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# A mobile Web 2.0 framework: reconceptualising teaching and learning

Thomas Cochrane and Roger Bateman

## Abstract

This chapter presents a mobile Web 2.0 framework for pedagogical change based upon the implementation of over 30 mobile learning (m-learning) projects between 2006 and 2011. These projects explored the potential of m-learning as a catalyst for pedagogical change within architecture, product design, landscape architecture, contemporary music, computing, graphics design, performing and screen arts, accountancy law and finance, civil engineering, and journalism. The projects utilised mobile devices for student-generated content and for enabling student-generated learning contexts, bridging situated experiences with the formal classroom. Examples of the development and implementation of the framework are drawn from the context of the bachelor of product design programme at Unitec, New Zealand. The framework is founded upon contemporary social learning theory and illustrates the potential of mobile Web 2.0 tools to bridge pedagogically designed learning contexts between formal and informal learning and across international boundaries.

**Keywords:** m-learning, pedagogy-andragogy-heutagogy continuum, mobile Web 2.0 tools, pedagogical change, pedagogy 2.0

## Introduction

This section outlines the authors' experiences of implementing mobile Web 2.0 projects from 2006 to 2011, the main drivers, and the key impacts on teaching and learning achieved, in particular the ability to bridge the formal and informal learning contexts.

The research was driven by a desire to bring about positive pedagogical change, informed by this research, in the areas of professional development for lecturers to utilise and integrate mobile Web 2.0 tools into their curricula to support flexible social constructivist learning environments, while facilitating the changes in institutional strategy and wireless infrastructure required to foster a student-owned wireless mobile device model of computing.

Several factors contributed to make this a possibility: the roll-out of almost ubiquitous wireless connectivity via Wi-Fi and 3G broadband, the maturing of smartphones into powerful mobile multimedia computers with unique affordances to augment how we conceptualise and interact with the world around us, the rapid development of mobile Web 2.0, and the development of new social constructivist pedagogies such as authentic learning (Herrington and Herrington, 2006; Herrington and Oliver, 2000), pedagogy 2.0 (McLoughlin and Lee, 2008, 2010), connectivism (Siemens, 2004) and navigationism (Brown, 2005, 2006).

The authors formed a collaborative partnership beginning in 2006 with an initial m-learning pilot project within the bachelor of product design (BPD) programme at Unitec. Based in Auckland, Unitec is New Zealand's largest institute of technology, with 600 lecturers and 10,000 students studying courses ranging from vocational certificates to doctoral post-graduate degrees. Based upon a participatory action research methodology (Swantz, 2008) the authors' m-learning projects led to the development of an implementation framework across the three years of the product design degree programme in 2009 and 2010 (Cochrane and Bateman, 2011a).

This research methodology was very similar to the design-based research methodology that Reeves (2005) advocates for transformational educational technology research. These experiences were further built upon in 2011 in the context of an international collaborative project exploring the potential pedagogical

impact of mobile Web 2.0 tools across the contexts of six different learning communities in four countries across the globe (Cochrane et al., 2011).

The present authors' collaborative m-learning projects have included:

- *2006*: An initial m-learning trial among third-year BPD students using Palm TX and LifeDrive personal digital assistants (PDAs).
- *2007*: Instigation of third-year BPD students' Web 2.0 e-portfolios.
- *2008*: Voluntary m-learning projects with first, second and third-year BPD students, using Nokia N80, N95 and iPhone 3G and Web 2.0.
- *2009*: Integration of mobile Web 2.0 e-portfolios across the entire BPD course, using Nokia XM5800, N97 and Dell Mini9 3G netbooks.
- *2010*: Building on 2009, but with a focus upon student-owned devices and collaborative projects with other student groups around the world.
- *2011*: Establishment of an international collaborative m-learning project involving four countries and six student groups.

Beyond the context of product design, the researchers have also facilitated wireless mobile device (WMD) m-learning projects within a variety of other tertiary education contexts, as summarised in Figure 3.1.

**Figure 3.1:** The authors' m-learning projects 2006 to 2011

## **Background**

Several theoretical foundations were used to inform the implementation framework and practice, and are outlined in the following section.

### **Social learning theory**

The researchers chose social constructivism (Vygotsky, 1978) as the foundational learning theory on which to base the m-learning projects. As such, pedagogical frameworks that emphasise social learning and collaboration informed the projects' design and assessment decisions. These included the following pedagogical frameworks: pedagogy 2.0, student-generated contexts, communities of practice (COPs), and authentic learning.

#### *Pedagogy 2.0*

Pedagogy 2.0 (McLoughlin and Lee, 2007, 2008, 2010) involves the appropriation of Web 2.0 tools to enable new and emerging pedagogies such as communities of practice, authentic learning and learner-generated-contexts. Key aspects of pedagogy 2.0 involve the integration and modelling of the use of mobile and Web 2.0 technologies in educational contexts.

#### *Learner-generated contexts*

Learner-generated contexts and the pedagogy-andragogy-heutagogy (PAH) continuum (Cook, 2010; Garnett, 2010; Luckin, et al., 2010) focus upon transforming teaching from teacher-directed pedagogies to learner-directed or negotiated activities, empowering learners to become self-directed learners. Learner-

generated contexts bridge the typical divide between teacher-directed pedagogies (pedagogy) associated with lower-level education, student-centred pedagogies (andragogy) and the student-directed learning pedagogies (heutagogy) usually the domain of higher education such as doctoral studies.

We describe the process of reconceptualisation of teaching and learning from pedagogy to heutagogy as an ontological shift (Chi and Hausmann, 2003) for the participants: as based upon their previous educational experiences, the lecturers reconceptualise what it means to teach, and students reconceptualise what it means to learn within social constructivist paradigms. The m-learning projects have illustrated that these ontological shifts require significant time and scaffolding, which can be achieved by framing courses around COPs.

### *Communities of practice*

'Communities of practice' is a social learning theory (Lave and Wenger, 1991; Wenger et al., 2005, 2009). COPs can provide a framework for developing and nurturing learning communities. Central to the development of COPs are the concepts of legitimate peripheral participation, technology stewardship, and brokering of the boundary objects that represent the reified activities of the COP beyond the confines of the COP.

The goal of a COP is to bring the peripheral members of the community into full participation within the community guided by expert (or more experienced) peers who form the core group of the COP. This is similar to the concept of the zone of proximal development (Vygotsky, 1978; Bryant, 2006). The activities of the m-learning project COPs are physically represented in participant-generated artefacts such as YouTube videos, blog posts and Twitter streams. These artefacts were then used by the authors to model and broker the impact of this approach to other lecturers and students across the institution and internationally.

### *Authentic learning*

Authentic learning (Herrington and Herrington, 2007; Herrington et al., 2009) provides a methodology for creating and supporting learner-generated content and contexts. Authentic learning is based on constructivist learning paradigms, and specifically on situated learning theory, focusing upon bridging theory and practice in learning. In the authors' view, the ability of m-learning to bridge learning contexts and facilitate student-generated contexts provides a powerful way to address the critics of authentic learning who contend that situated learning cannot authentically occur in the classroom. Networked mobile technologies (NMTs) can facilitate the design of pedagogical activities that enable students to continue learning conversations and experiences both in and beyond the classroom.

### **M-learning**

The authors view m-learning as a catalyst for pedagogical change that can be leveraged by lecturers modelling the pedagogical use of mobile Web 2.0 tools for facilitating reflective reconception of teaching and learning, moving from teacher-directed pedagogy to learner-generated content and learner-generated contexts. The introduction of m-learning into a course can act as a catalyst for pedagogical change by disrupting existing power relationships within the teaching and learning environment, creating a foundation for facilitating student-generated content and student-generated contexts. Thus, a move from pedagogy (lecturer-directed and lecturer-generated content) to andragogy (student-centred and student-generated

content) and finally heutagogy (student-directed or student-negotiated and student-generated contexts) can be facilitated. 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. (Belshaw, 2010: 63)

M-learning 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 emphasises the potential impact of m-learning:

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: 181)

### *Pedagogical transformations through m-learning*

The ability of m-learning to act as a catalyst for pedagogical change is of great interest to the present authors. Indeed, it formed the basis for developing a design framework for m-learning that is founded upon a social constructivist pedagogy that enables learner-generated content and learner-generated contexts that bridge both formal and informal learning environments. Thus, rather than being technology-centric, the impact of m-learning can be seen in terms of its potential for pedagogical transformation. We are therefore in agreement with Pachler et al.:

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 utilise 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 et al., 2010: 6)

Thus, our focus has been upon exploring the potential for pedagogical transformation enabled by the educational affordances of smartphones as the device that students already own. Smartphones are a subset of the NMTs referred to in this book, emphasising the wireless connectivity and communication affordances of these technologies. The potential of these devices to enable the design of new pedagogical strategies that bridge formal and informal learning are illustrated in the BPD examples that follow.

### **Mobile Web 2.0 design framework: some examples of use**

A mobile Web 2.0 framework was developed across several iterations of m-learning project implementation within the context of the BPD course at Unitec, New Zealand. This framework was subsequently transferred and implementation to an international collaborative project between six different courses in four different

countries in 2011. Thus, these examples demonstrate the use of a mobile Web 2.0 design framework to bridge multiple learning contexts (including formal and informal) and reconceptualise teaching and learning.

### **The BPD programme, 2006 to 2011**

In 2006, when the BPD programme initially explored the mobile Web 2.0 framework, it was a three-year undergraduate degree programme of 360 credits of full-time study. The programme was launched in 2003 and was borne out of a previous bachelor's programme that had its roots in a traditional approach to design studio teaching that favoured the atelier or 'private method' of instruction, where an individual staff member works with a small group of students to train them progressively.

Art and design education has frequently argued that the atelier method or studio environment, mirrors the 'real world'; however, the intellectual landscape of the twenty-first century made up of emergent organisations, open source development and networked innovation, rises from new and constantly changing human connections.

The landscape of work environments has also been changing to strengthen these connections and give people more variety and choice in where to work and how to work. Technology and the internet allow constant access and wider access than ever before.

The standard atelier method or studio teaching environment of one communal space and one fixed timetable is unlikely to offer the best support and learning opportunities for today's creative students; it does not mirror the 'real contemporary world'.

Over a four-year period, the integration of mobile Web 2.0 tools into the BPD course facilitated significant flexibility for students, allowing them to stay connected, share their ideas widely, participate in worldwide creative communities and choose to work in virtually any context on and off campus.

#### *2006*

Beginning in 2006, an m-learning trial using Palm Wi-Fi PDAs and Web 2.0 tools such as Blogger.com and instant messaging was implemented within one project in the third year of the BPD programme (Cochrane, 2006). This was the first attempt at integrating m-learning within the course. However, there was little course integration, limited buy-in from course lecturers, limited campus Wi-Fi coverage, and the results effectively illustrated how not to approach m-learning. At the same time, the lead researcher was developing a COP model for educational technology literacy in tertiary academics (Cochrane and Kligyte, 2007).

Product design course lecturers were invited to form an intentional COP (Langelier, 2005) to investigate the use of Web 2.0 tools within their teaching. This first attempt at establishing a lecturer COP was short-lived, although one lecturer was motivated to explore these ideas further in 2007. While no formal changes were made to the traditional paper-based implementation of the major project in 2006, reflections on these experiences merged to form the foundational concepts underpinning subsequent implementation and research into mobile learning. The 2006 trials were also used to develop and test the research questions and data collection instruments.

#### *2007*

In 2007, the main third-year lecturer decided to integrated the optional use of Web 2.0 tools such as blogging (via WordPress) into the third-year course using student-owned laptops and desktops. This integration was

achieved with regular technological support from the lead researcher. Significant advantages in moving to this learning environment were envisioned by the lecturer:

Research shows us that there are 'far more dyslexic Art and Design students than we ever realised' (Hercules, 2001: 2) and that dyslexia raises many issues for studio-based teaching methodologies. By implementing the use of student reflective design journals as living, media-rich blogs it was hoped that these students would be engaged and empowered in their learning. (Course lecturer, 2007)

This was achieved by modifying the core assessment of the third-year programme that focused upon three student-defined product designs throughout the entire year. The impact of this pedagogical intervention on the teaching and learning environment are summarised by the lecturer below:

Thinking about what for us as designers and training young designers – what is 'real world learning'? Real world learning involves team working, and blogs allow you to work in teams in a way that you can't work if you don't use them. We see the use of blogs as a way of being able to stay in touch in a kind of multi-lane highway – rather than a single stream. It's something that's allowed staff to engage with students in a way that doesn't happen with e-mail and so on. In terms of our profession it's absolutely vital that we do this – and I'm keen to sit down with my colleagues and see how we can embed this into the programme rather than in a particular year of the programme – and we can get the students from first, second and third year interfacing with each other and their blogs. (Lecturer, 2007)

To support the 2007 work, a product design lecturer COP was set up to investigate the integration of Web 2.0 and mobile Web 2.0 into the course in the second half of 2007. The lecturer COP was then used as a model for supporting students in a COP that comprised the researcher as the technology steward (Wenger et al., 2005), the course lecturers, and the students.

## *2008*

In late 2007, the goals for 2008 were set out. The focus was on an m-learning integration plan that would utilise a range of mobile Web 2.0 tools and software with the BPD students along with a range of assessment criteria including podcasting and vodcasting. The hope was that those students who underperformed due to literacy problems would find a 'natural' way to blog their projects and thus develop the desired critical reflective thinking skills.

A project outline for 2008 was developed by the researchers and presented for discussion with the other course lecturers. The 2008 m-learning project budget allowed for students to be supplied with smartphones and Bluetooth folding keyboards. Students were encouraged to use them as if they owned the devices. Students were also supplied with a 1 GB data plan for the duration of the course. It was our opinion that programmes need to provide the hardware or make purchase a compulsory course-related cost.

The initial stages of the 2008 project saw a drop-off in 'normal' project activity as students explored the mobile Web 2.0 tools, including setting up the software and hardware and having fun exploring the new technology that was available to them. However, as the tools became integrated into the students' daily workflows, a significant uptake in engagement in the course was observed. This formed the foundation of

student-generated e-portfolios that students could use to capture and share their learning experiences in virtually any context, both formal and informal, using their mobile devices.

### *2009*

In 2009, a further m-learning project iteration was rolled out for the duration of the third year of the course. In 2009, students were required to integrate Web 2.0 into their studio practice. To this end, the programme provided Nokia N95 smartphones and a weekly COP meeting that focused on understanding and experimenting with Web 2.0 tools and technologies. Whereas in 2008 students were given a 1 GB data plan for the duration of the course, in 2009 they funded the data and voice connection plans themselves but were provided free Wi-Fi access while on campus.

### *SHaC09*

The Sustainable Habitat Challenge (SHaC) is a national competition in the form of a collaborative project for teams around New Zealand to design, develop, and build sustainable housing in their local community. Throughout the SHaC09 project, data-sharing was enabled through a range of software applications. Staff and students made project work and resources available to the rest of the world online, via blogs, wikis and other Web 2.0 applications. Figure 3.2 illustrates the range of Web 2.0 tools used and the types of interaction between the project members facilitated by these tools.

#### Figure 3.2: SHaC09 mobile Web 2.0 network

Good project management, collaborative working and cross departmental communications were vital to the success of the project. Within the context of SHaC09, departmental-specific academic briefs were developed collaboratively by lecturers in the departments of design, landscape design, communication and applied trades.

Web 2.0 tools including Vox, Ning and Flickr were used to develop the briefs and supplement in-person meetings during the writing stage. Product design students worked in one of five groups, each of which focused on a specific design challenge. Students were required to carry out aspects of research in their group, sharing information via group meetings and Web 2.0 tools (Cochrane et al., 2009a). This project thus explored the potential of mobile Web 2.0 tools to enable and enrich student collaboration across departmental boundaries.

### *The nomadic studio*

Social software tools can be effectively integrated into both face-to-face and online environments; the most promising settings for a pedagogy that capitalises on the capabilities of these tools are fully online or blended so that students can engage with peers, instructors, and the community in creating and sharing ideas (McLoughlin et al., 2008: 3). Moving further away from the atelier method as outlined above and building upon the work carried out in 2008, our research focus for 2009 focused on the seamless integration of Web 2.0 into the BPD course as well as augmenting the level of flexibility for students to allow them to choose to work in virtually any context on and off campus.



In the second semester of 2009, students were required to undertake a regular 'nomadic' session where they would work away from the studio, but continue collaborating and learning conversations via mobile Web 2.0 connectivity (Cochrane et al., 2009a).

During the 'nomadic' studio session, students were expected to:

- be online via MSN or following their lecturer and classmates on Twitter;
- make at least one relevant blog post summarising their work;
- upload some multimedia content capturing what they were doing – for example a Qik or Flixwagon videostream or recorded vodcast, or to geotag and upload a photo to Flickr, Picasa or similar.

Thus, the nomadic studio formed a virtual bridge between the formal physical studio context and the informal situated learning contexts in which the students chose to work and research.

### *2010*

In 2010, the researchers' aim was to embed the Web 2.0 framework into the BPD course as a whole. The researchers planned a strategy to work with the first-year students as they had not previously introduced the first-years to the mobile Web 2.0 framework. The first-year implementation focused on the first stage in this transformation, facilitating student-generated content and collaboration (Cochrane and Bateman, 2010b). Examples of assessment alignment and integration of the mobile Web 2.0 tools within the course are outlined below.

Students and lecturers were provided with Dell Mini9 Wi-Fi and 3G capable netbooks for the first semester. At the end of the first semester, the students and lecturers were also provided with a Wi-Fi and 3G capable smartphone that integrated a 3.2 megapixel camera, video recording, GPS, touch-screen for text input, and multitasking operating system for a variety of Symbian based applications. Students and lecturers were encouraged to personalise the use of these mobile devices and treat them as if they owned them for the duration of the year.

The first-year m-learning projects focused primarily on students establishing and personalising the use of core Web 2.0 tools that could then be built upon more explicitly in the second year of the course where the focus moves to mobile-specific affordances. The focus was therefore more upon the use of the netbook than the smartphones during the first-year course, establishing students' Web 2.0 e-portfolios that would be built upon in 2010. The following sections outline the first year projects.

#### *Semester 1: Ergonomics assignment*

The goal of this assignment was for students to take into account the product user, the physical product and the context of use within a product design project. The project was designed to give students an introduction to conducting a controlled research project and prototyping test rigs to measure quantitative and qualitative data. Students used their netbook to create and establish an online journal/blog of their design investigation via the now defunct Vox blogging service. Students invited their peers, lecturers and the researchers (including the technology steward) into their 'neighbourhood' to facilitate sharing, commenting and critiquing, creating a virtual collaborative learning environment to augment the traditional face-to-face studio environment. Thus, students used Web 2.0 tools for social collaboration within their course, but also had the

opportunity to share this process and content with a potentially worldwide audience. These blogs then become the core of the students' online e-portfolio that will be developed over the next three years of their course.

#### *Semester 2: Practice in context 2, assignment 1*

Practice in context is a theory-based course that introduces students to key exponents in contemporary design history, helping them to contextualise their practical activities and position their own practical endeavours. The researchers saw practice in context as being ideally suited to students using Web 2.0 tools to explore and document key historical and current influences on their field of study. Students used their first-year blog, accessed via the netbook, to upload written reflections, photos (geotagged via the smartphone), video reflections, interviews, web links, and other original material captured using their smartphones. Thus, the focus was upon shared student-generated content and critiques by their peers and lecturers.

Students were required to undertake a written assignment in the form of an online blog that further elaborated on the weekly introductions to the history of contemporary product and furniture design. Building on their existing Vox blog, the students created a 'PIC Group'. This blog ran throughout the course, with students posting to their blog at least weekly, collating information about the people, movements, companies etc. covered in the weekly lectures, and writing up their self-directed research. Students were asked to comment regularly on one another's Vox blog posts – providing critique, feedback and links to appropriate resources. Unfortunately, the Vox e-portfolio site closed in mid-2010, leading to a migration to WordPress as the core student e-portfolio system.

#### *Semester 2: Practice in context, assignment 2*

The second assignment was built upon the processes and affordances of mobile Web 2.0 that students built up during the first PIC2 assignment. The assignment focused upon student-generated content, additionally using Web 2.0 tools to present to the rest of the class and the course lecturers. Students were required to create a chronological timeline (design-line) that identified and discussed key moments in design through products, craft objects, fashion, cars, architecture, exhibitions, literature, music, politics, war, graphics, manifestos, design schools, etc. Their design-line had to be visual as well as text-rich. A clear use of graphical communication was required. Student-sourced quotes from designers, industrialist, politicians were add to the design-line.

Final submissions could take the form of a Google Docs hosted booklet or poster, or some other form of digital product, such as a Picasa or Flickr annotated slideshow from an online web album with geotagged data, descriptions and mobile QR codes for sharing URL links via smartphones. Thus, the 2010 projects solidified the integration of mobile Web 2.0 tools within the foundational first year of the BPD course for student-generated e-portfolios, allowing students to capture and share their learning experiences in virtually any context, including formal and informal, using their mobile devices.

### *2011 and beyond*

Building on the success of integration of mobile Web 2.0 within the course, the researchers explored the transferability of this approach across multiple learning contexts. Consequently, a group of like-minded lecturers from around the world were recruited by the researcher to form a COP to explore the potential of mobile Web 2.0 tools for international collaboration between groups of students (Cochrane et al., 2011).

This international collaboration (the Icollab11 international project) aimed to enhance student teamwork by requiring students to utilise the communication and collaboration affordances of smartphones (for example Twitter, and Qik mobile video-streaming) as they formed international teams and negotiated learning outcomes and team projects with the lecturers in all four countries creating a virtual cultural exchange experience. Students explored the roles of digital identities in online communities.

The project focused upon each student group forming a COP and sharing their own mobile-generated content as appropriate for their context and garnering feedback from the other international groups. Thus, each local physical COP was also augmented by a virtual COP made up of the participants from all four countries. Each lecturer brings unique m-learning experience and expertise to the collaborative project. The project involved exploring the use of:

- international collaboration;
- Google Docs for collaborative project mapping and management by the lecturers;
- Twitter for communication and sharing of ideas;
- student blogs for recording project progress and peer commenting;
- mobile student-generated media;
- remote presentation and peer critique of student-team projects;
- student-generated augmented reality;
- collaborative teaching.

The artefacts produced as reified learning objects by each student team COP became boundary objects that the lecturers used to broker the international virtual COP between the five local physical COPs. The goal was that this international project would facilitate pedagogical shifts from teacher-directed learning towards heutagogy or student-directed and negotiated learning contexts within the context of each of the participating countries. This project thus explored the potential of mobile Web 2.0 tools to enable and enrich student collaboration across international boundaries.

### **Mobile Web 2.0 framework: key aspects**

Here follow some key aspects related to the use of a mobile Web 2.0 design framework to bridge multiple learning contexts, including formal and informal, and reconceptualise teaching and learning.

### **Critical success factors**

Six critical success factors were identified across the 30 m-learning projects from 2006 to 2009 (Cochrane, 2010a), informed by the chosen social learning frameworks. These were identified as common critical issues when attempting to create new social constructivist learning environments in the variety of contexts explored by the researcher. Data analysis to reveal common themes was taken from pre-project surveys of

participants, regular blog posts throughout the projects by the participants, post-project surveys of the participants, and focus groups from each project. The identified critical success factors were used to guide the design of the evolving m-learning projects, including the BPD m-learning projects (Cochrane, 2010b).

The six identified critical success factors were:

- the pedagogical integration of the technology into the course and assessment;
- lecturer modelling of the pedagogical use of the tools;
- creating a supportive learning community;
- appropriate choice of mobile devices and Web 2.0 social software;
- technological and pedagogical support;
- creating sustained interaction that facilitates the development of ontological shifts, both for the lecturers and the students.

These critical success factors are informed by the chosen theoretical learning frameworks, and led to the development of a mobile Web 2.0 framework. These are explored in more depth in previous publications by the researchers (Cochrane, 2010a, 2012; Cochrane and Bateman, 2011a).

### **Scaffolding the PAH Continuum**

The concept of bridging the PAH continuum provided a measure of how much pedagogical transformation was achieved by each m-learning project, as the goal of each project was to develop a move from teacher-directed pedagogy towards student-directed heutagogy (Cochrane and Bateman, 2010b; Cochrane et al., 2009b). However, this transformation is a process, often involving a significant reconceptualisation of teaching and learning (or an ontological shift) by the participants. This process requires both pedagogical and technical scaffolding, and was achieved by the establishment of a collaborative partnership between the researcher as an academic adviser and technology steward, and the course lecturers and students.

The problem with technology-focused interventions in education tends to be their short-term nature as they typically involve an early-adopter educator working with final-year students. This leaves little scope for building on these projects or any significant sustained engagement for students. To move beyond such scenarios, our framework takes a staged and scaffolded approach to technology integration across the entire length of a programme, allowing significant sustained engagement for the participants, and enabling the ability to build on the appropriation of the technology and pedagogical change over multiple years, as illustrated in Table 3.1.

Insert Table 3.1 here

### **Facilitating ontological shifts via communities of practice**

Each m-learning project was treated as the establishment of a unique learning community, modelled as a COP. The projects therefore put the most effort into nurturing and developing these COPs rather than the development of mobile-formatted content delivery or developing mobile platforms or applications (Cochrane, 2007; Cochrane and Narayan, 2011).

Framing the m-learning projects around the establishment of COPs facilitated regular and sustained engagement of the participants. Peer and expert modelling of the educational use of mobile Web 2.0 tools

within these COPs helped the participants to reconceptualise their roles within a social-constructivist learning paradigm.

### **Establishing a design framework**

The design framework developed for each of the m-learning projects is shown in Table 3.2. This framework was developed iteratively over the life of the research, which began in 2006 with two test projects that informed the practical implementation of the subsequent projects in 2007 to 2011 (Cochrane, 2011; Cochrane and Bateman, 2011a).

The framework table format is based loosely on that suggested by Sharples et al. (2009). The emphasis is upon starting with desired learning practices then choosing appropriate technologies to manage and support these practices. This implies that the starting point of the design process is the learning practice and chosen pedagogical framework, which then informs the appropriate choice of mediating technologies.

Within the researcher's framework presented in Table 3.2, the elements of assessment, and pedagogical and technological support are explicitly dealt with within the lecturer pre-project COP and in the implementation stage of the project within the student and lecturer collaborative COP.

Insert Table 3.2 here

### **Mapping mobile Web 2.0 affordances**

The m-learning projects explored how a mix of mobile Web 2.0 tools could enhance the students' learning throughout their whole course, and in particular how these tools could facilitate social constructivist learning environments, including student-generated content and student-generated contexts (Cochrane and Bateman, 2010a).

Table 3.3 provides an example of a mobile Web 2.0 tool and the pedagogical alignment with social constructivist activities and outcomes, building upon the mobile Web 2.0 framework described above.

Insert Table 3.3 here

The researcher worked with lecturers to explore how mobile Web 2.0 tools could be integrated into new course activities and assessments that leveraged social constructivist pedagogy. This often involved the use of Google Docs for collaborative editing and brainstorming of course outlines and aligned assessment activities.

### **Discussion**

The impact of the developed mobile Web 2.0 implementation framework described in this chapter is clearly seen in the changes implemented in the BPD course at Unitec from 2006 to 2010. Beginning with initial explorations of mobile blogging in the third year of the course in 2006, the course now features student-generated e-portfolios as a core assessment, formative feedback, and a tool for collaboration.

The use of mobile devices (specifically smartphones) has enabled students to capture, record, share, curate and categorise ideas, processes and collaborative activities in and beyond the classical studio environment. Bridging formal and informal learning experiences has become explicit and authentic via mobile Web 2.0 tools.

The integration of lecturer and student COPs as a core support structure within the course has led to sustained collaboration between the course lecturers and the educational researcher as the technology

steward. An outcome of this collaborative partnership has been not only pedagogical change but also significant practice-based research outputs that have been used to broker the concepts and approach to other lecturers in other learning contexts, including an international COP established in 2011.

While the commitment and input of the participants have been intense, the outcomes have been rich. The results have been significantly better than the previous approach of scaffolding educational technology integration via a short series of introductory workshops. Making project decisions explicitly founded upon a chosen social learning theory and associated learning frameworks has guided the implementation and development of the projects. The developed mobile Web 2.0 framework effectively satisfies Reeves' (2005) call for a new research methodology and new support strategies for educational technology integration. As Reeves (2009: 2) adds: 'design research requires intensive, on-going collaboration among researchers and practitioners to design and refine prototype e-learning environments tailored to the unique contexts in which they will be used'.

Thus, the research has resulted in the development of a transferable design framework and implementation strategy for mobile Web 2.0 in tertiary education that is sufficiently flexible to allow for new and unique contexts (Cochrane, 2010c). The implementation strategy matches the unique affordances of mobile Web 2.0 with social constructivist pedagogies, minimising the technical support needed for the participants, and maximising transferability.

The implementation strategy places the emphasis upon lecturer professional development and student scaffolding with the goal of transforming pedagogy rather than the development and programming of technically complex mobile software applications. The research developed explicit staging of the integration of mobile Web 2.0 within courses and scaffolding and nurturing of the required ontological shifts in pedagogical transformation via a structured and sustained intentional community of practice model over the length of the course, resulting in positive pedagogical change for both the lecturers and the students.

Coupled with an action research methodology, this ensured that each new m-learning project did not have to reinvent the wheel, but built upon the lessons learnt from previous projects. The range of learning contexts covered by the 2006–11 m-learning projects demonstrates the transferability of the implementation strategy for mainstream adoption.

## **Conclusion**

This chapter outlines a design framework for implementing mobile Web 2.0 within higher education with the goal of transforming pedagogy from lecturer-directed pedagogy to student-directed heutagogy. This mobile Web 2.0 framework enables the design of student-generated content and learning contexts.

The BPD m-learning projects between 2006 and 2010 illustrate how mobile Web 2.0 can be used as a catalyst to enable student-generated content and student-generated learning contexts in and beyond the classroom. Modelling lecturer professional development and class interactions as intentional COPs that are collaborative partnerships between the participants and educational technology researchers as technology stewards was found to provide a powerful support structure for pedagogical change and is a key component of the framework.

The framework is based upon social learning theory to guide implementation strategies and match the unique collaborative and communicative affordances of mobile Web 2.0 tools, ensuring that appropriate and transformational choices are made.

In summary, the mobile Web 2.0 framework can be used to support the design of m-learning projects that bridge learning contexts, including formal and informal (for example, in the creation of student-generated e-portfolios), physical and virtual (for example, the nomadic studio), situating learning within authentic collaborative student experiences (for example, the Shac09 project and the lcollab11 international project).

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Table 3.1: Staging and scaffolding the PAH continuum

Stage	Learning context	MLearning project focus	Course timeframe	PAH alignment
Level 1	Social collaboration with peers and lecturer Student generated content	Establishment of student-generated e-portfolios using student-owned mobile devices, Learning Management System and basic Web 2.0 sites	One-year certificate programmes, or first year of longer programmes	Pedagogy (lecturer directed)
Level 2	Social collaboration with peers and 'authentic environments' Context aware	Establishing the unique communication and collaboration affordances of student-owned mobile devices	Second year of two-year or longer programmes	From pedagogy to andragogy (students become the content creators)



Level 3	Context independent, bridging formal and informal learning Student generated contexts	Student-negotiated team projects exploring (for example) mobile augmented reality using student-owned mobile devices	Third year of programme	From andragogy to heutagogy (students become independent learners)
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Table 3.2: M-learning project design framework

Learning practice	Mediating circumstances		
Social constructivism	Context	Technology	Agent
Lecturer community of practice	Lecturer professional development, pedagogical brainstorming	Face to face, scaffolded using Learning Management System, smartphone, Web 2.0 services	Lecturers as peers, with researcher as technology steward
Student and lecturer community of practice	Pedagogical integration and technical support	Face to face, scaffolded using LMS, smartphone, Web 2.0 services	Students as peers, lecturer as guide and pedagogical modeller, with the researcher as technology steward
Collaboration	Group projects	Social networking, collaborative documents	Google Docs, student peers
Sharing	Peer commenting and critique	Web 2.0 media sites, e-portfolio creation	RSS, student peers, lecturer
Student content creation	Student individual and group projects	Smartphone with camera and microphone, content uploaded to Web 2.0 sites	Student and peers
Reflective	Journal of learning and processes, recording critical incidents	Web 2.0 hosted blog	Personal appropriation, formative feedback from lecturer
Learning context bridging	Linking formal and informal learning	Smartphone used as communications tool and content capturing	Student interacting with context, peers, and lecturers

Table 3.3: Mapping mobile Web 2.0 affordances to social constructivist design

Learning practice	Mediating circumstances		
Social constructivism	Context	Technology	Agent
Group projects and team communication	Student collaboration across global boundaries, including questioning, commenting, polling and sharing of student-generated content via web links	Twitter via smartphone with embedded links to student-generated blog posts, YouTube videos, and polling via Polleverywhere.	Modelled by expert lecturers, and appropriated by student peers