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## **Authentic mobile learning in higher education**

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### **Abstract**

The ready availability and uptake of devices such as mobile phones, personal digital assistants and mobile music players, have permeated the manner and means of human communication, socializing and entertainment on a large scale. In this paper, we present a description of the shift in philosophical and theoretical underpinnings, and the practical developments in education over the last two decades that demand marked changes in the kind of learning environments we need to design. We argue that these changes have created justifiable conditions for the pedagogical use of mobile technologies based on authentic learning. A summary of research in the authentic use of mobile technologies in higher education is presented and implications for future theory development and research are drawn.

### **Introduction**

The challenge for the educators and technology developers of the future will be to find a way to ensure that this new learning is highly situated, personal, collaborative and long term; in other words, truly learner-centred learning.

Naismith, Lonsdale, Vavoula & Sharples (2004, p. 36)

The use of mobile technologies has grown to such an extent over recent years that they now overtake the proliferation of personal computers in modern professional and social contexts (Attewell, 2005). The ready availability and uptake of devices such as mobile phones, personal digital assistants and mobile music players, have permeated the manner and means of human communication, socializing and entertainment to such an extent that it is rare to find a person in western society who does not own at least one such device.

And yet, the pedagogical use of these powerful devices is not widespread in higher education. Notwithstanding the existence of the 'digital divide', the decreasing cost and increasing social currency associated with mobile devices, means that many university students own one or more such devices. However, it appears that little use has been made of these convenient and ubiquitous tools in learning contexts, and that there is little theoretical foundation to the learning environments that do use them. While the so-called 'early adopters' are willing to use new technologies for pedagogical purposes, it is not yet clear that there are sound theoretical reasons for the use of mobile devices in learning.

In this paper, we argue that the advances in philosophical and practical developments in education have created justifiable conditions for the pedagogical use of mobile technologies based on authentic learning.

### **Philosophical, theoretical and professional dimensions of learning**

The theoretical foundations of learning have moved at a rapid pace over the last two decades from behavioral to cognitive to constructivist, and it is the confluence of the advances in theory and the affordances of technology that create excellent opportunities for teachers in higher education. The shift in philosophical, theoretical and professional understanding about

learning that has been supported by a great deal of research in the use of technology in higher education (cf. *Edit Digital Library*, and many journals and associations such as AJET, BJET, ASCILITE, etc.) can be identified across a number of dimensions, and in Table 1 below, they are presented with an indication of the nature and direction of the shift.

**Table 1:** Shift in philosophical, theoretical and professional dimensions of learning

| Dimension                    | Moving from  | Moving to  |
|------------------------------|--|--|
| <b>Philosophy</b>            | Instructivist  | Constructivist   |
| <b>Theory</b>                | Behaviorist, cognitivist                             | Situated, socio-constructivist, andragogical           |
| <b>Course design</b>         | Bounded scope and sequence                           | Open-ended learning environment, flexible content      |
| <b>Time and place</b>        | Fixed in educational institutions                    | Distributed, to suit the contexts of the learners      |
| <b>Knowledge base</b>        | 'Objective' knowledge, largely determined by experts | Knowledge built and shared among the community         |
| <b>Tasks</b>                 | Decontextualized, concise, self-contained            | Authentic, reflective, complex and sustained           |
| <b>Resources</b>             | Fixed, chosen by teacher                             | Open, chosen by learners with access to search tools   |
| <b>Support</b>               | Teacher  | Community of learners,                                 |
| <b>Mode</b>                  | Individual, competitive                              | Collaborative, networked                               |
| <b>Technology tools</b>      | Fixed, located in learning spaces                    | Mobile, portable, ubiquitous, available                |
| <b>Knowledge outcomes</b>    | Facts, skills, information                           | Conceptual understanding, higher order learning        |
| <b>Products</b>              | Academic essays, exercises, or no tangible product   | Authentic artifacts and digital products               |
| <b>Assessment</b>            | Standardized tests, examinations                     | Performance-based, integrated and authentic assessment |
| <b>Transfer of knowledge</b> | Stable knowledge adapted to different contexts       | New and changing knowledge acquired when required      |
| <b>Professional learning</b> | Courses, group events, workshops                     | Personal, just-in-time, community-based                |

Sharples, Taylor, and Vavoula (2005) have identified a parallel shift in the use of emerging technologies that reflects this general movement, where such technologies are becoming personal, user centred, mobile, networked, ubiquitous and durable. These shifts have implications for the manner in which mobile learning can be used productively in complex problem solving applications that go beyond the simple transmission and communication aspects commonly associated with mobile devices.

But how prepared are teachers in higher education to meet this challenge?

### The knowledge differential in mobile learning

Many university teachers, uncomfortable with their own use of technology, feel somewhat threatened by these new forms of communication knowing that in many cases their students are more technology-competent than they are themselves. Peters (2005) found that teachers who may be very comfortable using computers, are not so familiar with mobile technologies—unlike many of their students. The idea that there are generational differences in learning styles, for instance between the Boomers, GenXers, Millennials, Neomillennials or the Net Generation, has found much currency in the last few years (e.g., Dede, 2005 who described the learning styles of neomillennial learners; and Tapscott, 1999, and Oblinger & Oblinger, 2005, who describe characteristics of the Net Generation). However, a recent review of hundreds of research studies and papers on generational learning styles (Reeves, in

press), has found that the majority of these survey studies are methodologically flawed, and that differences within these generational groups are greater than differences between them. It is not our intention to argue that a particular learning style of current university students requires the use of particular technologies, but rather to make the observation that many students today are competent with ubiquitous technologies, and that for many they play an important part in their daily social networking. The facility with which these small and pervasive technologies are used implies that they have a great deal of potential to be used in higher education. However, for many teachers it is easier to prohibit the use of these 'disruptive' technologies than to risk the illicit use of communication methods that they themselves are unable to understand or detect in use (*Mobiles fuel rise in cheating*, 2006; Bower, & Christensen, 1995).

The risk for university teachers is that they may become increasingly alienated from many of the students they teach. The educational and sociological implications of these technologies are significant for teachers, not only for the need to understand the way students communicate, but for understanding the 'speeding up and intensification of system-environment interactions' (Geser, 2004) that extends to the university context.

### **Some current uses of mobile technologies in higher education**

In general, mobile learning—or *m-learning*—can be viewed as any form of learning that happens when mediated through a mobile device (Winters, 2006) and a form of learning that has established the legitimacy of 'nomadic' learners (Alexander, 2004). While it has been described as 'an emergent paradigm in a state of intense development' (O'Malley et al., 2005) few universities have adopted widespread m-learning technologies, and in those that have, it is not clear that they are being used in pedagogically appropriate ways. For example, teachers in higher education in the UK have made use of SMS (short messaging service) as prompts for course requirements, polling classes and pop quizzes with some universities experimenting with phone exams where the users voice print identifies them as the test taker (NMC and Educause, 2006). There is evidence that some young people resent this 'usurping' of their favoured technologies for such prosaic and teacher-centred activities (Geser, 2004). Kim, Mims, and Holmes (2006) reviewed the way universities use personal digital assistants (PDAs), and found that storage and retrieval of information such as e-books, courseware, and timetables are the general uses. Similarly, digital audio players such as Apple's iPod have primarily been used in higher education to 'deliver' lectures that are recorded and subsequently podcast as RSS feeds to students' computers to be downloaded to iPods (Belanger, 2005). These devices then allow for repeated listening anywhere, anytime.

A framework for classifying educational uses of mobile technologies provided by Patten, Arnedillo Sanchez and Tangney (2006) suggest that the uses indicated above relate mainly to *administration* functions such as calendaring and timetabling; *reference* functions such as e-books and dictionaries; and *interactive* functions as in response and feedback activities. They argue that the theoretical underpinnings of these activities appear to be either non-existent or principally behaviourist in nature.

### **Theoretical perspectives for the use of mobile technologies in higher education**

Uses of mobile technologies in higher education, in their design, reflect their theoretical approaches. For example, the practice of podcasting lectures is a growing trend and the attraction for lecturers and students appears evident. Enabling students to repeatedly listen to and in many cases transcribe the lecturer's words of wisdom are welcomed by many learners (Tynan & Colbran, 2006). However, the teaching strategy of transmitting information and the learning strategy of repetition and practice fits firmly into a behaviourist paradigm. Similarly, mobile phones used as support mechanisms for reminding students about assignment submissions and course enrolments reflect a theory of practical support that is useful in guiding and managing learning rather than seeking to develop and enhance higher order thinking.

While there are many practical reasons to adopt m-learning strategies and technologies in higher education (cf., Gayeski, 2007), theoretical justification is arguably even more important. O'Malley et al., (2005) pointed out that when there is scant empirical evidence of effective learning with mobile technologies, guidelines for use should be theory-informed. Fishman, Soloway, Krajcik, Marx and Blumenfeld (2001) contended that a lack of theoretically grounded guidelines represent 'a major impediment to the successful use of new technologies' (p. 7). Many research studies and projects have examined mobile learning from an identified theoretical perspective, and Table 2 below summarises some of the studies, and their theoretical foundations (adapted and expanded from O'Malley, et al., 2005; Naismith, Lonsdale, Vavoula, & Sharples, 2004; BECTA, 2006, and the individual studies cited).

**Table 2:** Example mobile learning projects and their theoretical perspectives

| <b>Theory*</b>  | <b>Example project/research study</b>   |
|---|---|
| <b>Behaviourist theory</b><br><i>Activities that promote learning as a change in observable actions</i>   | Mobile phones and PDAs for language learning (Thornton & Houser, 2004)<br>Classroom response systems for providing feedback on multiple choice questions (Wood, 2004)   |
| <b>Constructivist</b><br><i>Activities in which learners actively construct new ideas or concepts based on previous and current knowledge</i>     | The virus game (use of PDAs to simulate the spread of a virus) (Colella, 2000)<br>Environmental detectives (students investigate an environmental problem using GPS in pocket PC) (Klopfer & Squire, in press)<br>Issues related to educational media explored through videos, documentaries, animations of educational concepts and news bulletins with mobile phones (Chesterman, nd)   |
| <b>Situated learning</b><br><i>Activities that promote learning within an authentic context and culture</i>                                       | Ambient wood (use of PDAs to explore environmental habitats) (Rogers et al. 2002)<br>Multimedia tools at the Tate Modern (use of pocket PCs to view videos and listen to expert commentary) (Proctor & Burton, 2003)<br>Role playing to investigate social interactions among family and friends (mobile phone) (Owen, 2005)  |
| <b>Collaborative learning</b><br><i>Activities that promote learning through social interaction</i>   | Mobile computer-supported collaborative learning (dissemination of activities, collaboration, and analysis of results using hand held computers) (Cortez, et al., 2004)<br>Teacher trainers use PDAs to beam questions for a virtual treasure hunt to groups of teachers (Palm Inc., 2005)  |
| <b>Informal &amp; lifelong learning</b><br><i>Activities that promote learning outside a dedicated learning environment and formal curriculum</i> | Disadvantaged youth (using mobile phones to deliver interactive stories or quizzes) (Attewell & Savill-Smith, 2003)<br>Breast cancer care (delivery of text images and audio-visual materials to patients' PDAs during their course of treatment) (Wood, Keen, Bassu, & Robertshaw, 2003)   |
| <b>Learning and teaching support</b><br><i>Activities that assist in the coordination of learners and resources for learning activities</i>       | Managing teachers' workloads (PDAs to record attendance, marks and organize lesson plans) (Perry, 2003)<br>Supporting computing students at risk (sent SMS messages on appointments, feedback, room changes and study tips) (Riordan & Traxler, 2003)<br>Teachers used 'phone exams' where users' voice print identifies them as the test taker (NMC & Educause, 2006)<br>Duke University used iPods with beginning undergraduate students and staff (Belanger, 2005)<br>Retrieval of information such as e-books, courseware, and timetables with PDAs (Kim, Mims, & Holmes, 2006) |

\* Categories of theory are as described by Naismith et al., (2004)

Despite the significant potential of mobile technologies to be used as powerful learning tools in higher education, their current use appears to be predominantly within a didactic, teacher-centred paradigm, rather than a more constructivist environment. It can be argued that the current use of mobile devices in higher education (essentially content delivery) is pedagogically regressive. Their adoption is following a typical pattern where educators revert to old pedagogies as they come to terms with the capabilities of new technologies, referred to by Mioduser, Nachmias, Oren and Lahav (1999) as 'one step forward for the technology, two steps back for the pedagogy' (p. 758). Adopting more recent theories of learning has the potential to exploit the affordances of the technologies in more valuable ways. Patten, Arnedillo, Sanchez and Tangney (2006) argue that the benefits of mobile learning can be

gained, through collaborative, contextual, constructionist and constructivist learning environments. Authentic learning environments in higher education typically involve these characteristics (Herrington & Herrington, 2006).

### **Authentic frameworks and possible scenarios for the design of m-learning environments**

Theories such as *situated learning theory* (Brown, Collins & Duguid, 1989; Lave & Wenger, 1991) or *authentic learning* (cf. Herrington & Oliver, 2000; Herrington & Herrington, 2006) are useful for guiding the design of learning environments in higher education. The construct of an authentic learning environment is principally based on situated learning theory, and can be defined in terms of the context of the task and roles of the participants. For example, characteristics include: problems are set within an authentic and realistic context, they are ill-defined and complex, they require a significant investment of time and intellectual resources, problems require examination from multiple perspectives, they require collaboration and reflection, they are integrated with assessment, and supported by scaffolding.

Such characteristics support the use of mobile technologies as tools for complex and sustained tasks and problem solving, as opposed to simple communication devices. The educative use of mobile phones could be more than just information delivery and retrieval, with Prensky (2005) urging educators to recognise their potential and design appropriate tasks:

Educators should bear in mind that cell phones can be used for context as well as content ... Just as we are designing and refining Web-based tools for such tasks, so must we be designing similar tools for cell phones ... the communication and social features of the phones are likely to be of great help. (p. 8)

The multimedia capabilities of mobile phones, such as capturing digital pictures and video can enable the development of themes and issues that benefit from representations using educational media by, for example, producing videos, documentaries, animations of educational concepts and news bulletins (Chesterman, nd). The ability to communicate and share these artefacts through Web 2.0 technologies such as blogs and wikis provides authentic products that students can use for reflection and foundations for 'remixing' and further knowledge constructions. It is not surprising then that the latest *Horizon Report 2007* states that 'In the next two years, we predict that mobile phones will be accepted tools on campus, as desirable and common as personal computers' (p. 15).

Some sound educational activities have been described for PDAs where, for example, students gather and analyze data on science field trips, and where concept mapping tools have been used to reflect upon course content. Like WebQuest computer investigations, virtual field trips have been developed for PDAs where students visit locations and complete learning activities. In a teacher certification course in Orange County, USA, teacher trainers use PDAs to beam questions for a virtual treasure hunt to groups of teachers, who are then directed to web sites where they learn about services and resources provided by the district. Teachers are able to use the Notes feature in the Palm Reader for their answers, which they then export and beam back to the trainers (Palm Inc., 2005). Challenging the students and teachers to develop the field trips or web quests would add a further element of authenticity to these tasks.

Recently, the convergence of mobile phones and PDAs into 'smart phones' has become a major trend (Peters, 2005). The ability of multimedia messaging enables digital still and video data collection, storage and retrieval to occur across wide locations. Activities such as creating 'digital narratives' (McGreen, & Arnedillo Sanchez, 2005) become possible in a wide range of educational contexts where students work collaboratively to construct a story line, record audio and video data using their smart phones, combine data using computer software such as iMovie and publish and present their products.

While the current use of podcasting is generally implemented within a didactic, more behaviourist tradition, it is not difficult to envisage this mobile technology being used in an authentic way. For example, providing students with iPods, and enabling them to create their own podcasts of interviews with peers and experts on topics within a course, refocuses the energy for learning on the student. The student now becomes the generator of knowledge and is able to collect, display, share and analyse multiple perspectives on issues and problems. Chan, Lee and McLoughlin (2006) describe a study where positive learning outcomes were achieved through experienced university students creating and producing podcasts for novice students on aspects of information technology. As a field recording tool, iPods can be used in authentic contexts such as school practicum where teachers', preservice teachers', and children's recorded observations and reflections could be made, for example, on classroom management. Such recordings could be saved in a playlist in a content management system such as iTunes making them available as downloadable resources for individual or group projects. A wide variety of authentic educational contexts could be considered, including news broadcasts, sports events, oral histories, languages and music (Meng, 2005).

The use of mobile technologies has further accelerated the move away from didactic, teacher-centred learning environments that was begun with the widespread availability of computers in higher education. Furthermore, these smaller, ubiquitous and multifaceted mobile devices have the potential to detach and distribute learning even more comprehensively from fixed and inflexible conditions (as illustrated in Table 1). However, in seeking to move to more constructivist approaches, some theoretical frameworks are more useful than others.

### **Theoretical frameworks for the design of m-learning environments**

Theories such as *situated learning theory* and *authentic learning* described above, are useful for guiding the design of technology-supported learning environments for higher order learning. Other theories are also useful in explaining the learning affordances of mobile devices. For example, theories of *communities of practice* (Wenger, 1999; Wenger, McDermott & Snyder, 2002) are useful because they emphasise the social and collaborative nature of learning, as are the theories of *distributed intelligence* (Pea, 1993) or *distributed cognition* (Hutchins, 1995; Roschelle & Pea, 2002) where the just-in-time and distributed nature of mobile technologies is recognized. More recently, a theory called *connectivism* (Siemens, 2004) has been described as 'a learning theory for the digital age', and its characteristics include:

- Learning and knowledge rests in diversity of opinions
- Learning may reside in non-human appliances
- Capacity to know more is more critical than what is currently known
- Nurturing and maintaining connections is needed to facilitate continual learning
- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.

Even more specifically, Sharples, Taylor, and Vavoula (2005) have attempted to engage in dialogue leading to a *theory of mobile learning*. Drawing on principles of *activity theory*, (as does *situated learning theory*) they too present a tentative model, and in their discussion suggest that any useful theory of mobile learning must be tested against the following criteria:

- Is it significantly different from current theories of classroom, workplace or lifelong learning?
  - Does it account for the mobility of learners?
  - Does it cover both formal and informal learning?
  - Does it theorise learning as a constructive and social process?
  - Does it analyse learning as a personal and situated activity mediated by technology?
- (p. 4)

Wineburg, writing in 1989 in a critique of the theory of situated learning noted that: 'To survive in the marketplace of ideas, a theory has to be situated in a *theory of schooling*. Otherwise, it may leave its mark on archival journals but leave the world of classrooms virtually untouched' (p. 9). We agree, and note that a theory of mobile learning would require further research and development to inform a model or framework for teaching, with practical higher education applications.

## Conclusion

Mobile learning challenges many of the fundamental assumptions that have been made for decades about higher education. It challenges what it means to teach and what it means to learn in higher education. It challenges the wisdom, timing and fixed spaces of established pedagogies and the usefulness of traditional tools and resources. The affordances of mobile technologies and appropriate theoretical frameworks have the potential to enable teachers to adopt mobile learning in sound and significant ways, and to ensure that it survives beyond novelty and convenience value. Research is needed to establish these affordances in the context of appropriate theoretical underpinnings and pedagogical applications (Roshelle, 2003).

## References

- Alexander, B. (2004). Going nomadic: Mobile learning in higher education. *Educause Review*, 39 (5), 28–35.
- Attewell, J. (2005). Mobile technologies and learning [Electronic Version]. *A technology update and m-learning project summary*, Technology Enhanced Learning Research Centre, Learning and Skills Development Agency Retrieved, May 31 2007 from <http://www.lsd.org.uk/files/PDF/041923RS.pdf>
- Attewell, J., & Savill-Smith, C. (2003). m-Learning and social inclusion: Focussing on learners and learning. In *M-Learn 2003: Learning with mobile devices* (pp. 3-12). London: LSDL.
- Belanger, Y. (2005, June). *Duke University iPod first year experience final evaluation report*. Retrieved, April 2 2006 from [http://cit.duke.edu/pdf/ipod\\_initiative\\_04\\_05.pdf](http://cit.duke.edu/pdf/ipod_initiative_04_05.pdf)
- British Educational Communications & Technology Agency (2006). *Emerging technologies for learning*. UK: BECTA.
- Bower J.L. & Christensen, C.M. (1995). Disruptive technologies. *Harvard Business Review*, (1), 43-53.
- Brown, J.S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32-42.
- Chan, A., Lee, M.J.W. & McLoughlin, C. (2006). Everyone's learning with podcasting: A Charles Sturt university experience. In Markauskaite, L., Goodyear, P., & Reimann, P. (Eds). *The 23rd Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education Who's Learning? Whose Technology?* (pp. 111- 120). Sydney, NSW, December.
- Chesterman, E. (nd). *Pocket education*. Retrieved April 2 2006, from [http://westmidlands.ideasfactory.com/new\\_media/features/](http://westmidlands.ideasfactory.com/new_media/features/)
- Colella, V. (2000). Participatory simulations: Building collaborative understanding through immersive dynamic modeling. *Journal of the Learning Sciences*, 9(4), 471-500.
- Cortez, C., Nussbaum, M., Santelices, R., Rodriguez, P., Zurita, G., Correa, M., et al. (2004). Teaching science with mobile computer supported collaborative learning (MCSCCL). In *proceedings of The 2nd International Workshop on Wireless and Mobile Technologies in Education* (pp. 67-74). JungLi, Taiwan: IEEE.
- Dede, C. (2005). Planning for neomillennial learning styles. *Educause Quarterly*, 28(1). Retrieved October, 2005 from <http://www.educause.edu/apps/eq/eqm05/eqm0511.asp>
- Fishman, B., Soloway, E., Krajcik, J., Marx, R. & Blumenfeld, P. (2001). *Creating scalable and systemic technology innovations for urban education*. Paper presented at AERA 2001, Seattle, WA.
- Gayeski, D. (2007). Mobile learning technologies. In B. Khan (Ed.), *Flexible learning for an information society* (pp. 146-152). Hershey, PA: ISP.
- Geser, H. (2004). *Towards a sociological theory of the mobile phone*. Retrieved March 28, 2004 from University of Zürich, [http://socio.ch/mobile/t\\_geser1.htm#7.2](http://socio.ch/mobile/t_geser1.htm#7.2)
- Herrington, A., & Herrington, J. (2006). What is an authentic learning environment? In A. Herrington

- & J. Herrington (Eds.), *Authentic learning environments in higher education* (pp. 1-13). Hershey, PA: ISP.
- Herrington, J., & Oliver, R. (2000). An instructional design framework for authentic learning environments. *Educational Technology Research and Development*, 48(3), 23-48.
- Hutchins, E. (1995). *Cognition in the wild*. Cambridge, Mass: MIT Press.
- Kim, S.H., Mims, C., & Holmes, K.P. (2006). An introduction to current trends and benefits of mobile wireless technology use in higher education. *AACE Journal*, 14(1), 77-100.
- Klopfer, E. & Squire, K. (in press). Environmental detectives: The development of an augmented reality platform for environmental simulations. *Educational Technology Research and Development*.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: CUP.
- McGreen, N., Arnedillo Sanchez, I. (2005). Mobile Phones: Creative learning tools. In P. Isaias, C. Borg, P. Kommers, & P. Bonanno (Eds.), *Mobile Learning 2005* (pp. 213-217). Malta: IADIS Press.
- Meng, P. (2005). *Podcasting & vodcasting: A white paper: Definitions, discussions & implications*. Columbia: The University of Missouri
- Mioduser, D., Nachmias, R., Oren, A., & Lahav, O. (1999). Web-based learning environments: Current states and emerging trends. In B. Collis & R. Oliver (Eds.), *EdMedia 1999* (pp. 753-758). Seattle: AACE.
- Mobiles fuel rise in cheating (2006, March 28). *The Age* [Online Technology Edition]. Retrieved March 28, 2006 from <http://theage.com.au/articles/2006/03/28/1143441123577.html>
- Naismith, L., Lonsdale, P., Vavoula, G., & Sharples, M. (2004). *Literature review in mobile technologies and learning*. Birmingham: Nesta Futurelab.
- New media consortium and Educause (2006). *Horizon Report*. Stanford, CA: The New Media Consortium.
- New media consortium and Educause (2007). *Horizon Report*. Stanford, CA: The New Media Consortium.
- O'Malley, et al. (2005). Mobilelearn WP 4: Pedagogical methodologies and paradigms. Retrieved 4 July 2006 from [www.mobilelearn.org/download/results/public\\_deliverables/MOBI\\_learn\\_D4.4\\_Final.pdf](http://www.mobilelearn.org/download/results/public_deliverables/MOBI_learn_D4.4_Final.pdf)
- Oblinger, D. G., & Oblinger, J. L. (2005). *Educating the net generation*. Retrieved July 2 2006, from Educause, <http://www.educause.edu/educatingthenetgen/>
- Owen, M. (2005). Killer apps for mobile phones - an educational view. Retrieved, April 2 2006 from <http://www.futurelab.org.uk/viewpoint/art63.htm>
- Palm Inc. (2005). *Handhelds assist alternative teacher certification*. Retrieved, April 2 2006 from [http://solutions.palm.com/regac/success\\_stories/education/education\\_details.jsp?storyId=376](http://solutions.palm.com/regac/success_stories/education/education_details.jsp?storyId=376)
- Patten, B., Arnedillo Sanchez, I., & Tangney, B. (2006). Designing collaborative, constructionist and contextual applications for handheld devices. *Computers in Education*, 46(2006), 294-308.
- Pea, R.D. (1993). Distributed intelligence and designs for education. In G. Salomon (Ed.). *Distributed cognitions: Psychological and educational considerations* (pp. 47-87). Cambridge: Cambridge University Press.
- Perry, D. (2003). *Handheld computers (PDAs) in schools*. Coventry, UK: BECTA.
- Peters, K. (2005). *Learning on the move: Mobile technologies in business and education*. Canberra: Commonwealth of Australia.
- Prensky, M. (2005). What can you learn from a cell phone? Almost anything!. *Innovate* 1 (5). <http://www.innovateonline.info/index.php?view=article&id=83> (accessed September 18, 2006)
- Proctor, N., & Burton, J. (2003). Tate Modern multimedia tour pilots. In *MLEARN* (pp. 127-130). London: LSDA.
- Reeves, T. C. (in press). *Learning across the generations: A literature review*. Atlanta, GA: Research, Design, & Evaluation Associates.
- Riordan, B., & Traxler, J. (2003). Supporting computing students at risk using blended technologies. In *4th Annual Conference Centre for Information & Computer Science* (pp. 174-175). Galway: LTSN.
- Rogers, Y., Price, S., Harris, E., Phelps, T., Underwood, M., Wilde, D., et al. (2002). *Learning through digitally-augmented physical experiences: Reflections on the Ambient Wood project*. Equator Report.
- Roschelle, J. (2003). Unlocking the learning value of wireless mobile devices. *Journal of Computer Assisted Learning*, 19, 260-272.
- Roschelle, J., & Pea, R. (2002). A walk on the WILD side: How wireless handhelds may change CSCL.

Proceedings of CSCL 2002.

- Sharples, M., Taylor, J., & Vavoula, G. (2005). *Towards a theory of mobile learning*. Paper presented at the mLearn 2005 4th World conference on mLearning, Cape Town. Retrieved August 20, 2006 from <http://www.mlearn.org.za/papers-full.html>
- Siemens, G. (2004). *Connectivism: A learning theory for the digital age*. Retrieved August 20, 2006 from <http://www.elearnspace.org/Articles/connectivism.htm>
- Tapscott, D. (1999). Educating the net generation. *Educational Leadership*, 56 (5), 7-11.
- Thornton, P., & Houser, C. (2004). Using mobile phones in education. In *The 2nd International Workshop on Wireless and Mobile Technologies in Education* (pp. 3-10). JungLi, Taiwan: IEEE.
- Tynan, B., & Colbran, S. (2006). Podcasting, student learning and expectations. In Markauskaite, L., Goodyear, P., & Reimann, P. (Eds). *The 23rd Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education Who's Learning? Whose Technology?* (pp. 825- 832). Sydney, NSW, December.
- Wenger, E. (1999). *Communities of practice: Learning, meaning, and identity*. Cambridge University Press.
- Wenger, E., McDermott, R., & Snyder, W.M. (2002). *Cultivating communities of practice: A guide to managing knowledge*. Harvard Business School Press.
- Wineburg . S. S. (1989). Remembrance of theories past. *Educational Researcher*, 18(4), 7-10.
- Winters, N. (2006). What is mobile learning? In M. Sharples (Ed.). Big issues in mobile learning. Retrieved, May 28 2007 from <http://telearn.noe-kaleidoscope.org/warehouse/Sharples-2006.pdf>
- Wood, J., Keen, A., Basu, N., & Robertshaw, S. (2003, 5-7 June). *The development of mobile applications for patient education: Designing for user experiences*. San Francisco: Dux.
- Wood, W.B. (2004). Clickers: A teaching gimmick that works. *Developmental Cell*, 7, 796-798.