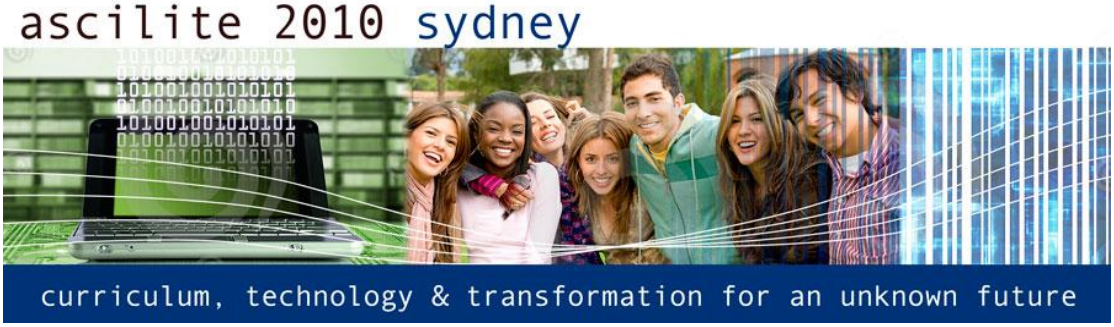


# Lessons in designing sustainable mobile learning environments

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There has been an increase in mobile learning projects reported in scholarly conferences and publications. Our project consists of investigating the integration of mobile learning into an undergraduate Zoology module in which students undertook research projects in groups. In this paper, we report on students' adoption rate of the mobile learning option and their perceptions of its utility, with the aim of informing the design of sustainable mobile learning environments. Few students made use of the mobile learning infrastructure because existing means were preferred and mobile learning was perceived to be irrelevant for the learning task.

Keywords: mobile learning, sustainability, project-based learning

## Introduction

Mobile learning (or m-learning) has garnered increased attention from scholarly conferences and publications in recent years (Frohberg, Göth, & Schwabe, 2009). This attention is matched by a rise in the use of mobile devices: for example, the New Zealand Broadcasting Standards Authority (2008) found that 71% of 12-13 year old children used cellphones, a figure which supports Looi et al.'s (2010) claim that personal, networked technologies are becoming ubiquitous in our students' lives.

But is mobile learning poised to become ubiquitous? While we are aware of several successful m-learning projects, our own experience has cast some doubts regarding their sustainability. A review of mobile learning projects reported in the *Australasian Journal of Educational Technology* (Volumes 25 and 26) revealed that, out of the nine projects located, the various institutions provided the students with mobile devices in six cases (Cochrane & Bateman, 2010; Dyson, Litchfield, Lawrence, Raban, & Leijdekkers, 2009; Gkatzidou & Pearson, 2009; Lam, Lam, Lam, & McNaught, 2009; Tsai, Tsai, & Hwang, 2010). We believe that the temporary provision of devices to students is not sustainable: firstly, students are unable to continue m-learning in the same way after the project is completed; secondly, few institutions are willing to bear the logistical burdens of cost and equipment tracking in the long term. As Sharples (2000) suggested, the mobile tool should be "individual" (p. 178) and "persistent" (p. 179), adapting to the individual's abilities and preferences as well as managing their personal learning throughout their lifetime. In addition to not being sustainable, providing students with (typically cutting-edge) mobile devices can create enthusiasm for the devices and result in an 'inflated' level of adoption.

Out of the three projects where students used their own mobile devices (Dyson et al., 2009; Vuojärvi, Isomäki, & Hynes, 2010), only one case study (involving mobile supported fieldwork) involved the

integration of m-learning into a specific mainstream course as one of the multiple means of collecting data. The other two studies involved the general use of laptops and mp3 players around the university. In this paper, we report on a class of students' adoption rate of the mobile learning option in an undergraduate Zoology module and their perceptions of its utility. The aim is to inform the design of sustainable mobile learning environments.

## Mobile learning and pedagogy

Mobile devices can be used for learning in many ways: from delivering content (Gkatzidou & Pearson, 2009), revision questions (Petrova, 2007), to facilitating the co-construction of meaning (Cochrane & Bateman, 2010; Looi et al., 2010). Frohberg et al. (2009) believe that mobile devices are most fruitfully deployed in social constructivist learning environments by virtue of their affordances (portability, location-specific inter-personal communication). However, the authors found an unexpectedly low proportion of such social constructivist learning experiences among the 102 mobile learning projects they reviewed.

Mobile tools also offer the distinct advantage of bridging different contexts to provide a seamless learning environment for students (Cochrane & Bateman, 2010; Looi et al., 2010), blurring the boundaries between in-school and out-of-school spaces. Cross (2007) contends that mastering such unbounded, informal learning has become a crucial skill for workers in this uncertain world.

## Enhancing the zoology curriculum with mobile learning

The objective of this current project was to foster self-directed learning both in and beyond the classroom in order to develop the dispositions of lifelong learning. Mobile technologies were thought to be potential tools to enable such forms of learning. We report our early findings here.

Our initial investigations focused on mobile learning in an undergraduate Zoology module in which a class of 36 students undertook research projects (e.g. exploring the running speeds of cockroaches or the reaction of starfish to hormonal injections). These projects were carried out over seven weeks in groups of four. We envisaged that, with a mobile learning option, some groups would capture and share raw data using their mobile devices and make meaning of those artifacts collaboratively. For that purpose, we augmented an in-house developed media-sharing web application UniTube (http://unitube.otago.ac.nz) to receive files via either Multimedia Message (MMS) or e-mail from any mobile phone carrier (Telecom NZ, Vodafone, 2 Degrees) and to allow commenting around artifacts.

In designing our learning environment, we were informed by Frohberg et al.'s (2009) recommendations: we emphasised students producing and making sense of data (not content delivery); we maximised the degree of learner control (students had the freedom to shape project goals/processes and were encouraged to discover new ways in using mobile tools); the task required regular intra-group communication to achieve shared understandings; and the students were advanced third-year students (not novices). Our learning task resembled *Myartspace* (Vavoula, Sharples, Rudman, Meek, & Lonsdale, 2009) in that we planned for mobile phones to be used to gather and share data to support an inquiry. To reduce the potential problems of students not knowing what to do with their mobile devices (Dyson et al., 2009), we suggested several usage scenarios (e.g. recording research methods used, capturing a 'eureka moment') during a group briefing and actively invited their personal suggestions.

To increase sustainability, we chose to allow students to use their own mobile devices. A pre-project survey revealed that, while all but one student possessed cellphones, only one in four had a camera phone (averaging one per research group). Using their own cellphones would incur some costs, but the students were reassured that a sum of money was set aside to reimburse the costs of uploading files from their cellphones to UniTube. Beyond reimbursement, student support included a live demonstration on how to upload files into UniTube, step-by-step instructions on a handout and video clip (http://bit.ly/aW7OCM), and a contact person in case of technical difficulties (whose service was not utilised).

## Findings

We conducted a pre- and post-survey: the former focussed on students' likelihood of taking up the mobile learning option; the latter on their actual use of mobile tools. The pre-survey (N=31) indicated that students in general felt that they were unlikely to use mobile phones to capture either research data or procedures (yielding a mean of 3.8 where 1=likely and 5=unlikely). However, to the question of whether mobile phones were relevant for their projects, students were equally divided (yielding a mean of 3.3 where 1=irrelevant and 5=relevant). In particular, texting group members and taking pictures (e.g."photos of treated fish") were identified as potential uses of mobile phones in this project.

At the end of the group research projects, the post-survey (N=31) indicated that only 16% of the students made use of the mobile learning infrastructure (to view and/or upload images). In fact, only three photographs were uploaded by two students into UniTube. Two photographs showed the laboratory set-up while the other showed a beetle running (http://bit.ly/bFQbJg). One photograph was sent via a mobile phone and two from a computer.

To understand the students' reasons for not adopting the mobile learning option, we coded their post-survey free-text responses into seven categories (see Figure 1). Among the 37 views expressed (several students expressed more than one view), almost 50% pertained to how students preferred existing means to mobile tools: 19% related to how mobile devices were irrelevant or superfluous for the task at hand (e.g. "system wasn't needed for our project"); and 29% pertained to how students preferred to accomplish their task with existing tools such as emails, high-resolution cameras, and face-to-face meetings (e.g. "easier to use camera, verbally communicate in lab"). For example, three out of the five students who initially expressed that they were likely to use the mobile learning option found that existing means were more appropriate in the end. In terms of equipment, 21% of responses related to students not having an up-to-date cellphone (e.g. "doesn't have camera") and their free text comments also indicated that many students possessed digital cameras.

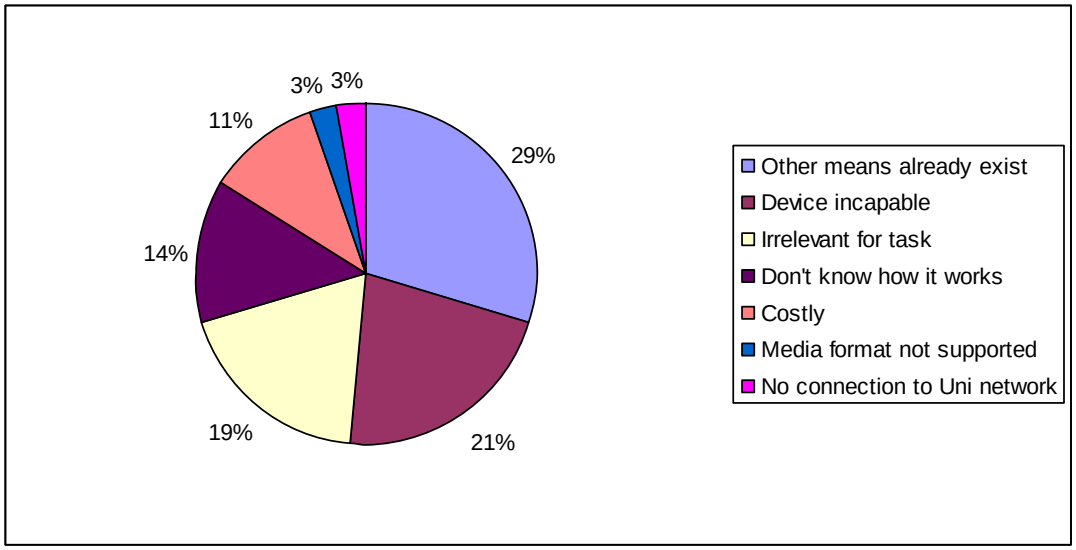


**Figure 1: Distribution of reasons for not adopting the mobile learning option**

The students' suggestions for improvement (21 responses) revolved around reimbursement (29%), provision of up-to-date cellphones to all (19%), and increasing task relevance (14%). We note that reimbursement *was* available, but acknowledge that more precision in its communication would have been desirable. The cost of sending files from mobile phones remains a challenge in seeking sustainability because the additional charges will have to be borne by the students and/or the university.

## Discussion

In our study, few students adopted the mobile learning option mainly because existing means were preferred and mobile learning was perceived to be irrelevant for the learning task. This happened despite the pedagogical design of the learning environment being informed by current best practices. Our choice to maximise the sustainability of the mobile learning environment (i.e., students using their own mobile devices, m-learning as an option among others, integration of m-learning into a mainstream course) had a definite impact on the low adoption rate: it is harder to ponder the relevance of a mobile device if it is given and if it is the *only* tool to realise the learning task (e.g. Lam et al., 2009; Tsai et al., 2010). We hence urge fellow educators—once again—to let the learning activity (not the technology) drive the design of sustainable learning environments: students should always have a range of tools to choose from to accomplish their learning tasks. This freedom of choice is also the pre-requisite for them to appropriate the tool and to personalise their learning.

From our experience, we would also like to qualify Tapscott's (2008) optimism that young people have a "natural affinity for technology" (p. 9). While we believe that most of our students are fluent in using digital technologies in certain situations (e.g. to manage their social lives), we join Dyson et al. (2009) in questioning their ability and (uncritical) willingness to use mobile tools for schooling. Indeed, our students' critical literacy can be observed from their discerning choice of appropriate tools for the job.

We wish to encourage experimentation with new technologies as a form of professional development for teaching staff. Even if the technology fails to be adopted by students, it provides an opportunity for teachers to reflect on the nature of the learning environment and its impact on developing students' disciplinary and critical skills. In the second stage of our project, we will include a mobile learning option to support Zoology-related fieldwork (August-September 2010). We intend to persist in seeking sustainability and we hypothesise that the affordances of mobile tools would be better exploited in fieldwork situations where students are required to share data instantaneously from different locations.

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