Using Mobile Devices as Learning Resources for Alternative Models of Teaching and Learning

Literature Review

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[word count 7,461]

Tuesday, August 2, 2011

Section A: Introduction

A.1: ICT and Learning

We are in the midst of unprecedented change unfolding on a global scale, as digital technologies are becoming a ubiquitous presence in our human affairs. Our interactive relationships, our access to information, and our network capabilities to produce and disseminate information are upsetting institutional structures that were once the arbiters of power and knowledge (Castells, 2007). The balance of power in educational institutions has shifted, as learners have control of when and where they want to learn (Ally, 2009). In response to these external forces, a significant trend in higher education is to adopt an approach of blended learning (Lopez-Perez, Perez-Lopez, & Rodriguez-Ariza, 2011). Blended learning attempts to combine the best elements of online and face-to-face learning experiences (Yen & Lee, 2011). The online aspect of blended learning can include a combination of web-based learning (tethered) and mobile learning (untethered).

Outside educational institutions, the use of digital technologies is influencing the emergence of participatory learning cultures (Jenkins, Purushotma, Weigel, Clinton, & Robison, 2009). Educators are finding that bringing digital technologies into their learning processes entails these learning cultures within the educational institution (Warin, Kolski, & Sagar, 2011). These emergent learning cultures respond quickly to evolving technological conditions: there are no experts because the devices, applications, and infrastructure change too quickly (Dobbin, 2011). Institutions have little control over these changes, and there are seemingly infinite options available to address any particular pedagogical or curricular challenge (Dobbin, 2011). A key challenge for educational institutions is adapting professional practices to these emergent conditions.

A.2: Mobile Learning and Educational Institutions

"Mobile" technologies are showing their mobility in more than one sense of the word. Not only are the devices themselves portable and accessible in diverse situations, but the applica-

tions designed for these devices are proving useful to adapt for learning purposes (EDUCAUSE, 2010). Software applications designed outside educational institutions are being utilized to support learning activities within institutions (for example, Lim, Fadzil, & Mansor, 2011). Alexander (2004) referred to this technological proliferation as an expanding, disruptive, device ecology. He talked about social practices that emerge as cultures grapple with, and generate new, device-based practices (ie. learning collaborative social skills while utilizing online forums to generate knowledge). In turn, in the spirit of bricollage, social practices are influencing the emergence of new technologies, ie. the ability to take a picture with a cellular phone and upload it onto a blog without having to physically tether the phone to a computing device (ie. iPhone, Evernote and Posterous).

Traxler (2009) defined mobile technologies as handheld computers and mobile telephones, including other devices that draw on the same functionalities. He pointed out that mobile learning is developing rapidly, utilizing pedagogies from technology enhanced learning as well as pedagogies from classroom teaching and community based learning.

There are numerous benefits to be derived from incorporating mobile learning into a blended learning structure. A unique aspect of incorporating mobile learning into educational institutions is the opportunity to access digital-world resources while experiencing real-world learning (Hwang, Chu, Lin, & Tsai, 2011). While educators have expressed concerns for students' equitable access to mobile devices, these concerns do not reflect that it is also true that in many parts of the world mobile computing enfranchises millions of users who have no other access to digital resources and online repositories (Dobbin, 2011). The possibility that these people might have access to higher education through their mobile devices is a compelling argument to develop this area of institutional activity. In more developed economies, Bliss (2010) predicted it will be an educational institution's ability to leverage mobile technology that will contribute to institutional survival. He said universities that cannot meet the demands of today's technology-based society will find themselves left behind.

A.3: Purpose

The purpose of this literature review is to provide an overview of recent research on mobile learning (ie. m-learning pedagogies) and the use of mobile technologies (ie. m-technology devices, software and infrastructure) in educational institutions. The focus of this literature review is: 1) to look at learner perspectives and practices as they are influenced by mobile technologies, particularly learner interactivity in formal and informal learning environments; 2) to learn how mobile devices are being used in educational institutions as a resource to enhance learning experiences; 3) what special considerations arise when utilizing existing resources, including user provided mobile devices; 4) pedagogies associated with m-learning; and 5) instructional design for m-technologies.

A.3.a: Learner Perspectives and Practices

Students are demanding richer and more engaging learning experiences within educational institutions, reflective of their learning experiences outside of school (Bonk, Kim, & Zeng, 2006). However, students are likely unprepared for the complex learning experiences that blend face to face, e-learning and m-learning activities (Hwang et al., 2011). Student skills and knowledge for e- and m- learning activities cannot be assumed to be sufficient to meet course expectations. It is likely that m-learning activities will be an extension of e-learning activities, such as utilizing wikis, blogs and podcasts. One place to look for indications of best practices for preparing students for m-learning on m-technologies is to adapt what has been reported in the field of e-learning (Boulos, Maramba, & Wheeler, 2006). Also, there needs to be sensitivity to the ways learners use m-technologies to communicate and share knowledge - these practices will probably influence the formation of communities of inquiry within the contexts of formal education (Stein et al., 2007).

A.3.b: Utilizing Existing Resources

The International Telecommunications Union estimates that access to mobile networks is available to over 90% of the world population, of which 143 countries offer 3G services (Acharya & Teltscher,). By the end of 2010, 71% of the population in developing countries will be online. In developed countries, growth in mobile subscriptions has slowed as the mobile market is reaching saturation with an average of 116 subscriptions per 100 inhabitants (Acharya &

Teltscher,). This proliferation of mobile devices makes it possible to access the largest possible groups of learners using the simplest devices (Elias, 2011).

A.3.b.i: Blended Learning

There are many definitions of blended learning, depending on the position and history of a particular educational endeavour. For the purposes of this paper, the term 'blended' refers to one or more learning activities incorporating some form of ICT. The real test of blended learning is the incorporation of two or more components (ie. face to face and e-learning, face to face and m-learning, face to face and m-learning utilizing e-learning repositories) such that the composite unity of these components constitutes a new organizational structure, not simply adding to an existing dominant approach or method (Garrison & Kanuka, 2004). When incorporating m-technologies to facilitate m-learning, the concept of blended learning can be expanded to include blending web applications and online repositories with native or client applications on user's personal devices (Thomas, 2010).

A.3.c: M-Learning Pedagogies

One of the areas of this literature review are significant elements that need to be taken into consideration when designing m-learning pedagogies. Naismith et al (Naismith, Lonsdale, Vavoula, & Sharples, 2004) identified several challenges that present when mobile technologies are incorporated into teaching and learning. These challenges included: 1) ethical issues pertaining to collecting personal information from students in order to couple information layers provided by users' devices and layers of information generated through classroom or online coursework; 2) the mobility of the users' devices can work against learning activities when they are used inside classroom or coursework activities in ways that do not correspond with either the teachers' agenda or the curriculum; 3) when learning over time learners need a way to record, organize and reflect on their mobile learning experiences; 4) student buy-out: the benefits of students' engagements with their mobile devices may be lost if their use in formal education is perceived as an incursion into users' personal social networks; and 5) when users provide access to their personal devices for the purposes of formal education, the institution is giving up institutio-

nal control of the technology. These factors will be taken into consideration as an m-learning pedagogy is developed in the Implementation section (C.2).

A.3.d: M-Technologies Instructional Design

Another area this literature addresses is instructional design for m-technologies. Researchers have indicated a need to develop learning guidance systems for assisting students to learn within the complex learning scenario that arises when m-technologies are incorporated into educational instutions' practices (Hwang et al., 2011). From an instructional design perspective, it is also important to focus on content design issues rather than utilizing the next new technology for technologies' sake (Elias, 2010). One approach to address this problem is to integrate knowledge management (KM) into instructional design (Yeh, Huang, & Yeh, 2011). Knowledge management can contribute to designing blended learning experiences by considering three major approaches: technological, organizational, and ecological (Yeh et al., 2011). The purpose of considering these approaches is to conceive blended learning as a flow of information, circulating amongst learners in a collaborative group wherein that information flow is generating knowledge amongst participants (Hasanali, 2004).

Section B: Theoretical Approach

B.1: Social Cognition

Theories of enactivism (Varela, Thompson, & Rosch, 1991) and embodied mind (Maturana & Varela, 1980; Varela et al., 1991) propose consciousness emerges as a continuous learning process within a linguistic cognitive domain (Maturana & Varela, 1980; Edelman, 2004). Language and interactive communication not only influence what we think, but also influence what we are capable of thinking (Berger & Luckman, 1966; Edelman, 2004). Social cognition refers to this phenomena, that our interactive communication contributes to our cognitive processes (Cosmelli & Ibáñez, 2008). Our interactive communication is mediated by language, and, in the case of mobile technologies, it is mediated by the devices we have on hand, and the

applications we are capable of utilizing (Jarvela, Naykki, Laru, & Luokkanen, 2007). Collaboration contributes to the emergence of social cognition as multiple participants engage in interactive communication (Nosek, 2004). Mobile devices contribute to the emergence of consciousness as they mediate these interactive, collaborative, learning relationships (Alexander, 2004).

B.2: Communities of Practice

Etienne Wenger (1998) developed a theory of learning that started with the assumption that engagement in social practice is the fundamental process by which we learn and from which we emerge. He argued the primary learning unit was not the individual, nor the institution, but rather an informal "community of practice" that forms when people engage in a shared enterprise for a period of time. A key learning concept from a theory of communities of practice is that learning is a process of social participation. Brown and Duguid (1991) viewed learning, from a practice-based standpoint, as a bridge between working and innovating. Lave and Wenger (1991) emphasized the necessity of focusing on the formation and change in communities as they learn through working. Brown and Duguid argued evolving communities of practice constitute sites of innovation. Mobile technologies can be considered prosthetics for information, memory, and creativity (Alexander, 2004). They can also be viewed as mediating devices that regulate the dynamic flow of interpersonal communications. Thus, the use of mobile technologies could play a significant role in the capacity for any community of practice to learn and innovate.

B.3: Situated Learning

The theory of situated learning extends the concept of communities of practice by taking into account the situated conditions within which a community of practice is enacted. Rather than considering activity and context ancillary to learning, the situated conditions and activity in which knowledge is developed and deployed is considered inseparable from learning and cognition (Brown, Collins, & Duguid, 1989). Lave and Wenger (1991) theorized situated learning as legitimate peripheral participation. They theorized viewing the whole person, engaged in activity, within an environment as mutually constituting learning. They argued for the quintessentially social character of learning. Legitimate peripheral participation refers to the position of learners within a situated community of practice. According to this theory, new learners may position

themselves as outliers to a community of practice, gradually increasing their participation and engagement as they move more deeply into the complexity of learning, the situated conditions, and the cultures of intercommunication of a particular community of practice. It seems reasonable to apply a theory of situated learning to implementing an m-learning pedagogy utilizing m-technologies instructional design. Depending on participants' familiarity with multiple elements (ie. course topic, course management system, personal device affordances, applications available for personal devices, accessing online repositories or communication sites, etc.) they would probably enter the process from a peripheral position, moving into a more complex web of connectivity and communication as basic functionalities give way to more sophisticated learning activities.

B.4: Connectivism

As mentioned earlier, there is a recursive, reflexive, evolving relationship between the emergence of new technologies, and the emergence of social and cultural practices that take advantage of those technologies. Howard Rheingold (2003) theorized the use of m-technologies will not just duplicate computing and communicating from tethered to untethered devices, but will also constitute innovations and adaptations that were not previously capable of being done, ie. the phenomena of flash mob activities in public places. Connectivism is a learning theory that proposes a similar emergence of social phenomena as enactivism, but rather than emerging from biological processes, connectivism argues for the emergence of social phenomena constituted by network-creation. Connectivism is proposed to address the shortcomings of existing learning theories by arguing that learning is a connection-forming (network creation) process (Siemens, 2005). Connectivism conceives social cognition as learning ecologies (Boitshwarelo, 2011) where learning is emergent, as it is situated, within learning networks and systems of broader learning ecologies (Williams, Karousou, & Mackness, 2011). Connectivism draws on complexity theory, incorporating emergence and emergent learning as constituted by conditions that enable emergent, self-organized learning (Williams et al., 2011). Incorporating m-learning and m-technologies into formal education adds another layer of sociotechnical contexts and conditions to

the overall learning experience. These sociotechnical contexts are dynamic and place new demands on those responsible for implementing technology-enabled learning (Bell, 2011).

One final note on adopting a theoretical approach to provide context for implementing an m-learning pedagogy to incorporate m-technological instructional design into a blended learning strategy in formal education. When we are talking about incorporating mobile technologies into educational practice, we are setting up conditions for increased communicative activity. The design of this communicative activity is the challenge of the instructional designer, while the job of facilitating, guiding, and sustaining new communicative practices will fall to the course instructor. It is important to acknowledge the dialogic dimension of this endeavour (Ravenscroft, 2011), paying particular attention to the development of interactive structures that engage learners in a meaningful exchange regardless of the technologies that are employed to mediate the communicative flow.

B.5: M-Learning Technologies Affordances

The concept of affordances, in this context, is borrowed from Gibson's use of the term to discuss an interactionist relationship between individuals and the dynamic contextual conditions they find themselves within (Greeno, 1994). In the context of educational institutions and mobile learning technologies, the concept of affordances refers to the skillful capacity (Thompson, 2007) to innovate, or adapt, existing technological resources to enhance, enable or enrich learning. Perceptions of technological affordances are influenced by technological resources (Wallace, 2004; Robertson, 2011), users' history with various technological devices and resources (Song & Fox, 2009; Levy & Wilensky, 2011), instructors' pedagogical and instructional practices (Park, 2011; Deng & Yuen, 2011), and institutional cultures of practice (Oshlyansky, Thimbleby, & Cairns, 2004; Barab & Roth, 2006). For the purposes of this literature review, we are interested in developing institutional capacity to utilize existing learner-owned mobile technologies within the context of undergraduate teaching and learning. These adaptations will require development of instructional designers' and instructors' skillful perception of the pedagogic and curricular possibilities afforded by these devices within the institutional constraints of assessment, infrastructure, and control.

It is important to note here that existing and upcoming technologies provide potentially powerful and useful collaborative features, but they are not socially, nor academically neutral (Parker…, 2011). It is very important to identify the pedagogical and curricular purpose to be addressed by blending mobile, web-based, and classroom teaching (Yen & Lee, 2011). Whether the strategy is to adopt e-learning, m-learning or u-learning (ubiquitous), each approach entails and constitutes particular pedagogical and/or curricular affordances (Park, 2011). One aspect of the development of skillful perceptions of affordance, that in turn emerge as a non-neutral effect, is whether instructors and learners found their learning experience pleasurable or stressful (as they engaged with new technological mediations in their learning) (Teo & Noyes, 2011). These experiences can have a behavioural effect, either motivating incorporation of mobile technologies, or dissuading a professional educator from trying to use them.

Section C: Implementation

C.1: Devices, Applications, and Infrastructure

We considered m-technologies as devices, software applications, and the network infrastructure that gives them life. M-technologies may include mobile phones, smartphones, handeld PCs, tablets, the iPad and netbooks, as well as devices able to run mobile applications such as the iPod touch (EDUCAUSE, 2010). Two broad dimensions that can be used to define m-technologies are: 1) personal rather than shared devices; and 2) portable rather than tethered devices (Naismith et al., 2004). Applications for mobile devices are proliferating at an unprecedented rate, with new functionalities and resources published every month. M-technologies access high speed Internet wireless networks and connect through satellite or cellular networks. Connectivity appliances include bluetooth enabled devices, wireless access points, and subscriptions to cellular phone services. With the multi-functionalities of m-technologies (ie. digital camera, cellular subscription, remote blog hosting), the possibilities for perceiving ICT affordances increases exponentially. The ability to make skillful use of multiple functionalities within multi-layered domains and institutional infrastructure (ie. a departmental course management system, faculty

provided server space, university provided blogging software, personal mobile devices) becomes very important.

In terms of repurposing existing mobile technology resources, a few points were gleaned from the literature. Cushing reported an increased call for the use of mobile phones to support learning. This use of user provided mobile technologies will contribute to cost efficiencies by subsidizing institutional IT budgets. These efficiencies would be enhanced by utilizing wifi signals to defray transmission charges (Cushing, 2011).

C.2: M-Learning Pedagogies

The best m-learning pedagogies aspire to create conditions for learning that reflect the self-organizing, emergent processes taking place in online environments outside the educational institution. In this context, learning is driven by learner interest, and the processes of learning are informed by social skills of collaboration and multi-modal inter-personal communication. Cobcroft (2006) identified several theories that contribute to the pedagogical underpinning of mobile learning in the university context, including an approach to blending best practices. Cobcroft argued that best practices for blended teaching and learning requires a commitment to consider online methods for teaching and learning as expanding the context for learning, rather than perceiving digital technologies as tools.

Bonk (2006) reported findings from a Delphi study of experts in instructional technology. These experts believed online courses designed from constructivist principles should be relevant, interactive, project-based, and collaborative, while providing learners with some choice or control over their learning. Bonk found instructional strategies that create an environment that supports and encourages inquiry broadens learner's experiences of the subject matter and contributes to active and critical reflection by learners as their experience base grows. Unfortunately, Bonk reported a significant gap between those instructors who actually provide online learning activities. Bonk found that, although instructors might place high importance on learning experiences related to critical and creative thinking, hands-on performances, interactive labs, data analysis, and scientific simulations, there was reason to use caution implementing course management systems that are designed to manage learners rather than promote rich, interactive learning expe-

riences. The online use of course management systems to control learner activities can detract from learner experiences of online learning as social, inquiry-based activities that enable, enrich or enhance learning.

Salmon (2002) described a five step model for constituting a positive progression in the quality and intensity of e-learning interaction between students and their teachers. Some of Salmon's ideas also contribute to enhancing the experience of m-learning. In Step 1: Access & Motivation, Salmon encourages instructors to help students handle negative emotions and frustrations that arise when there are technical difficulties. It would probably be a good idea to ensure instructors also have this support! In Step 2: Online Socialisation, Salmon suggests building a foundation of vibrant community interactivity by using short e-tivities to cultivate trust between students and their instructors. For Step 3: Information Exchange, Salmon suggests providing students with e-tivities that promote discovery learning to encourage students to explore and share knowledge, fostering students' successful processing and sharing of information. At Step 4 Knowledge Construction, students are utilizing the online space to communicate their findings and they are advancing to higher order thinking skills that enable them to develop as independent learners. At this stage, instructors need to design their online feedback to enhance students' critical thinking skills. This is when students shift from being knowledge transmitters to creators or authors of innovative ideas. These four steps lead to Step 5 Development. This step shows the development of new cognitive skills that enable students to learn to take personal ownership of their learning experiences and practice peer-based learning and support. At this point, students have reached the capability to engage in continuous and situated learning support for themselves and each other (Elias, 2011).

Naismith et al (2004) adopted an activity-centered, rather than curriculum specific approach to considering new practices in relation to existing learning theories. They identified six broad theory-based categories of activity and provided examples of the use of mobile technologies in each. Their theory-based categories included: 1) behaviourist - activities that promote learning as a change in learners' observable actions; 2) constructivist - activities in which learners actively construct new ideas or concepts based on both their previous and current knowledge; 3) situated - activities that promote learning within an authentic context and culture; 4) collabora-

tive - activities that promote learning through social interaction; 5) informal and lifelong - activities that support learning outside a dedicated learning environment and formal curriculum; and 6) learning and teaching support - activities that assist in the coordination of learners and resources for learning activities.

A central concept for designing m-learning pedagogies is ensuring learners are positioned as creative, communicative participants rather than passive, receptive consumers of knowledge transmissions (Alexander, 2004). This would include fostering dialogic processes mediated by digital technologies (Scherer, 2011). Deductive instruction begins with theories and progresses to applications of those theories. Active learning inspires inductive instruction, that is, beginning with a specific problem that introduces a topic. With an inductive instructional approach, knowledge of theories are acquired on a need-to-know basis (Moura & van, 2011). As is the case elsewhere in education, although instructors may hold learner-centered beliefs, in practice (including practices with m-learning), these beliefs do not necessarily translate into learner-centered pedagogies (Liu, 2011). For example, Anjewierden et al (2011) found chat communication improved intuitive knowledge when students provided elaborated explanations of concepts rather than receiving elaborated explanations.

There is a tendency in educational institutions to adopt a technological 'tool' (computer lab, rolling laptop cart, one to one laptop, iPad, etc) and then expect instructors to develop pedagogies and curriculum that take advantage of that resource. One instructional technology coordinator found it was more pedagogically efficacious to provide students with a variety of m-technologies rather than ensure every student has exactly the same technology. She stored iPads, netbook computers and iPod touch media players side by side throughout classrooms in a 550 student K-5 school readily accessible as learning needs arose (Quillen, 2011).

C.3: M-Technologies Instructional Design

When designing for instruction with m-technologies there are a number of dimensions to take into consideration. For one, there is no single solution to push richly interactive mobile content onto every possible phone, all mobile devices are not created equal (Stead, 2010). However,

there is a spectrum of possible solutions, from designing for the richest possible interactivities, to designing for the widest possible device coverage (Stead, 2010). These uses can run from simple status checks, just-in-time information sharing, and collecting student responses to complex tasks that use multiple applications disseminated over multi-layered social networks (EDUCAUSE, 2010). It is important to remember to make a distinction between carefully crafted learning activities and the kind of user-generated learning activities that are arising from learners' own spontaneous requirements (Kukulska-Hulme, Traxler, & Pettit, 2007). Learners are already using their m-technologies for learning outside formal education. Kukulska-Hulme et al (2007) argued that instructional designers need to take user-generated mobile activity into consideration, and, although this activity does not replace the role designed activity plays, it does (and should) influence the development of designed learning activities for m-technologies.

It is important for instructors to set up conditions that foster productive, generative discussion in digitally mediated relationships (Scherer, 2011). In order to do this, instructors will probably need release time to develop, or re-develop, content and instructional strategies that take advantage of increased communication and learning as socially enactive communication (Quillen, 2011). There needs to be a tolerance for error, implementing m-learning activities utilizing participants' m-technologies will require scaffolding and support (Elias, 2011). Situated learning methods entail a shift in instructors' self-concept: a dynamic movement from 'sage on the stage' to 'guide on the side' (Labone, Butcher, & Bailey, 2005; Cross & Hong, 2009). This points to the need to ensure instructors' are also provided opportunities to participate as a community of practice, to study and learn about their own situated learning to teach with m-technologies (Elias, 2011).

Although there is not space here to elaborate on the full breadth or depth of instructional design with m-technologies, a few tips were gleaned from the literature. To foster m-learning, the instructor must have a strategy to push regular communicative activities to students (Elias, 2011). These activities maintain a pulse of interactivity and encourage students to generate content for the learning group (Elias, 2011). These communications must necessarily be brief, the content should be comprehended within 5 minutes or less (EDUCAUSE, 2010). Elias (2011) recommended adapting distance education approaches to instructional design, rethinking distance to

include geographic, temporal, and also psychological dimensions. Elias also advised to keep instructional design simple and intuitive: keep code simple and use open source software. File management and file storage are concerns for incorporating m-technologies into instructional design. Elias (2011) recommended using cloud-computing file storage and sharing systems. It was noted that iPad does not have a file structure, instructors need to understand this to organize how students access their files (Quillen, 2011).

There were many examples of specific instructional design for particular m-technology devices. One study reported using an iPad feature for highlighting and learning vocabulary words (Quillen, 2011). In another study, Chen et al (2011) utilized m-technologies to supplement materials and questions to support student's reading. Smartphones were used to fetch pre-designed digital resources and scaffolded questions over the Internet. M-technologies were also used to collect data from real-world contexts for further inquiry and development in the classroom (Beddall-Hill & Jabbar…, 2011). Other uses included geolocation functions, data access, readers, and maps for learning purposes (EDUCAUSE, 2010).

At the Open University of Malaysia they have adopted SMS text-messaging as a mobile learning initiative. Lim et al (2011) reported the university found the use of text messaging helpful to bridge the gap learners feel when they are learning at a distance in isolation. They found text messaging to be unobtrusive, yet psychologically engaging, supporting learners to keep pace with course schedules and assignments. They provided a list of text-messaging activities that can be incorporated into instructional design: administrative support reminding learners of important dates; chunking course content into small sizes to support academic progress; providing e-counselling services; learner support to help manage their studies; and learner assessment through interactive SMS quizzes for learning self-assessment.

Naismith et al (2004) also provided specific examples of learning activities associated with their six theory-based categories. For example, to illustrate the behaviourist approach they mentioned using classroom response systems and delivering content by text messages to mobile phones. They describe a constructivist use of mobile technologies provided learners with an opportunity to act out key parts in an immersive experience of a dynamic system such as the Virus Game (Colella, 2000) and the Environmental Detectives (Klopfer, Squire, & Jenkins, 2002).

Examples of situated learning include the many ways museums and art galleries are adopting mobile technologies to enhance visitor experiences. In terms of collaborative learning, Naismith et al discuss the use of mobile devices in relation to conversation theory. Conversation theory describes learning in terms of conversations between different systems of knowledge (Pask, 1980). Mobile devices can support collaborative learning by providing another means of communication without replacing human to human interactions. Informal and lifelong learning takes a broad view of learning, taking it outside the classroom and embedding it in everyday life. Naismith et al referred to a study of breast cancer patients who were enabled to access trustworthy information about their condition, communicate with other patients, and keep track of issues that concerned them using m-technologies. In their sixth and final category, Naismith et al described how learning and teaching support can be facilitated by m-technologies for such functions as attendance reporting, reviewing student marks, accessing central school data, and managing schedules.

Cushing (2011) provided many examples of mobile learning in practice. A sampling of activities included: taking photographs of board work to augment notetaking; allowing a dyslexic student to voice record his essay so it could be transcribed from an interview; using a digital timer for classroom activities; photographing and sharing work; using Live note for lesson observations; passing a phone around with a video on it for comments; photographing artwork and projecting the images for peer evaluations; recording and analyzing students' pronunciation for language learning; using photography and video recording to document practicum experiences; instructors using mobile phones to record student interviews about the course; taking notes on mobile phones and emailing them; and, augmenting existing computing resources with mobile devices to ensure all students can participate in blended learning activities.

C.3.a: Assessment

M-learning and m-technologies (particularly user-owned) increase the complexity of learning activities by introducing multiple variables into the learning experience: space/time differentials, real-world learning contexts, digital-world learning resources, multi-modal representations of knowledge, user-generated knowledge, shifting locus of control and power in learning

relationships, multiple channels of communicative activity, etc. The role of assessment must change to meet these new demands, as it is no longer sufficient to benchmark knowledge acquisition when learners are engaged in knowledge generating activities, and collaborating to build knowledge within communities of practice. What is needed is development of new assessment methodologies or tools that assist students in their learning (Hwang & Chang, 2011). For example, Coulby et al (2011) studied the use of personal digital assistants (PDAs) amongst a group of final year undergraduate medical students who used mobile technology for assessment during their practicum placements. The students found the PDA assessment process straight forward and the structured format of the assessment resulted in an increased, improved level of feedback, allowing students to improve their skills during their placement.

The area of assessment highlights emerging tensions faced by educators. Although educational institutions are paying lip service to the need to develop "21st century learning skills", educators find themselves in a paradoxical situation: 1) they are encouraged to adopt learner-centered, constructivist pedagogies to foster critical inquiry skills and self-paced learning activities in concert with adopting digital technologies into their educational practice; 2) they are pushed to incorporate digital technologies into their teaching for fear, they, or their students, will be left behind; and 3) educators are forced to comply with standards driven, evidence-based curriculum and assessment to fulfill government mandates for certification and funding. These tensions show up in the area of assessment, where an online course management system might provide administrative controls for content acquisition testing, or, an online database might provide an activity log where learners can chart their learning investments and conduct their own time and task analysis as part of a formative assessment process.

C.4: Challenges

C.4.a: Instructor Buy In

Just as instructors need support to transition into online teaching (Shattuck, Dubins, & Zilberman, 2011), they also need training to teach in the context of mobile learning and devices(EDUCAUSE, 2010). A common concern expressed by instructors is the possibility of an

inequitable distribution of technological resources amongst students (those who own m-technologies and those who do not) (Dobbin, 2011). This points to a need to educate instructors on the importance of arguing for equitable distribution of resources for all students, rather than refusing to teach with particular digital technologies. Students who neither have an opportunity to own digital technologies nor learn about, and with, them, are at a double disadvantage. Similarly, those students who have access to these technologies but are not taught to use them to enhance their learning are also put at a disadvantage.

There is a need for quality, accessible training for faculty preparing to teach in blended contexts (Shattuck et al., 2011). Instructors must be prepared to adapt pedagogically to take advantage of the participatory learning cultures associated with digital media, including m-technologies (Cobcroft, 2006). Part of the task of preparing instructors to engage with mobile technologies is addressing their perceived value of these investments of time and energy to make adaptations (Quillen, 2011). Instructional designers and those providing implementation support need to remember that instructors are not only changing their pedagogical and curricular approach, they are also undergoing an identity shift in what it means to be a professional educator (Young, 2011). This identity shift entails a careful consideration of managing online identities and relationships (Young, 2011).

Three key areas of challenge have been identified for instructors to buy into a blended learning approach: instructional processes, community concerns, and technical issues (Ocak, 2011). Within these three categories of challenges, Ocak identified eight themes of interest: 1) preparing educators for more complex instructional contexts; 2) institutional planning and policies that govern the uses of mobile technologies for teaching and learning; 3) addressing historical positions of isolation, such as adjunct faculty, and addressing the need for effective communication amongst all stakeholders; 4) allocating time for instructors to make the cultural, cognitive, instructional and practical shift to new teaching environments and processes; 5) institutional support to make the social, cultural, logistical, technological, pedagogical, and curricular adaptations necessary; 6) instructors and learners adopting new roles and relationships in their learning activities; 7) providing for difficulty adopting new technologies - both instructors' skills and knowledge, but also learners'; 8) practical considerations such as wifi strength, dead zones,

and data access plans. These concerns are in addition to the need for instructors to manage their online identities through social networking sites (Twitter, Facebook, blogging) (Young, 2011).

The importance of instructor buy-in cannot be underestimated. There were examples of instructor resistance in the literature, for example, cases of instructors disconnecting wireless access (Alexander, 2004). Instructors are nervous about the disruption and uncertainty that attend changes in roles and relationships with learners as they are constituted through mobile technologies, often resulting in an outright ban on all mobiles in schools (Cushing, 2011). Another potential source of resistance is instructors' perception that the use of mobile technologies increases their workload because they must prepare face to face and mobile learning activities (Atkinson, 2011). These concerns can be addressed by facilitating instructors and students to communicate across departments, schools and faculties, to build effective approaches for addressing these issues (Ball, 2009). One final point is to ensure instructors' questions, concerns, and possibilities are addressed within the context of their particular dynamic conditions. Although there are infinite solutions available to diverse situations, there is no "one size fits all" response that will resolve instructor buy-in.

C.4.b: Other Considerations

One benefit of having learners use their own mobile devices is that they are already familiar with the features on their devices and are practiced at using them (Elias, 2011). An added challenge for instructors and instructional designers is that they must adapt content to fit learner capabilities (Quillen, 2011). Despite the cost of adapting to user provided devices, it is relatively inexpensive to take advantage of devices and cellular services (Elias, 2011). The downside of this approach showed up in Japan where a schools are blocking SMS access to thwart cheating (Alexander, 2004), although this issue could be used to pedagogical advantage, if "cheating" behaviour was used for collaborative learning.

C.4.b.i: Device Limitations

There are device limitations to take into account. For example, 85% of the mobile market is comprised of mobile phones that have tiny screens and numeric keypads (Elias, 2011). These

small screens have poor resolution, colour and contrast, they are not suitable for writing documents (Quillen, 2011). Depending on the learner owned devices, they may have very small keyboards that make text input difficult, limited memory, and poor quality photo, video, audio capabilities (Cushing, 2011). Another factor is battery-life, when devices are using multi-media functions they tend to run out of power sooner (Cushing, 2011).

Hardware compatibility must also be taken into consideration. Data contract may be expensive, transferring data by USB can be difficult, and bluetooth connections may not be enabled on all devices (Cushing, 2011). Slow download speeds and limited Internet access can impede instructional activities (Elias, 2011). If a classroom of students is going to be fully equipped with online mobile devices, there needs to be adequate bandwidth to handle the increased traffic, especially when a particular lesson calls for all students to utilize online resources at once (Cushing, 2011).

In addition to pedagogical, curricular and technological concerns, there is a need to define and implement codes of conduct for using mobile technologies within an educational institution (Cushing, 2011). This needs to addressed from the perspective of instructors (ie. appropriate uses of technology while engaged in institutional learning activities) and from the perspective of the students (ie. images and video from learning activities do not appear on the Internet and students are assured their work is for study purposes only) (Cushing, 2011). Other codes of conduct also come into play, particularly socially relevant issues such as cyber-bullying, online gossip, etc.

C.5: Impact and Potentials

C.5.a: Case Studies

I came across a few references to case studies of m-learning in educational institutions. By far the most frequent references cited one to one iPad projects in K - 12 school systems, as well as iPhone, iTouch, and netbook deployments. It would be very helpful to have a comprehensive list of mobile technology learning initiatives, and a companion collection of research that is being used to study these efforts. I did not find such a collection during this literature review.

Too often I found mention of an institution and its use of m-learning, but when I tried to find actual research published on that instance, there was nothing on record. A couple of cases came to my attention that provide research data on m-learning in higher education.

Abilene Christian University (ACU) adopted an inclusive approach to incorporate m-technologies rather than attempt to restrict student use of communication devices to out-of-class activities (Perkins & Saltsman, 2010). In February of 2008 ACU announced that every freshman entering the university would receive an iPhone or an iPod Touch. Perkins and Saltsman (2010) conducted faculty and student surveys at the end of the first year of the program and reported overall success. They noted that the iPhone users reported increased levels of usage over the iPod Touch. Significant positive findings were found regarding student engagement and several aspects of faculty adoption. Challenges to the success of the program were found in relation to incomplete classroom saturation (at the time of the study no everyone had received their mobile device) and limited resources for application development. Perkins and Saltsman reported the mobile learning initiative (MLI) had an influence on instructor roles and pedagogy. They found instructors adopted a role as teaching-experimenters, and a culture of innovation was fostered on the campus. Those research participants who chose an iPhone were responsible for the cost of setting up a two-year contract with AT&T.

Seton Hill University (SHU) has also adopted a program of providing every full-time freshman with an iPad. Following up this initiative, SHU has taken an additional innovative step, providing user support to address network issues through social media. The administration will have the ability to respond in real-time to address student and faculty needs with great efficiency (SHU, 2010).

Section D: Concluding Comments

D.1: Evaluating Student and Instructor Experiences

As with any new programmatic endeavour, there needs to be a methodology in place to collect participants' data. Shattuck et al (2011) employed a mixed-methods approach, utilizing

surveys and reflection journals to provide data to measure effectiveness and identify how their program could be improved for future participants. One area that showed up throughout this literature review was a need for more research and development of formative assessment processes situated within the dynamic contextual conditions of mobile technologies, collaborative communicative practices, learning through knowledge generation, and learning associated with the acquisition of mobile technologies skills, knowledge, and social practices. At present, the role of assessment must serve two masters: 1) to facilitate learner-centered, constructivist knowledge generation; and 2) to provide evidence of successful completion of course requirements and summative knowledge acquisition.

D.2: Evolving Cultures of Learning

When we no longer think of our uses of technology as separable from life learning processes, it starts to make sense that the separation of digital life in educational institutions is an artificial construct. The virtual world is not virtual, it is another expression of life experience (Proctor, 2011). Whatever technological adaptations or adoptions we choose to make in educational institutions, perhaps our driving force should not be whether we can transform a student of mediocre achievement to exceptional achievement (although this might happen), but should be making the learning processes taking place in our educational institutions relevant to the lives we live outside the institution.

There is no doubt that our uses of technology influence the emergence of cultures of learning, just as cultures of learning influence the emergence of new technologies. It is neither about device-based practices, nor practice-based devices. It is a recursive, reflexive process of mutual adaptation and design: instructional designs that take advantage of existing technologies, and technologies that take advantage of existing instructional design. These are not self-limiting interactions, rather they are generative, productive interactions. In education we need to foster learning networks comprised of instructors and learners, working together through blending online and face to face inquiry processes (Mackey & Evans, 2011). The process of teaching and learning is no longer separable from the processes of professional development. Our develop-

ment as professional educators is taking place everytime we interact with our particular group of learners within a situated learning context.

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