casual feel. Various podcast styles/formats can be used, instead of formally presented monologues or lectures, e.g. talkback radio, mailbag, interviews. Music and sound effects can also be incorporated to set the tone or feel and create a friendly, informal atmosphere.
Contextual	Aware of and sensitive to situational factors, time, location and the learner's current state/activity.	This attribute is only exhibited in a very limited sense of the term in that the onus is on the user (learner) to adapt the use of the content/material to particular contexts in his/her life. The technology in itself is incapable of providing contextualisation without significant human intervention.
Portable	Can be used in various locations and/or on multiple device types.	Podcasts can be transferred to and played back on a range of portable MP3-capable devices.
Ubiquitous	Available everywhere and/or using universally available devices.	MP3 playback functionality is universally integrated into devices that are already ubiquitously used by people in their day-to-day lives for work, communication and entertainment.
Pervasive	Integrated tightly and unobtrusively with daily activities.	Listening to podcasts can not only be listened to in 'wasted' or 'dead-time', but can also coincide with other, manual tasks in a truly unobtrusive fashion.

Table 3. ITC204/504 distance education students' end-of-semester responses: Perceived value, effectiveness and impact of the podcasts

<i>Please rate the following statements using the scale 1=Very Strongly Disagree, 2=Strongly Disagree, 3=Disagree, 4=Neutral, 5=Agree, 6=Strongly Agree, 7=Very Strongly Agree:</i>	Mean	Standard Deviation
Q8a. I found the podcasts useful for this subject.	6.17	0.36
Q8b. I found listening to the podcasts educational.	6.00	0.36
Q8c. I found the podcasts to be entertaining.	5.17	0.59
Q8d. Listening to the podcasts is trendy and socially acceptable.	5.33	0.71
Q8e. The ability to listen to material on the move makes it more likely for me to use it.	5.28	0.72
Q8f. Subscribing to the feed using an aggregator/podcatcher to allow automatic download of the podcasts makes it easier for me to obtain them.	5.00	0.68
Q8j. I found it easy to access the podcast audio files.	5.94	0.46
Q8k. I found it easy to play the podcast audio files.	6.35	0.27
Q8m. Listening to the podcasts helped clarify and/or enhance my understanding of the subject.	5.83	0.46
Q8n. I found the 3 to 5 minute podcasts to be of the right length.	5.44	0.56
Q8r. I felt that listening to the podcasts was not a productive use of my time.	1.94	0.84
Q8s. I would recommend that other students undertaking this subject listen to the podcasts.	6.06	0.42

Table 4. ITC204/504 distance education students' end-of-semester responses: Preferred methods of obtainment and consumption

<i>Q3. How do you prefer to obtain the podcasts?</i>	N	%
By downloading the files using a web browser (via online subject outline)	11	61.11
By subscribing to the podcast channel with my podcatcher/aggregator	5	27.78
Using both methods above	2	11.11
I have not downloaded any of the podcasts to date	0	0.00
Did not respond	0	0.00
<i>Q5. How do you prefer to listen to the podcasts?</i>	N	%
Using a desktop/laptop computer	13	72.22
Using a portable device (e.g. MP3 player/iPod, PDA, mobile phone)	3	16.67
Using both methods above	2	11.11
I have not listened to any of the podcasts to date	0	0.00
<i>Q6. Where do you usually listen to the podcasts?</i>	N	%
At home	14	77.78
At work	0	0.00
On the road	3	16.67
I have not listened to any of the podcasts to date	0	0.00
Other	1	5.56
<i>Q7. When do you usually listen to the podcasts?</i>	N	%
While travelling	3	16.67
While waiting	1	5.56
While carrying out other tasks (e.g. household chores, exercising)	1	5.56
I set aside dedicated time to listen to the podcasts	13	72.22
I have not listened to any of the podcasts to date	0	0.00
Other	0	0.00