mLearning: Why? What? Where? How?

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This paper explores the state of play of mlearning in education. Mlearning bridges pedagogically designed learning contexts, enables learner generated contexts, and content, while providing personalization and ubiquitous social connectedness. The researcher makes a case for the impact of mlearning to act as a catalyst for transforming pedagogy informed by the implementation of over 30 mlearning projects, and reflects upon example implementations of mlearning within a variety of contexts.

Keywords: mlearning, mobile web 2.0, student-generated content, student-generated contexts.

Introduction: Why mLearning?

Worldwide ICT statistics (Acharya & Teltscher, 2010) provide a compelling argument for investigating the potential of wireless mobile devices (WMDs), and in particular mobile phones and smartphones, as these devices have by far the highest ownership of any computing or connected devices (see Figure 1). Figure 1 provides approximate worldwide averages for access to a range of ICT technologies garnered from the International Technology Union 2010 report.

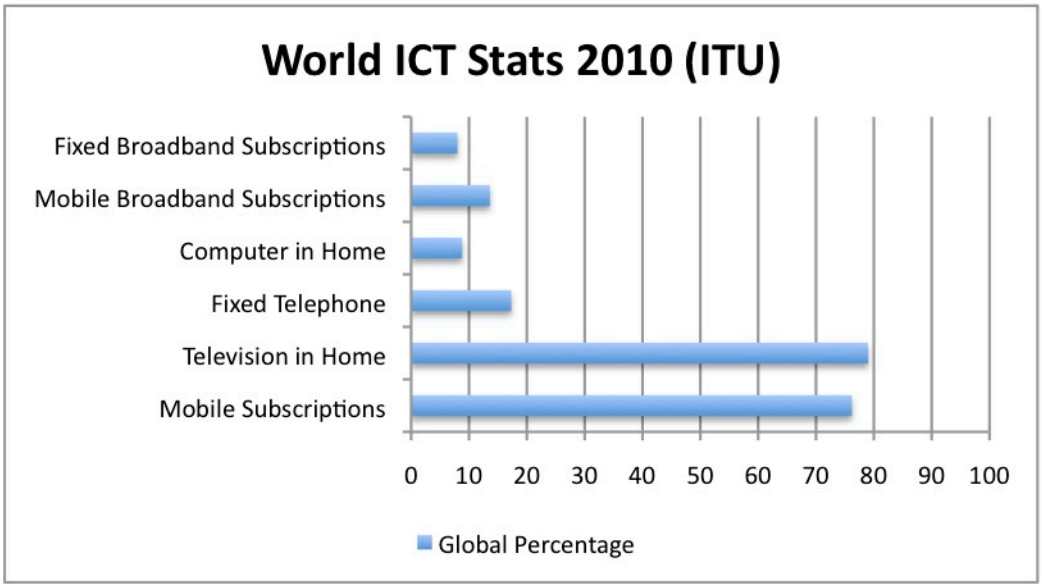

Figure 1: Average World ICT statistics taken from the 2010 ITU report (Acharya & Teltscher, 2010).

The unique potential impact of WMDs on education is founded upon their rise to almost ubiquitous ownership (ITU, 2009) and their primary functionality as ubiquitously connected communication devices. These two characteristics of wireless mobile devices enable their use as disruptive devices to act as catalysts for pedagogical change by mediating student-generated learning contexts and sharing student-generated content as key elements of social constructivist learning or Pedagogy 2.0 (McLoughlin & Lee, 2008). The 2010 JISC mobile review (Belshaw, 2010) concludes that mobile learning presents the potential to drive innovation in education.

> Mobile learning may mean different things to different people, but it is the dialogue that an institution begins with itself, its' staff, its' learners, its' community - that matters. It is certainly not time for 'business as usual'. It is time to define and start driving innovation. (p. 63)

This potential for innovation is both driven and hampered by the rate of change in mobile technologies. Although the rate of change of mobile technology is very high the choice of a pedagogical framework and foundational pedagogical theory can guide the appropriate pedagogical use of future WMD developments. The rise of mobile application ecosystems (for example: the iTunes Store for dissemination of iOS WMD applications and media, the Android Market for Android WMD devices, and the Nokia Ovi Store for Symbian based WMDs) that bridge information, content and productivity with laptop or desktop computing via web 2.0 platforms, has created a mobile learning framework that can be easily appropriated by a wide range of educators without requiring specialist computing skills, creating the potential for mainstream adoption of mlearning in tertiary education. WMDs can be utilized as content creation devices for students' online eportfolios, and for establishing a digital identity that can become a key element of their on-going professional careers. WMDs can also be utilized as communication and collaboration tools within an increasing range of social networking tools. Mobile Learning (mlearning) has moved beyond the realms of fantasy to become a viable platform for contextual learning that bridges formal and informal learning environments in and beyond the classroom. Kukulska-Hulme (2010) emphasises the catalytic nature of mlearning:

> With its strong emphasis on learning rather than teaching, mobile learning challenges educators to try to understand learners' needs, circumstances and abilities even better than before. This extends to understanding how learning takes place beyond the classroom, in the course of daily routines, commuting and travel, and in the intersection of education, life, work and leisure. (Kukulska-Hulme, 2010, p. 181)

It is the ability of mlearning to act as a catalyst for pedagogical change that has interested the author and formed the basis for developing a design framework for mlearning that is based upon a social constructivist pedagogy that enables learner-generated content and learner-generated contexts. Thus rather than being technology centric, the author sees the impact of mlearning in regards to the potential for pedagogical transformation.

> Mobile learning - as we understand it - is not about delivering content to mobile devices but, instead, about the processes of coming to know and being able to operate successfully in, and across, new and ever changing contexts and learning spaces. And it is about our understanding and knowing how to utilize our everyday life-worlds as learning spaces. Therefore, in case it needs to be stated explicitly, for us mobile learning is not primarily about technology. (Pachler, Bachmair, & Cook, 2010, p. 6)

Background: What

One of the key realizations of previous large mlearning projects (for example: MOBILearn) was that it is the learner that is mobile, and the learners interact continually throughout the day facilitated by mobile devices. Therefore focusing on the mobility of the learner is central to mlearning (Sharples, 2010). While technology continually changes, how learners learn and interact, and what educators want our student graduates to be able to achieve is persistent. Mlearning by nature involves interaction with continually changing technologies, but rather than being eventually assimilated into traditional computing, the researcher argues that mlearning is reinventing and transforming computing from a tool to integrating computing into our lifestyles. Two-thirds of the world's population already own and carry a cellphone (ITU, 2009). Mlearning is not just the miniaturization and convenience of portable computing, but is transforming how we conceptualize and interact with computing and our environment, communicate, and create and manipulate information (Cheney, 2010; Pachler, et al., 2010). Mlearning is about ubiquitous social connectivity, instant information access, and enhancing how we view the world through digital augmentation (Cook, 2010a). It is empowering for learners, who can become content and context generators within authentic learning environments (A. Herrington & Herrington, 2006, 2007) rather than simply consumers of transmitted content in classrooms. Additionally, emerging touch and voice interactivity with mobile computing will change our expectations of how learners interact with computing.

Therefore, mobile learning, as defined by the researcher, involves the use of wireless enabled mobile digital devices (Wireless Mobile Devices or WMD's) within and between pedagogically designed learning environments or contexts. Mlearning can support and enhance both the face to face and off campus teaching and learning contexts by using the mobile wireless devices as a means to leverage the collaborative use of web 2.0 tools. The WMD's wireless connectivity and data gathering abilities (for example: photo blogging, video recording, voice recording, and text input) allow for bridging the on and off campus learning contexts – facilitating "real world learning" (Unitec New Zealand, 2010). It is the potential for mobile learning to bridge pedagogically designed learning contexts, facilitate learner generated contexts, and content (both personal and collaborative), while providing personalization and ubiquitous social connectedness, that sets it apart from more traditional learning environments. From an activity theory perspective, WMD's are the tools that mediate a wide range of learning activities and facilitate collaborative learning environments (Uden, 2007). However, the use of

Wireless Mobile Devices (WMDs) as part of the teaching and learning environment requires changes in pedagogy and integration into the teaching and learning processes. Mlearning enables learner-generated content and learner-generated contexts. Figure 2 is the author's Mobile Web 2.0 Concept Map that attempts to represent the interactions between multiple learning contexts and web 2.0 tools enabled by mobile devices.

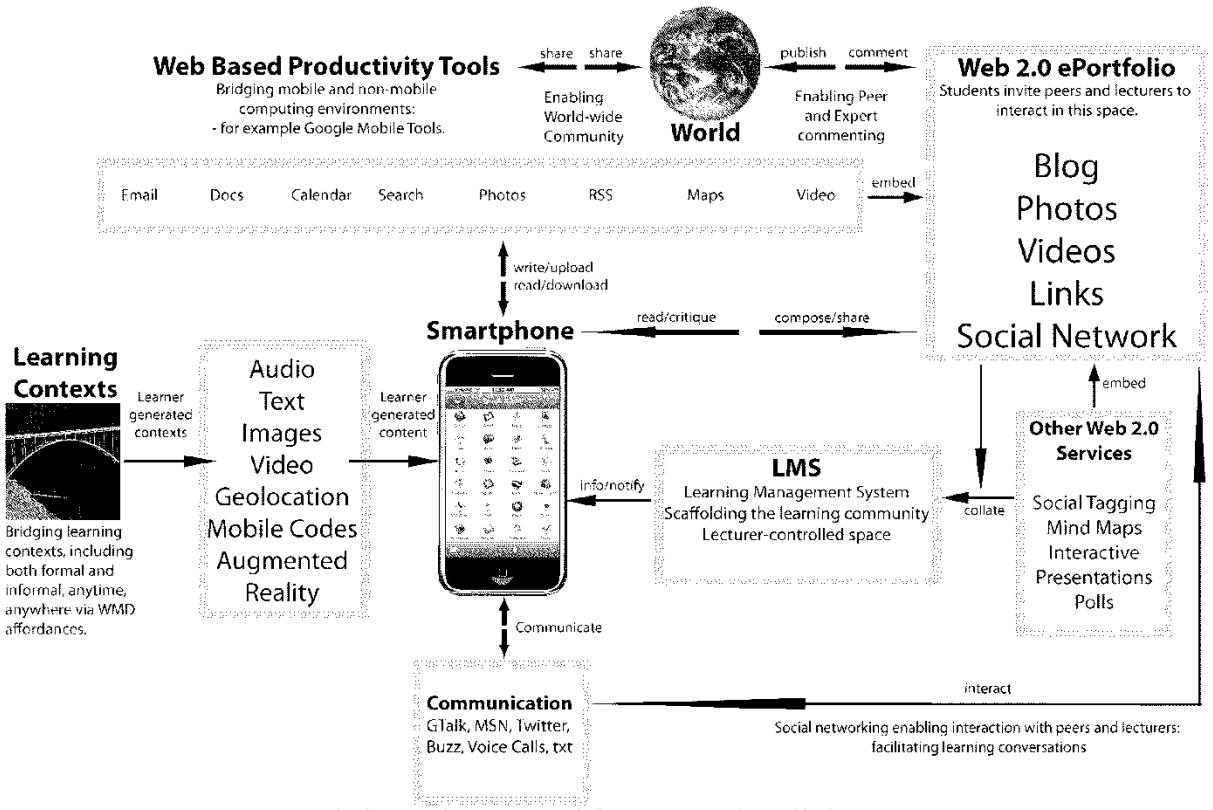

Figure 2: Mobile Web 2.0 Concept Map.

Research Overview: Where

Cook (2009a) and Sharples (2009, 2010) characterize the development of mobile learning research according to three general phases:

1. A focus upon devices (For example: Handheld Computers in Schools (Perry, 2003))
2. A focus on learning outside the classroom (For example: MOBILearn (O'Malley, et al., 2005))
3. A focus on the mobility of the learner (For example: MyArtSpace (Sharples, Lonsdale, Meek, Rudman, & Vavoula, 2007), CONTSENS (Cook, 2010a))

Approaches to mlearning vary from a focus upon content delivery (McKinney, Dyck, & Luber, 2009), SMS (Mellow, 2005), polling (Dyson, Litchfield, Lawrence, Raban, & Leijdekkers, 2009), and location awareness (Educause Learning Initiative, 2009a; Pachler, et al., 2010), to facilitating student generated content sharing (Sharples, et al., 2007), and augmented reality (Priestnall, Brown, Sharples, & Polmear, 2009; Sharples, 2009). In their review of one hundred and two innovative mobile learning projects published between 2002 and 2007, Frohberg et al. (2009) found that only five percent of these projects focused upon social learning, less than four percent required higher level thinking, with eighty nine percentage targeting novice learners, and ten percent

facilitated user-generated content. Many mlearning studies focus upon content delivery for small screen devices (Stead & Colley, 2008) and the personal digital assistant capabilities of mobile devices (Corlett, Sharples, Bull, & Chan, 2005) rather than leveraging the potential of mobile devices for collaborative learning as recommended by Hoppe, Joiner, Milrad and Sharples (2003):

> Content delivery to mobile devices may well have a useful place in m-learning, however, there is an imperative to move from a view of e- and m-learning as solely delivery mechanisms for content… Handheld devices are emerging as one of the most promising technologies for supporting learning and particularly collaborative learning scenarios. (Hoppe, et al., 2003, p. 1)

The researcher has managed and implemented almost thirty mlearning projects between 2006 and 2011 using a participatory action research methodology (Swantz, 2008; Wadsworth, 1998) with each successive mlearning project forming a research cycle within a longitudinal research project. The focus of these mlearning projects has been on exploring the potential of mlearning as a catalyst for transforming pedagogy from instructivist lecturer-directed pedagogy to social constructivist pedagogy enabling student-generated content and student-generated contexts (heutagogy). The mlearning projects encompassed nine different tertiary courses, effectively forming nine case studies involving several research cycles spanning from one to four years of implementation and refinement, utilizing a range of wireless mobile devices (WMDs), and involved a total of 690 participants. The learning contexts included:

- Bachelor of Product Design (2006 using Palm Lifedrive, 2008 using Nokia N80, N95, and Apple iPhone 3G, 2009 using Nokia XM5800, N95, N97, 2010 using student-owned laptops and cameraphones, and Nokia N97)
- Diploma of Landscape Design (2006 Using Palm TX, 2007 using Nokia N80, 2008 using Sonyericsson P1i, 2009 using Dell mini9 netbook, 2010 using Nokia XM5800)
- Diploma of Contemporary Music (2008, 2009 using iPod Touch, iPhone 3G, 2010 using Apple iPad)
- Bachelor of Architecture (2009, using Nokia XM5800 and Dell Mini9 netbook, 2010 using Android HTC Desire smartphones and Apple iPads)
- Bachelor of Performing and Screen Arts (2009 using Dell Mini9 netbook and Nokia XM5800, 2010 using Dell Mini9 netbook, Nokia XM5800, and Nokia N97)
- Bachelor of Business (2010 using Apple iPad)
- Bachelor of Computing (2010 using Apple iPhone)
- Bachelor of Graphic Design (2010 using Nokia XM5800 smartphone)
- Bachelor of Civil Engineering (2010 using Apple iPad)

Figure 3 provides an outline of the growth and scope of the researcher's mlearning projects 2006 to 2011. The generic term Wireless Mobile Devices (WMDs) is used to cover the variety of smartphones, netbooks, and touch-screen devices used throughout these projects.

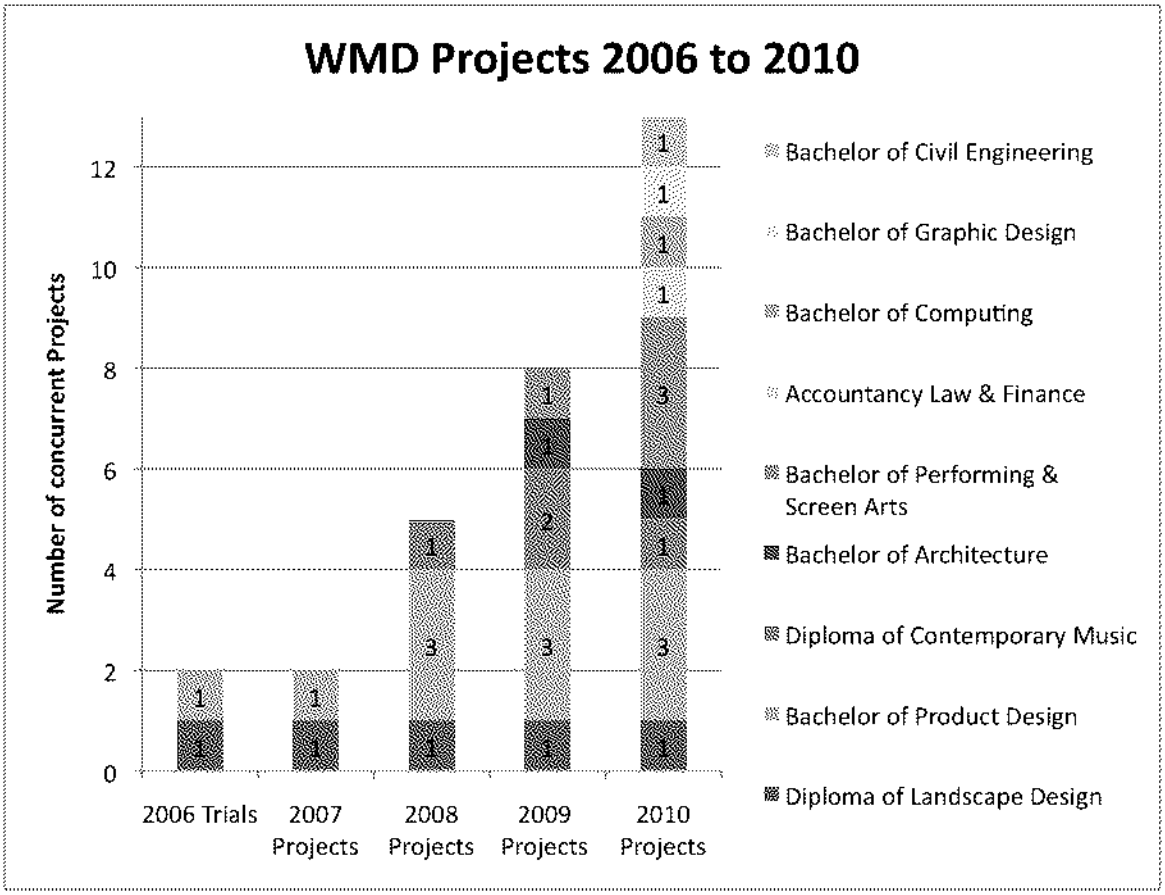

Figure 3: Number of mlearning projects 2006 to 2010.

Discussion: How

A significant body of peer-reviewed collaborative research between the researcher and a variety of lecturers from different course contexts has evidenced the impact upon lecturers' pedagogy and the depth of practice-based reflection that these projects have generated. For example: (Cochrane & Bateman, 2010; Cochrane, Bateman, Cliffin, et al., 2009; Cochrane, Bateman, & Flitta, 2009; Cochrane & Flitta, 2011; Cochrane, Narayan, & Oldfield, 2011; Cochrane & Rhodes, 2011; Flitta, Cochrane, & Bateman, 2009). This section discusses five examples of mLearning in different learning contexts, selected from the researcher's 2009 to 2011 mlearning action research cycles. The five examples illustrate the potential of the unique affordances of mlearning to enable pedagogical transformation that focuses upon student-generated content and student-generated contexts. Pre-project surveys of participating students have indicated that the majority of students were consumers of web 2.0 content rather than producers. In particular, the pre-project surveys revealed that prior to their involvement in the mlearning projects, the uptake of mobile tools such as Twitter was relatively low among these students.

We have found that for the majority of our students the engagement with these mobile web 2.0 tools for student-generated content and student-generated contexts is a new experience and requires significant scaffolding. This scaffolding was provided by embedding each mlearning project within a community of practice including the students, their lecturer, and the researcher as the "technology steward" (Wenger, White, & Smith, 2009) guiding the integration of these tools within each unique learning context.

QR Codes

Mobile codes are two-dimension codes similar to bar codes found on product information labels. There are a variety of mobile code formats, with the most popular being QR Codes (Quick Response Codes). A QR Code is decoded by an application on a cameraphone that uses the phones built-in camera to scan the code. QR Code decoding applications are available for a wide range of cameraphones, with most being free to download and install. QR Codes can represent a variety of information, including: URL's, a paragraph of text, an SMS message, a business card, or a geolocation (longitude and latitude information for an object). QR Codes can be simply generated using a variety of freely accessible web forms, such as: http://mobilecodes.nokia.com, http://www.splashurl.net, http://zxing.appspot.com/generator/. These codes can then be uploaded to websites, printed, or projected for decoding in a variety of contexts. The potential for the educational use of QR Codes resides in their ability to augment traditional information sources.

> QR codes link the physical world with the virtual by providing on-the-spot access to descriptive language and online resources for objects and locations. In this way, the codes support experiential learning, bringing scholarship out of the classroom and into physical experience. (Educause Learning Initiative, 2009c, p. 2)

During 2009, third year Product Design students featured the QR Code capabilities of their smartphones as a theme in their final graduation show. Students used QR Codes to annotate their presentations, and created individual business cards augmented with QR Codes that could be scanned creating an automatic address book contact on visitors' cameraphones. Each student created a QR Code that linked their final design project presentation to a Wordpress blog site providing visitors with more information on the students and their projects. The students demonstrated how to use the QR Codes on their smartphones to the Grad show visitors, decoding the QRCode URLs and showing the mobile version of their showcase blogs. Figure 4 illustrates the use of QR Codes within the third year Grad Show advertising flyer. The QR Code is the URL of the students' combined Wordpress blog with a summary of all of their projects. QR Codes were also used to theme the grad show booklet that was printed and made available to the show visitors.

Figure 4: 2009 Third year Product Design student Grad Show invitation flyer.

Augmented Reality

Augmented reality applications utilize a smartphone's camera to view the real world with overlaid augmenting digital information. This represents a significant unique affordance of smartphones, as described by Cook

(2010b). “The nature of learning is being augmented and accelerated by new digital tools and media, particularly by mobile devices and the networks and structures to which they connect people” (Cook, 2010b, p. 1). “An important affordance of mobile technology is that of digital augmentation, whereby contextual data is added to objects to enable a deeper understanding of them and richer meaning making” (Cook, 2010b, p. 2). However rather than being used as an enhancement for student-generated projects, the majority of smartphone based augmented reality applications have focused upon an enhanced teacher-directed content delivery paradigm. For example, Cook’s (2010a) mlearning research projects focused upon augmenting the learners experience in the field, and in reflection he asks “How do we get beyond good and useful exemplars?” (Cook, 2009b, p. 35). He proposed that to get wide scale practitioner and institutional up-take requires an institutional cultural change. Several criticisms can be leveled at Cook’s ‘exemplars’: the projects do not demonstrate a focus upon student-generated content or contexts as they are pre-defined, there is no long-term change in student learning paradigms as these are short day-long projects with no longitudinal scaffolding for students to personally appropriate the use of the mobile tools beyond the project, the students involved were self-motivated learners and involve small numbers minimizing transferability, and there is a high technical requirement for these projects involving the development of project-specific and intricate augmented reality multimedia.

To minimise the technical expertise required for mlearning implementation and maximise transferability, while explicitly using a social constructivist pedagogical foundation, the researcher decided to focus upon the potential of mobile web 2.0. Mobile web 2.0 enables learner-generated content and learner-generated contexts.

Using mobile web 2.0 developing Augmented Reality applications has become a relatively simple process that anyone with a compatible smartphone can now achieve (Butchart, 2011) by creating user-generated content for mobile web 2.0 augmented reality browsers such as Wikitude, Layar, and Junaio. These tools enable bridging learning contexts by supporting learner-generated contexts using the built-in camera, GPS and compass to overlay the physical environment with student created POIs (points of interest) and location-based data. However the uptake of these tools within educational settings is still in very early stages.

> Uptake of smartphone based AR in education has been very modest so far. We have not found any examples of channels being created in existing AR browsers such as Layar and Junaio that are specifically geared towards learning and teaching. Most likely, this is due to the immaturity of both the AR browsers and tools for publishing content rather than aversion to the idea of augmented reality itself. (Butchart, 2011, p. 38)

The educational use of student-generated augmented reality content is illustrated by the 2010 eCV elective project within the Bachelor of Architecture course at Unitec. The 2010 eCV10 Architecture mlearning project investigated bridging student generated ePortfolios and digital storytelling facilitated by the latest generation of mobile devices, allowing the capture and organization of this content to be contextual and based in authentic environments beyond the classroom. Lecturers and students were provided with an Android smartphone (HTC Desire) and an Apple iPad for the duration of the semester-long project. Students worked in four negotiated teams, initially proposing a group eportfolio project that utilized the unique affordances of the mobile tools. The Archifail team project captured images and mobile videos highlighting and critiquing poor Architectural design around Auckland City. The team created a Wordpress portfolio (http://archifail.wordpress.com/), and also created a layer for the Wikitude augmented reality mobile browser (http://prezi.com/byy1rnidvw-i/archifail/). This Wikitude layer included geographically tagged locations of failed Architectural design, supplemented with images and a short critique by the students of the design failures. Anyone with a compatible smartphone could then download the Archifail layer to Wikitude and use the smartphone’s built-in camera coupled with its GPS and compass to locate these points of interest overlaid as digital information on the real-world viewed through the smartphone’s camera. The students then created a tutorial explaining the steps involved in creating a Wikitude AR layer for the other eCV student teams (http://dave16288.blogspot.com/2010/11/wikitude-tutorial.html).

Twitter

Twitter has grown into one of the most popular microblogging platforms, with a user-base growing 1382 percent in 2008 (McGiboney, 2009) and over 1500 percent during 2009. Twitter can be used either asynchronously or synchronously to enhance communication and collaboration. As a primarily text-based tool Twitter is capable of working from any cellphone using SMS, but can be enhanced using smartphones with GPS, photo and video integration within a variety of Twitter applications, for example: the official Twitter mobile app, Twitterriffic, Tweetdeck, and the imminent 'deep integration' of Twitter into iOS5 for the iPod Touch, iPhone, and iPad (http://www.apple.com/ios/ios5/features.html#twitter). Twitter is a useful tool for enabling communication and collaboration (Educause Learning Initiative, 2009b), developing and maintaining geographically disperse communities of practice, and has become deeply integrated into many of the most popular web 2.0 blog hosts and media sharing sites (for example: Wordpress, Typepad, YouTube, Qik, Flickr, Ning). This integration with a wide variety of web 2.0 tools allows Twitter to become the social network linking users' eportfolios built from a collation of web 2.0 tools, allowing a flexible personal learning environment to be customized by the end-user. Thus in our mlearning projects that focus upon collaboration and student-generated eportfolios Twitter has become the primary communication and collaboration hub.

Buchem and Hamelmann (2010) discuss the potential for using Twitter for creating communities for professional development. Buchem (2011) also emphasizes the serendipitous nature of the use of Twitter in creating opportunities for unplanned collaboration and discovery. Our experience supports Buchem's propositions, as several of our mlearning projects that have utilized the affordances of Twitter have led to serendipitous (unplanned but fortuitous) outcomes (Cochrane, 2010). Twitter has been used in a variety of contexts within our mlearning projects, including: enhancing face-to-face discussions and brainstorms with live Twitter searches projected for the participants to view, beyond class discussions, and as a core asynchronous communication tool between geographically disperse student teams across international time-zones.

Mobile Movie Making and Video Streaming

Almost any cameraphone can record short video clips that can then be uploaded to web-based video hosts for sharing and distribution such as YouTube and Vimeo. Smartphones feature basic video editing tools directly on the smartphone, enabling titling, editing of multiple video clips and clip transitions – thus allowing a fully mobile video to be shot, edited, and shared from a mobile device. There are also several mobile live video-streaming applications and services for smartphones, including: Qik, Ustream, and Bambuser. The size, portability, ubiquitous connectivity, and long battery-life of cameraphones enable capturing of ideas and sharing of experiences in virtually any context, enabling student-generated content within student-generated contexts.

Mobile Film festivals have become popular in Europe (BBC, 2009; Mobigardens, 2010; Mobilizedtv, 2011) and Australia (Ratnanesan, 2010). This provided an opportunity to leverage some of the international expertise in this emerging field, and was particularly relevant for several mlearning projects within Film and Television elective courses between 2009-2011. The 2011 Film and television course elective "entertainment lab for the very small screen" (ELVSS11) explored team-based student-generated mobisodes (short mobile video episodes) using iPhones to capture video in unique ways, and iPad1's to edit and upload the mobisodes to YouTube. The five team mobisodes and student reflections on the project are available on the YouTube channel: http://www.youtube.com/user/ELVSS11#g/u. Using the iPhones students explored and made examples of filming techniques and positions that were unachievable via traditional film making using standard production-level digital cameras and crews. They also critiqued the advantages and limitations of the small screen format. This project not only explored an innovative use of mobile technology, but also enabled the course lecturer to reinvent the course's underlying pedagogy. The course was redesigned from a set of content-delivery lectures, to developing student-negotiated and student-generated team projects that were supported by the input of a range of mobile learning experts, both locally and internationally. Each face-to-face class session involved an overview of an aspect of mobile video production, and was followed by student-led discussions (enhanced with a live Twitter feed) around the development of their mobisode projects. Class notes and outcomes were negotiated with the students and made available on Google Docs. Remote guest lecturers from Wellington (NZ)

and the UK (Salford University) were brought into the class via live Skype feeds, with interaction and questions enabled via both the live and asynchronous use of Twitter.

Situated Learning

The mobility and ubiquitous connectivity of smartphones allows them to be used within a wide variety of contexts – enabling student-generated learning contexts beyond the classroom, and enables lecturers to design learning experiences that bridge multiple contexts. Laurillard argues that "M-learning, being the digital support of adaptive, investigative, communicative, collaborative, and productive learning activities in remote locations, proposes a wide variety of environments in which the teacher can operate" (Laurillard, 2007, p. 172). Similarly, Herrington et al. (2009) argue that mlearning enables the use of new pedagogies that support authentic contexts in learning. This is illustrated by the development of the integration of mlearning linking theory and practice on site within the building technology course at Unitec.

During 2010 a building technology lecturer participated in the inaugural 2010 class of the Social Learning Technologies course developed and facilitated by the author (Cochrane & Narayan, 2011). The course was modeled on an intentional community of practice (Langelier, 2005), with the participants investigating the potential impact of the integration of mobile web 2.0 tools in education, based upon social learning theories. The participants were required to apply what they learnt and experienced to their own teaching practice. As a result one lecturer conceptualized and designed (using Google Sketchup) a portable 'eShed' or 'smartshed' that could be transported to the building sites where his students engaged in practical work experience, creating a direct link between theory and practice without the separation of theory lessons taking place in the context of a classroom off the building site. The eShed became a reification of the lecturer's reconceptualisation of teaching and learning based upon social constructivism and Laurillard's (2001, 2007) conversational framework. The concept was enhanced by leveraging the affordances of student-owned smartphones via the utilization of QR Codes for annotating building site components with rich media including YouTube video construction examples and Google sketchup building plan detail, and also the embedding of student blogs as live journals of their learning experiences on and off the building site including student captured photos and videos via their smartphones. Live streaming of mobile video via services such as Qik were also designed to allow participation by remote students, or live demonstrations across the building site streamed directly to the eShed smartboard, creating a virtual community of practice that links the physical community of practice. The eShed was given faculty approval in 2011 and constructed mid 2011. The final version of the eShed includes: an interactive smartboard, a video projector, internet connected PC, a wifi access point providing internet access across the entire building site, and storage of class sets of mobile devices such as iPod Touchs. The eShed will also allow students to view, interact and modify building plans on site via Google Sketchup, and present and discuss their course eportfolios to their lecturers and fellow students on site. Thus the eShed will become a focus for linking theory and practice, and enabling on site discussion, reflection, action, and 're-action'. An online presentation of the eShed development and sample video footage is available at http://prezi.com/ymotphudnegm/real-world-learning/.

Conclusion

The paper makes a case for the impact of mlearning to enable student-generated content and student-generated contexts in tertiary education. Five practical examples of the application of mlearning are drawn from the researcher's experience of implementing and evaluating over twenty-five mlearning projects between 2006 and 2011. Thus the paper illustrates what can be achieved by the creative and innovative planned pedagogical appropriation of the devices that our students are most likely to own – a cameraphone or similar mobile device.

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