

New tools and techniques for learning in the field: studying the built environment

Final Report 2014

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Executive summary

The aim of the project was to investigate the potential for new forms of field-based learning in university education stimulated by recent advances in mobile digital technology. Four case studies were conducted of designing, building and evaluating field exercises that drew on mobile tools (chiefly smartphones and tablets) in distinctive ways. Four subjects in the Built Environment were identified as the sites of study across the three participating Institutions of The University of Melbourne, The University of Sydney and Monash University. Cases 1 and 2 focused on custom-built tools in the form of an iPod/iPhone-based tour of city buildings, and an iPad-based tour of an urban landscape. Case 3 used existing apps for physical light measurements of an interior built space. While Case 4 used mobile platforms as a target for students to design for, developing mock-up screen-shot apps informed by the concepts of urban thinkers applied to particular city locations. The project team consulted with a Reference Group of educators in the Built Environment and e-Learning, and presented several seminars and conference presentations about the work over the two-year project. A National workshop was held in the second year to present the case studies and related work by other researchers and teachers.

Recommendations to teachers, educational designers and institutions

- 1. Institutional support is needed to capitalise on the great potential of mobile-supported fieldwork.* Fieldwork offers a kind of learning that is vital to many disciplines, and may enhance many others. The four case studies in this project demonstrate the strong and varied potential of mobile technologies to create new learning opportunities in the field. These cases illustrate how digital technologies may be used to strengthen and enhance traditional forms of teaching as a complementary path alongside the more publicised approach of transforming teaching through Massive Open Online Courses and similar. To develop these opportunities for mobile-supported fieldwork, institutions need to provide support through small development grants and through continued recognition of the value of staff time spent in extended contact with students.
- 2. Developers of fieldwork must recognise and manage the risks involved.* The delivery of mobile-supported fieldwork is not without risk. Across all of the cases, it was evident that new technologies introduced significant obstacles and practical difficulties. Attention could be consumed by the technology and taken away from the environment. Some forms of mobile content could be alien and ineffective, and the complexities of tasks enabled by the technology could become unmanageable. Our studies showed that overall reception of a field exercise, including the relationship between teacher and student, is dynamic and complex and may be both positively and negatively impacted by the introduction of mobile technology. But it was found that positive outcomes could be improved with successive iterations. The development of fieldwork therefore needs to occur in an environment that accepts the short-term risks and has capacity for ongoing development and support.
- 3. Technology support for fieldwork should be created through a targeted, minimal and iterative development path.* The introduction of technology into fieldworks should occur as one component in the design of a fieldwork exercise intended to serve local learning objectives. The technology should be highly targeted, initially at least, towards a specific purpose in the field exercise. An effective strategy is to start with minimal uses of digital tools, including minimal digital content, alongside traditional paper-based materials. This avoids the problem of distracting complexity in the field task, and allows ongoing evaluation of how students receive and experience the exercise in practice. Successive iterations of the exercise can then progressively refine or add new uses and content for the tools as appropriate. The four cases all demonstrated the value of feeding early experiences into reflection and redesign for later iterations.

4. *The design of mobile-supported field activities can be enhanced by other exercises serving as models for development.* Although any field exercise is heavily embedded in its local learning context, the development of supporting tools is likely to face recurring design issues. Development should therefore attempt to learn from existing exercises. The four cases reported here are presented in a format intended to serve this purpose. In tandem, we offer more general guidelines of the major dimensions to be considered: the potential uses of mobile devices; development paths for acquiring and creating tools and learning materials; designing field activities; designing learning materials for use *in situ*; and the framing of exercises through briefing and debriefing.

Outcomes and deliverables

The project produced the following outputs:

1. The four case studies carried out by the project led to the creation of four mobile-supported fieldwork exercises that have run successfully and will continue after the lifetime of the project.
2. A project website presents the four cases as potential models for exercise development, along with general guidelines for mobile-supported fieldwork.
<http://mobilefieldworklearning.wordpress.com>
3. Three presentations have been made to conferences: the *Annual Conference of the Society of Architectural Historians of Australia and New Zealand (SAHANZ)*; the *International Conference of the Future of Education*; the *Annual Conference of the Australasian Society for Computer in Learning in Tertiary Education (ASCILITE)*. Two journal articles have been produced.
4. Five seminars have been presented by the project team to research and teaching and learning groups.
5. A National Workshop was held in November 2013 as a forum to present the project cases with similar work by other teachers and researchers, with an audience of 30 people from seven institutions.
6. The project developed a web-app for the delivery of quizzes to students in the field that allowed a range of question styles, some with immediate feedback. The team are working to have a stand-alone version of the app made available through Apple's AppStore.

Future Directions

The significance of mobile-supported fieldwork is anticipated to grow in the immediate future. An observation has been that, in addition to planned uses of mobile technology, students bring and use their own devices to make recordings and to coordinate with each other. In this sense, many learning activities outside of the classroom are becoming mobile-supported, and the issue is whether they are designed effectively to exploit this opportunity.

The most important future direction for the continuation of this work lies in enabling educators and institutions to embrace the benefits of student learning carried out in the field, and to see the development of mobile-supported materials and exercises as a viable and valuable investment. This represents an approach to digital technology in education that is complementary to, but distinct from, its more high profile role in enabling forms of online course delivery.

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Chapter 1. Project rationale

For an academic teacher sitting down to plan an upcoming semester, the idea of designing and running a new field exercise is likely to be an exciting but also daunting prospect. Weighing against it is the large amount of contact time with students, the physical resources and arrangements needed, requirements around health and safety, and uncertainty about what students will actually learn. Even for disciplines where fieldwork is part of a long tradition, from Archaeology to Zoology, pressure on staff time and limited institutional resources constrain what is possible.

The question that motivates this project is whether, and in what ways, the advent of new mobile digital technologies (chiefly smart phones and tablets) might transform the cost-benefit equation of delivering fieldwork. Students can now carry in their pockets machines capable of receiving rich instructional and learning materials, with connectivity to teachers and peers. What are the implications of these tools for delivering more effective and efficient fieldwork?

These questions are broad and defy simple or definitive answers. The rationale for the *New Tools and Techniques* project was to investigate them by directly experimenting with the introduction of mobile technologies into field exercises as part of ongoing taught subjects. Our focus was on teaching in disciplines of the Built Environment, though we argue that the implications are generalisable to other disciplines that use similar techniques. The primary aim was to gain first-hand experience of creating mobile-supported exercises and to create resources for other teachers and institutions weighing up the likely value and cost to their own subjects and courses. In this section, we set the scene for this investigation by considering its broader context in m-learning and the tradition of fieldwork.

The rise of m-learning

Over the past decade, there has been an explosion of interest in the application of mobile technologies to education, giving rise to the field of 'm-learning' (e.g., Abrantes and Gouveia 2011; Cochrane, 2010; Park, 2011; Sharples, 2000; Sharples et al, 2002, 2005; Vavoula et al, 2010). Much of this interest has focussed on the possibilities of 'anywhere anytime' learning enabled by the convenient delivery of learning materials and administrative help directly to students' personal digital tools, as promoted by vendors such as Apple computers. Numerous encouraging studies of the various uses of mobile technologies in education have been carried out (Cochrane and Bateman 2010; Costabile et al, 2008; Hafeez-Baig et al, 2006; Kahn and Chapel, 2010; Kinash et al, 2012; Roschelle, 2003). Positive media attention has been given, for example, to the 'Mobile Learning' project at Abilene Christian University in Texas to create an 'always on, always connected' learning environment (Cox, 2010). Another prominent example is the 'Oxford Mobile' project at Oxford University which provides a suite of resources to students and staff, but largely around administrative aspects of teaching: lecture and tutorial schedules, subject choices, public events, social networking.

However, some researchers have pointed to the practical difficulties of mobile delivery (e.g., Albion et al, 2012) and others argue that it has so far been mainly used for unidirectional teaching (e.g., Traxler, 2010) as defined by Berger and Karabenick (2011). Most effort has gone into providing efficient delivery of course content, and into making it conveniently accessible to increasingly mobile students (Murphy, 2011). But alongside this practical goal, there is increasing awareness that mobile devices and applications need new innovative designs and approaches if they are to genuinely stimulate and inspire active learning within a social collaborative context. To achieve this, it is recognised that more empirical evaluations are needed (McConatha et al, 2008; Corlett et al, 2005) including user reflections (Chang et al, 2012; Bachfischer et al, 2008) about the benefits of the use of mobile devices.

The value of field trips and field exercises

The aim of this project was to take the potential of m-learning into learning activities that have traditionally occurred outside the classroom, namely field trips and other kinds of fieldwork. Surprisingly, with a few exceptions (e.g., Dyson et al, 2009; Bedall-Hill 2011; Jarvis and Dickie, 2010), there has been little investigation of designing mobile applications to enhance student learning in the field. This is a curious gap in practice and understanding. One reason, perhaps, is that the most mainstream activities in m-learning are motivated by efficiency, timeliness and possibly cost reduction over the longer term. Fieldwork exercises, in contrast, are slow, time-consuming and expensive activities that are pursued only when they are believed to bring a unique and indispensable form of learning.

Fieldwork has been a traditional and fundamental part of learning in many disciplines such as geography (Welsh et al, 2012; Simm et al, 2011; Dunphy and Spellman 2009) and biology (Lee et al, 2011). Field trips and visits bring well-recognised benefits: learning to apply abstract knowledge to practical reality; promoting skills of interpretation; shifting the emphasis to student-initiated learning; and social interaction between students as a part of learning. As well as fostering greater understanding, the skills developed in fieldwork better prepare students for their careers and later lives; something increasingly sought by students in Universities in Australia (see Trede, 2010). In the context of geography and geology, Stokes et al (2011) found the chief benefits attached to field trips by students and staff were: 'to learn in a particular way or in a particular environment' (e.g., learning by doing); 'to learn to apply a particular approach, method or skill' (e.g., applying what has been learned in class); and, 'to understand how to make sense of the world' (e.g., putting learning into a broader context). Students emphasised learning in a particular way, while staff emphasised making sense of the world.

More recently-formed disciplines have made less use of fieldwork, although there are some exceptions, for example in information and communication technology (Dyson et al, 2008). Dunphy and Spellman (2009) and Stokes et al, (2011) consider fieldwork to be of intrinsic value and even of necessity to geography students, but at the same time provide cautionary remarks that it does not necessarily provide equal benefit to all students given that a disparate cohort of learners has differing learning styles (Kolb 1984; cited in Dunphy and Spellman 2009). Nevertheless, if well-designed, field exercises present an ideal opportunity to create 'authentic' learning experiences of the sort advocated by Herrington and Herrington (2007; also Herrington, 2009).

The potential of new digital mobile technologies

Mobile technologies present students and teachers with an evolving set of disparate tools with many different potentials for the field setting. Four kinds of potential especially relevant to this project can be identified. The first, and the major focus in this project, is the *delivery of enriched learning materials, tools and guidance* for field exercises. A key question of focus was in what ways might digital content (of images, audio and film) presented *in situ* support richer analysis and understanding of an environment? Might, for example, international exemplars of significant buildings help students to observe and identify present built elements within established typologies? Another key question was how new generations of apps downloaded onto smartphones might support learning activities in new ways including the collection and analysis of data, photographic and video recording of sites, and the sharing of student work as it unfolds.

A second area of potential is in facilitating *new forms of social interaction* between students in the field. Rogers et al (2010) found that a field exercise on environmental sustainability was successful only when the designed activity, supported by a mobile device, introduced the need to exchange data between students. Less emphasis was placed here on supporting this aspect through technology, although social interaction between students around the tools was always a relevant part of our observations. A third source of potential is the

greater integration of fieldwork into study programmes. It is often difficult to monitor and assess what students are actually learning in the field (e.g., Coulby et al, 2011) and it is hard to ensure that fieldwork is well integrated and managed in study programs. Field trips are time-consuming and resource-intensive for staff and students and there is increasing pressure in Universities to justify such costs. Again, this had relevance for the case studies reported here.

A fourth and final area of potential value was in developing *techniques of digital content handling and production*, relevant to new careers and work environments. Kafai and Peppler (2011) point out that creative digital media production by students, and their reflective review of new media sources has come to play an increasing role in learning in some disciplines. For many students, the opportunity to develop discipline knowledge and skills in this context is positive. Against this background, students in Australia are increasingly engaging with new media and many come to class with mobile computers, as noted in the recent report 'The First Year Experience' (James et al, 2010). However, while it is true that Australian students have increasing access to digital technologies (Oliver & Goerke, 2007), some researchers have found that students often lack many of the basic skills presumed in the 'digital native' (Kennedy et al, 2008), a point echoed in other countries (Coulby et al, 2011).

The need for empirical investigation and guidance to teachers

Some detailed studies of m-learning point to the ongoing difficulties of designing appropriate tools that deliver genuine value (e.g., Goh et al, 2012; Dimakopoulos and Magoulas, 2009; Wu et al, 2012). As noted by many commentators, although new technologies can be an important impetus for educational initiatives, their introduction can lead to counter-intuitive and undesired outcomes. Careful experimentation and ongoing evaluation is needed concerning where and how new tools are applied (Jung and Latchem, 2011; Pfeffer et al, 2009). As noted by James et al (2010: 46) for the tools of e-learning generally: 'Comprehensive pilot-testing and ongoing monitoring of both student and staff experiences with these technologies is critical to successful implementation'. Many educational researchers recognise, for example, a gap between providing content on mobile platforms and the more difficult challenge of designing mobile learning activities. For example, the London Mobility Group have published valuable collected works and insights (e.g., Pachler et al, 2010). Researchers and government in Australia have also made advances in conceptualising the challenge (e.g., Cobcroft et al, 2006; O'Connell and Smith, 2007).

Working from this general intention to carefully evaluate new applications of technology to learning, this project saw specific needs to provide directions to teachers and institutions about mobile-supported fieldwork. Firstly, despite the practical challenge of fieldwork, mobile technologies may open up new opportunities for fieldwork in disciplines where it has not traditionally been a part of teaching. For example, Dyson et al (2008) used social media recordings effectively for students of Information Systems. Secondly, there is a need for non-technologists to play an active role in shaping the direction of development. It is necessary for initiatives to be motivated by local learning objectives and styles that are specific to particular areas of teaching, and for new technologies to serve those ends. The intention here is to provide demonstration case studies as models of development for non-technologists. These cases provide holistic accounts of how mobile-supported fieldwork can further disciplinary learning objectives. And thirdly, as with James et al (2010), something we observed through the project is that students bring their own mobile technologies to the field situation, alongside those provided by their teachers, to record and share information. Any form of exercise performed outside the lecture room will be to some extent be mobile-supported. It is becoming unavoidable that the design of field activities address the use of connected smartphones and tablets.

Focusing on the disciplines of the Built Environment

A final element of the project's rationale was to focus the case studies on teaching in disciplines of the Built Environment. Given our aim to take a hands-on approach to delivering exercises, it was necessary to have a particular site of exploration. That said, the findings here are intended to be portable to other fieldwork situations. The Built Environment provided a promising setting in that regard, given its long tradition in innovative teaching and learning and varied forms of fieldwork. Within the disciplines engaged in designing and building environments, guiding students through seeing, walking, recording and understanding regions, landscapes and individual buildings are well-established methods of teaching. Professional knowledge has long been gained through the activities of touring, and the integration of practical site visits and fieldwork into university courses. The Built Environment disciplines can therefore claim a lead role in structuring broader paradigms for enhanced learning through fieldwork and site visits, and for bringing innovative pedagogical approaches to learning and teaching that are now widely applied in other disciplines through: studio-based models (Hardy and Teymur, 1996); visual-based analytical approaches to teaching delivery; and student-generated active project-based work and assessment.

Despite the distinctive approach to field-based teaching in the Built Environment, there has been far less innovation and research in the use of new technology; the exception being computer-aided design. One example of current international research that parallels our proposed project is being carried out at the School of Arts, Culture and Environment, at the University of Edinburgh, where investigations are being conducted into how innovations in mobile delivery and GPS may assist students in the collection and retrieval of digital documents while immersed in the environment, thus enhancing the possibilities of real-world sites to become 'the library' of learning. This research into the capabilities of mobile technologies for 'communicating and agreeing place and value' is seen as forming a 'cognitive scaffolding' through which learning can occur in the field (Coyne, 2009). However, notwithstanding such isolated developments, there is still great scope in the Built Environment and other field-based disciplines to transform modes of delivery through new technologies.

Chapter 2. Project plan

Original aims

The project set out with the following aims:

1. To conduct four inter-related but distinctive studies to evaluate a range of innovative techniques for fieldwork in the Built Environment. These techniques will draw on readily available mobile technology to create appropriate digital learning tools. The techniques and their supportive tools will address: the structure of mobile learning activities, the design of mobile learning materials and instructions, the design of mobile assessment tasks, greater integration of field activities into class-room teaching, and student creation of mobile content.
2. To provide forward-looking cross-disciplinary guidance for Australian universities in the methods of designing and delivering mobile learning for fieldwork. Generalising findings from the Built Environment is possible through the cognate relationship of its various sub-disciplines to science, engineering, the humanities and the arts. A dedicated website will provide information about the methods and findings of our four studies and will present our generic guidelines for designing mobile activities.
3. To engage with Australian educators to collaboratively reflect on and improve the use of effective field learning and teaching techniques and tools. This will occur initially through our Reference Group and non-participant observers. A national workshop will be held towards the end of the project to share and stimulate further development.

Elaboration of the aims

Aim 1: Four case studies of mobile-supported fieldwork

The four case studies conducted are shown in Figure 2, distributed across the three partner institutions (The University of Melbourne, cases 1 and 2; University of Monash, case 3; and The University of Sydney, case 4). These are described, respectively, in Chapters 3, 4, 5 and 6 of this report. In all four cases, the emphasis was on teacher-led development and strong integration into the learning objectives of the subject. In each case, the plan was to find out about both the process of development and student experience of the exercise.

Emphasis was also placed on formative evaluations of the experiences of teachers and learners rather than on more summative measurements of learning outcomes. The intention was to gain insights into the way the learning objectives of the wider subject were embedded in the field exercises, and to trace the design intentions of teachers through to actual experiences and activities carried out by students. Observations were made rigorously through a mixture of direct observation, interviews and focus groups, and survey questionnaires. We did not attempt to develop instruments to measure the learning effects of the field exercises, nor did we attempt to make experimental comparisons, both of which would require a narrower focus on specific elements. Rather, the intention here was to look broadly at teaching and learning processes as they unfold in ongoing real delivery.

Aim 2: General guidance for teachers and institutions

The findings of the four studies, as reported in Chapters 3 to 6, were analysed and presented in a format appropriate for other teachers to use them as models for their own development. In each case, we traced a design process from the overall context of the course, the subject, and the fieldwork exercise. The thinking behind the construction of the exercise is presented, with the history of successive deliveries, the unexpected challenges and the consequences in terms of student learning experiences.

In tandem with the four cases, we developed overall guidelines that attempt to capture more general principles of mobile-supported fieldwork design. Although our original project plan was to deliver each exercise only once, we found in practice that iterative repetitions of delivery was valuable. As shown in Figure 2.1, we delivered each case exercise two or three times over successive years making ten deliveries and evaluations in all. This iterative approach allowed the team to progressively develop more general principles. Throughout the programme of case studies there was an ongoing attempt to articulate and refine these principles and to apply them back to the later deliveries (See Figure 2.1)

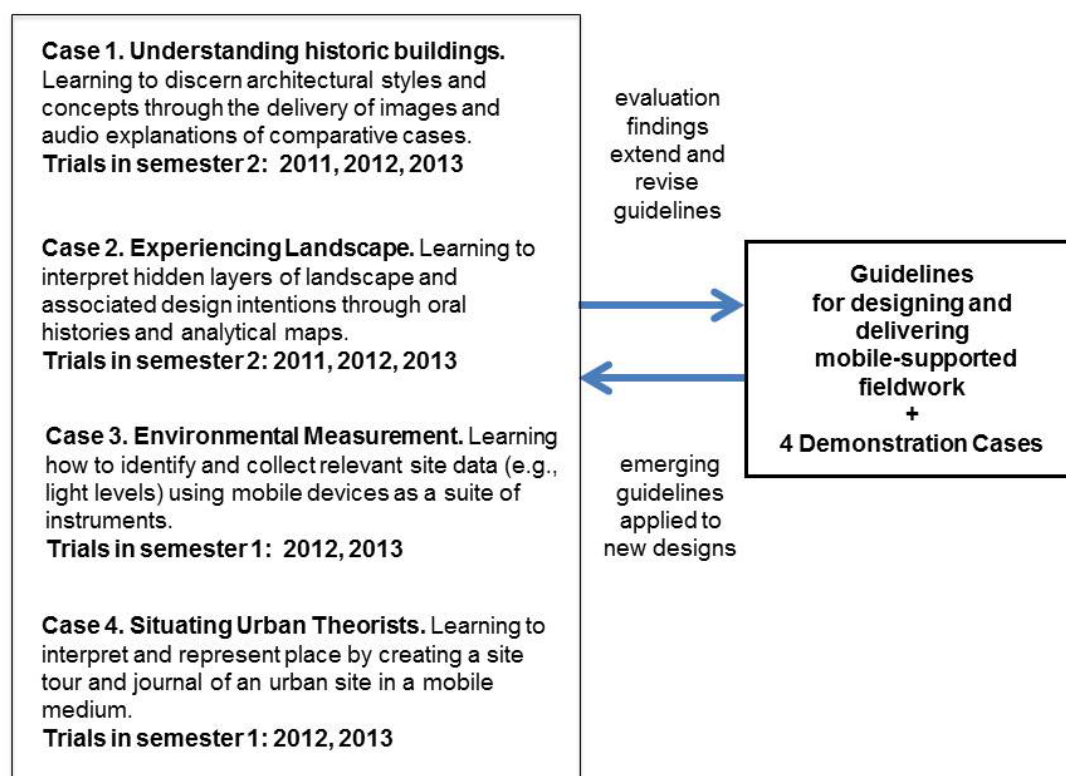


Figure 2.1 The plan of 4 case studies involving 10 deliveries of field exercises, with iterative development of general guidelines for mobile-supported fieldwork

Aim 3: Engaging with Australian educators

In the first year of the project a Reference Group meeting was held to consult on the direction of the project, with the following participants:

The investigators: Smith, Lewi, Chang, Ramirez-Lovering, Stickells, Chang, Saniga
Project Officer: Dr Dora Constantinidis
Dr John Sadar (Monash University)
A/Prof Pia Ednie-Brown (RMIT)
Prof Sandra Kaji-O'Grady (The University of Sydney)
A/Prof Gregor Kennedy (Director of e-Learning, The University of Melbourne)
Dr Ari Seligmann (Monash University)
Dr Stephen Neille (Architecture & Planning, Curtin University)

In the second year of the project, follow-up meetings were held with selected members of the Reference Group to update this consultation.

As reported in Chapter 7, the project further engaged with stakeholders through numerous seminars, conference presentations, and a project website. In November 2013, a national workshop of speakers from the project and other related projects presented work on mobile-supported fieldwork to an open audience of teachers and educators.

Chapter 3. Case 1 Understanding historic buildings

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Overview

ABPL30053 'Formative Histories of Architecture' is a core subject in the Architecture major of the Bachelor of Environments at The University of Melbourne. The purpose of the subject is to overview important ideas and precedents in architectural history. To apply this knowledge to local contexts and examples, fieldwork in the form of walking tours, has long been an important learning strategy. Case 1 is a fieldwork exercise based around a tour of buildings along Collins St (Melbourne) but now directed by an iPod/iPhone app guide rather than a lecturer. The iPod-based tour had been built by the researchers previously, and the current project involved its integration into effective learning activities and its delivery and evaluation for large numbers of undergraduate students. As part of this, a sketching task and a paper-based and digital quiz were created and implemented in 2011- 2013.



Figure 3.1 The Formative guide in use.

Aims of the fieldwork exercise

Looking at buildings and places *in situ* is a significant and established component of architectural history teaching. It is important for students to learn, outside the isolated context of the lecture theatre, how to look at actual buildings as material objects set in specific locations. Students of architecture need to develop skills and knowledge to place abstract and international concepts of architectural history into a local and familiar context. It is also professionally important that students learn about and appreciate the history of the city in which they are currently living.

With these broad learning aims in mind, a driving motivation for creating the Formative Histories tour was to communicate to students aspects of urban and building elements situated within their historical context in central Melbourne. Students were to be guided to experience, at first hand, the history of key streets and buildings, through learning to observe architectural details and qualities, through carefully looking, thinking and listening. The creation of a digital mobile guide, with a capacity to integrate new content in the form of images and sound narration, potentially allows for a richer learning experience than

traditional teacher-led field-walks.

As well as providing new audio and visual content and directed guiding, our aim was to promote social interaction between small groups or pairs of students, through their shared use of the technology in the field. A further motivation for the use of mobile devices for this fieldwork exercise grew from a major shift in teaching delivery required by a significant increase in class size from around 80 to over 300 students in the core undergraduate architecture subject *Formative Histories of Architecture*.

Designing and developing the tools and techniques

Table 3.1 shows the various components of the field work tools that were used and developed as part of this case study. They were developed and delivered progressively over the study, as made clear in the Evaluation section below. In this section, we describe the function and purpose of the various tools deployed and the techniques of fieldwork that they embodied.

Tools	Associated activities
iPod/iPhone tour guide app - 'Formative Histories' *	Delivered images and audio commentaries for each of the 20 stops of the tour.
Paper-based quiz	Presents 20 questions (one per stop) to be answered during the tour.
Quiz app	A web-app that delivered the same questions as the paper-based quiz to a smartphone owned by students. Feedback was given on correct answers in situ for some questions.
Sketching app on iPad	An existing app called Brushes, with 20 sketching tasks to be carried out on the tour.

*Table 3.1 Summary of fieldwork tools. *The Formative Histories app was developed by Lewi, Smith and Stitt prior to the current project, a second version was released to the public via Apple's AppStore in 2011.*

The iPod tour guide

The design of the tour content was undertaken by the subject coordinator Hannah Lewi, in collaboration with project member Wally Smith, and a research assistant, Helen Stitt who was also a tutor in the Formative Histories subject and familiar with the content and learning objectives. The research assistant also assisted in compiling content consisting of text notes and suitable images.



Figure 3.2 Home screen of the iPod tour app

The iPod tour was designed to explore and evaluate the delivery of visual and sound content through iPods/iPhones within the limitations of the busy and potentially distracting setting of central Melbourne. The introduction of mobile digital delivery also allowed for standardised content and delivery to all students, as previously a large cohort was being broken into discrete tour groups led by a number of different tutors, delivering a variable learning experience.

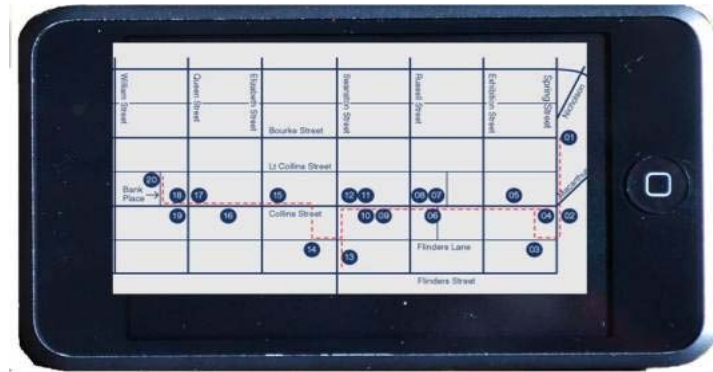


Figure 3.3 Map of the tour as presented to students

The tour involves a walk along Collins Street in the city of Melbourne. It comprises 20 stops along a linear route. The tour, along with associated field activities, takes about two hours on average to complete. The content was developed into a narrative, including audio and text narration at each stop. After developing and testing a prototype of this narration, it was further refined in a number of iterations between 2009 and 2011 to shorten and clarify the content and increase volume. More directive instructions to students were also included, emphasising and encouraging them to look at particular details and so on. The audio narration for each stop was recorded and edited using readily available software to achieve the correct tone, speed and volume.



Figure 3.4 Example of an image shown on the tour, an interior of the building at stop 16

There are up to three images and a maximum of three minutes of sound narration for each stop. The visual content comprises a mixture of new and archival images. Photographs were taken at each of the 20 stops to create “thumbnail” images that could be used to locate the user as they walked along Collins Street. Images at other stops included historical views of buildings in their original context, drawn details, elevations and plans, and views showing particular building elements and interiors. A graphic designer was contracted to assist with designing the interface of the main pages, buttons, and navigation. Graphics, design and

user interface was kept simple and clear with ease of use in mind. This content was provided to a programmer to create the app for approval and release. Some revisions were required at this stage to conform to Apple's requirements for help and contact pages, etc.

The assessment quiz (paper-based and digital)

A paper-based quiz to be completed by students during the walking tour was developed for the first iteration of the walking tour. Questions corresponded to the 20 stops on the walk. Some questions were multiple choice, while others were open to interpretation and required the student to seek out, and then to write about or sketch examples of particular building elements and styles. Results were brought back to class to discuss and evaluate.

A later digital web-app version of the quiz was developed as an alternative to the paper-based version. This option could be downloaded to an iPhone / iPad while on the tour, and users could carry out the activity and gain immediate feedback to their answers. Students could later download their answers and print out a report to bring to class for further discussion and evaluation.

The sketching task

An alternative to the quiz was also developed in the form of a sketching task through use of an existing iPad app called 'Brushes'. This allowed students to take photographs and overlay sketches and annotations. Uptake of this option was limited to students who could either bring their own iPad or borrow one of a limited number of devices from the University. This option was given to students who were interested in photographic recording and sketching. Results were brought back to class to for discussion.



Figure 3.5 Illustration of student sketch, and students carrying out the sketching task

Student access to tools

In selecting appropriate technologies for both the Formative Histories main tour, a key issue of concern was the need for equitable and robust delivery of the digital tour to all student users. Therefore, for the tour, two delivery options were provided: several iPods were purchased by the Faculty of Architecture, Building and Planning that could be borrowed by students with the tour pre-loaded; or students could download the tour to their own device through a free app made available through the app-store:

<http://itunes.apple.com/au/app/formative-histories-walk/id387291558?mt=8>

This allowed students to use their own devices where they had one, and it also made the tour available to the general public.

For the quiz, students had the option of a paper-based delivery if they did not own a mobile digital device that had connectivity on site. Students could also borrow a limited number of iPads or use their own. Another key consideration in designing the walking tour activity and quiz assessment was allowing enough time for students to undertake the activity during semester, something of particular concern to those borrowing equipment. The activity was introduced early in the teaching semester, and iPods were available over the non-contact teaching period mid-semester, with the assessment due in a tutorial after this break.

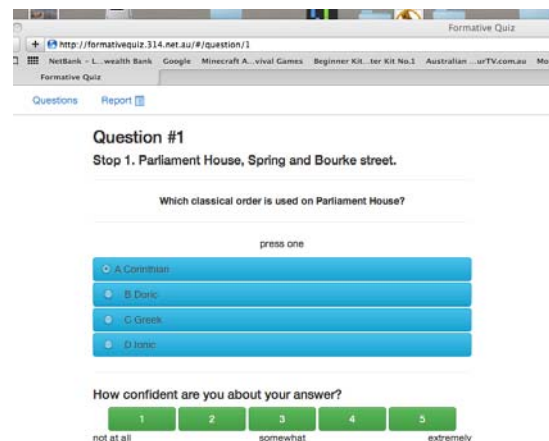


Figure 3.6 A question screen from the web-app quiz

Evaluation of the exercise

As shown in Table 3.2, the exercise was evaluated over three trials in which the tools and techniques were developed progressively.

Semester	Tools & techniques	N students	Evaluation techniques
2011, s2	Formative app* + paper-based quiz		direct observation
2012, s2	Formative app + paper-based quiz OR iPad sketching task	295	direct observation; questionnaire
2013, s2	Formative app + paper-based quiz OR iPad sketching task OR quiz app	153	questionnaire

Table 3.2 The three iterations of designing and delivering the fieldwork exercise

The main form of evaluation was a questionnaire delivered to students after completing the tour. It was designed to probe: the kinds of social interaction students experienced in the task; the perceived value of the exercise; and the perceived value of the different kinds of audio and visual content presented. In addition, direct observation of students was carried out in the 2012 trial with brief interviews as the tour progressed. For the digital sketching version of the task, two researchers travelled with the group also conducting direct observation and interviews around the exercise.

How did students carry out the activity?

Students carried out the activity alone (2012=31%; 2013=47%) or in a small group of mostly two or three people. By 2012, most used their own iPhone or that of a peer (90%). Most students reported completing all or nearly all stops on the tour (>95%) typically taking two or more hours (>85%).

Listening to audio in groups against busy city traffic was a practical obstacle. Most students reported listening together using a headphone splitter or using the speaker (about 60%) while others took turns. For 20% of students, one person listened and relayed information to the other(s), while a small minority (5.9%; 2.4%) reported not listening at all.

What did students who worked in groups discuss about the exercise?

In 2012, students in groups were asked if they discussed the buildings, the images on the app, the audio commentaries, and whether they had discussed the tour between stops. They were asked if they did these things at every stop, most stops, some stops, one or a few stops, or not at all. The most positive topic to discuss was the buildings (57% did so 'at every stop'); then images (modal response was 'at most stops', 38%); and then audio commentaries (modal response was 'at some stops', 39.3%).

What IMAGE content did students find most valuable?

In 2012, students were asked if the small number of images (about three per stop) was enough, and while 47% thought they were 'about right', another 47% would prefer more. As shown in Table 3.3, students in 2012 preferred image content on the app which was most closely related to the physical buildings before them (these being close-up details), next images that could be related to the present view (interiors, historical views), and least preferred images of buildings elsewhere that were not directly related to the current situation. Below we discuss this preference as the technique of 'directed looking'. Two comments from student gathered in the survey illustrate this point: 'The app really pointed your attention to details and history that was relevant to the building or style, this was very enriching' and conversely a suggested improvement from another student was that 'some photos ... were misdirecting; have most photos directly related/taken from the site.'

Types of Image Content 2012	mean relative ranking: 1= most valuable; 4 = least valuable
Close-up images of details	1.85
Interiors of the buildings	2.15
Historic images of the general site	2.20
Other related buildings	3.06

Table 3.3 Student-rated value of different kinds of image content

In 2013, we asked students to rate the value of each type of content separately and found a similar order of preference): interiors, close-ups, history of site, other buildings elsewhere.



Figure 3.7 Directed Looking– presenting content that reproduces the physical environment and directs attention to particular aspects

What AUDIO content did students find most valuable?

When asked about the overall length of audio commentaries, a large majority of students in 2012 (76%) responded that the length (edited down to two to three minutes) was 'about right'. Table 3.4 shows how these students rated the value of different kinds of content in the audio commentaries. Again there was a preference for content most related to the present situation (history of the current building, instructions to look at details) over less directly relatable material (general history, issues about conservation).

Types of Audio Content 2012	mean relative ranking: 1= most valuable; 4 = least valuable
History of the architecture of the buildings	1.67
Instructions to look at particular details	2.02
General history of Melbourne	2.72
Issues about the conservation of the buildings	2.76

Table 3.4 Student rated value of different kinds of audio content

In 2013, we asked students to rate the value of each type of content separately and again found an identical order of preference.

Enhancing the tour through other mobile-supported activities

To explore different techniques of enhancing student learning experiences *in situ* we introduced two mobile-supported supplements to the tour: a sketching task carried out on an iPad (2012/13) and a web-app version of the quiz that students accessed through an iPhone and which gave immediate feedback on the correctness of answers for some questions. The sample of students was small in both cases, limited in part by the availability of the right tools. However, the following observations are indicative.

For 13 students using the quiz app and completing an evaluation form, ratings on a five-

point Likert scale produced a modal response (61.5%) to 'agree' that the app was easy to use with a mean of 3.92. Comments and observations showed some frustration in using two apps (one for the tour and one for the Quiz) alongside each other though this could be shared for those working in groups. When asked about the value of having feedback on questions in the field, students were even more positive giving a modal response of 'agree' and a mean rating of 4.23. It was clear that this was a positive direction for tool development for this kind of field exercise.

A small number of students elected to complete the iPad sketching task in 2012/2013 which directed students to photograph and draw buildings and details. This option was encouraged for students who either had their own iPad, or were keen to carry out a more visually orientated task. In 2012, around six students carried out this activity as a group under direct observation by Hannah Lewi and subject tutors, supplemented by *ad hoc* interviews around the activity. It was observed that these students were all familiar with iPad tools and were at ease in using the iPad camera and 'Brushes' App. Switching between the tour and the activity was reported as manageable. All students offered the informal comment at the time that sketching and photographing enabled them to gain more from the tour and to experience it in a more engaged way. Results in the form of annotated sketches were much stronger, in general, than the sketches included in the paper-based quiz.

In 2013, around six students completed a short section of an evaluation questionnaire about the sketching task, indicating that they elected to use an iPad to sketch. Feedback was consistent in rating the question: 'Overall the photographing and sketching task helped me to observe the buildings more closely', as either 'agree' or 'strongly agree'. Feedback was also consistent on the issue of distraction, reporting that students either were neutral or disagreed that the iPad task was taking them away from learning directly about buildings on the tour. Open questions reported some frustrations with drawing and walking at the same time, but positive comments on the value of the task in observing details of buildings better, appreciating siting and perspective, and talking to passers by.

Overall reception of the exercise

Tables 3.5 and 3.6 show two ways we probed the overall reception of the exercise. Students tended towards a positive perception of its value for learning, but were relatively more positive about its role in helping them to appreciate the city buildings in a new way. This suggests that students saw value in the exercise that went beyond its direct contribution to their completion of the current subject.

Overall dimensions of reception		(% of students)				
		low		high		
Value for learning about the subject	2012	0	4.8	39.2	47.1	8.9
	2013	0	0	35.9	56.9	7.2
Enabled appreciation of buildings in a new way not done before	2012	0.3	5.2	4.5	32.8	57.1
	2013	0	0.7	1.3	36.6	61.4

Table 3.5 Student rated value of formative tour and its enabling of new appreciation

When students were asked about their preferred format for the tour in future, Table 3.6 shows that most of them preferred the experience of working in a small group, but wanted to have their own device. This was preferred over options including those where a staff member came on the tour with a larger group.

Student preferences, 2012	%
With a small group of students (two or three), each of us with an iPod	50.5
Alone at my own pace using a single iPod for my own use	19.8
With a large group of students and a lecturer as tour guide, but with no iPod	12.0
With a small group of students, but sharing an iPod using a headphone splitter	8.5
With a large group of students, each with an iPod, with a member of staff	8.5
With a large group of students (over thirty) each of us with an iPod	0.7

Table 3.6 Student preferences for future delivery of the exercise

Main findings

- Overall, the formative histories tour supported by an iPod/iPhone app was successful overall in creating a positive student experience. Although the tour was demanding and some aspects were not liked by students, the general reception was positive in relation to its value for learning and students found that it enabled new ways of looking at city buildings.
- The mobile guide worked best when it encouraged students to examine their present physical situation more closely (we call this 'directed looking'). This was achieved by designing the content of the app to reproduce elements of the environment as cues, rather than presenting abstract or external material. Students were most engaged by visual digital content showing details they could search for; with intermediate engagement with interior and historic images of the site, and least engaged by comparison buildings from elsewhere. This is similar to Sanders (2007) description of students 'looking with intention'. Similarly, for audio commentaries, they were considered more engaging as directions to look at features, and less so for historical background information. This preference for highly situated content, contrasts with the perspective of many teachers, including those in this case study, who favour the juxtaposition of external content with present realities, for example to make comparisons with related buildings elsewhere in the world. There was a conflict, therefore, between the teacher's emphasis on abstraction, and a learner's emphasis on interrogating the immediately present reality.
- The use of a mobile iPod-based guide limited the social interaction between students working in a group. This is not necessarily a problem for limited durations, but complementary tasks demanding social interaction were needed to compensate.
- The tour experience benefitted from additional activities that raised engagement of students with their environment. Both the quiz app and the sketching task were successful for this purpose. Students were positive about the immediate feedback given by the quiz app. Findings about the digital sketching task, though limited to 12 self-selecting students, were highly suggestive that sketching led to greater engagement with the field site. Also, digital sketching tools proved extremely practical and versatile for gathering site images and overlaying interpretive sketches and annotations. A potential downside is that a proliferation of tools (tour app, sketching app, paper materials) can be difficult to handle for students in the field situation.

Chapter 4. Case 2 Experiencing urban landscape

Andrew Saniga (Subject Coordinator) and Jacqueline Monie (Research Assistant)

Hannah Lewi, Wally Smith & Dora Constantinidis (Researchers)

Overview

ABPL90265 'History of Landscape Architecture' is a core subject within the Master of Landscape Architecture at The University of Melbourne. It provides a critical examination of the historical development of landscape architectural design and theory including the events, social influences and personalities involved. There is an extensive fieldwork component to the subject conducted in various sites in Melbourne. The major fieldwork exercise is a tour of the Royal Botanic Gardens and surrounding parkland supported by an iPad tour app. The intention is to communicate aspects of physical change in the shapes and forms that constitute a historic landscape, and to assist students in learning and experiencing at first-hand in the field, augmented with digital resources. The guide was implemented in updated versions between 2011 and 2013, and an assessment tool in the form of a paper-based workbook was created and delivered in 2012 and 2013.

Aims of the fieldwork exercise

Discovering the history of landscape architecture requires an appreciation of how and why sites have changed over time. The inherent qualities of landscape include the growth and decline of plants, the evolution of living systems or ecologies, and the ephemeral and intangible qualities that are a product of a range of sensorial information beyond the visual. Changing social and cultural worlds impact on how landscape is used, managed, portrayed and valued. Fieldwork extends these learning aims to explore themes of change by experiencing a designed landscape.

The main objective of the use of iPads for this fieldwork exercise was to facilitate the delivery of more extensive visual and auditory materials, to promote new ways of learning while interacting with the chosen site. It was expected that by providing access to images and audio explanations of features at the Royal Botanic Gardens, students could better interpret the form and experience of designed landscapes, and the history of design and how this has changed over time.

The iPad app also provided access to standardised content and delivery to all students, thus allowing for a consistent mode of delivery. Another aim of using iPads was to investigate the effectiveness of delivering mixed-media resources *in situ*. In particular, focusing on photographs, films and maps and evaluating how this content was used and understood by the students.

At the very core of the learning experience is the relationship developed between teacher and student in the course of a subject. For this subject, students had often noted in previous evaluation forms the importance of fieldwork with the lecturer and the dynamic experience it provided. In response, an important objective of the new field exercise was to gauge the extent to which a digital media platform for fieldwork could sustain a positive learning outcome despite the substitution of direct engagement between teacher and student with one mediated by digital technology. The aim was to simulate the lecturer's presence whilst correspondingly advancing the quality and quantity of information provided by digital means that would otherwise not be possible.

Designing and developing the fieldwork exercise

The design of the tour content was undertaken by the subject coordinator Andrew Saniga, in collaboration with project members Hannah Lewi and Wally Smith, and a research assistant, Jackie Monie, who was also a tutor in the subject and familiar with the content and learning objectives. Dora Constantinidis, Fiona Johnson and Sarah Hunter provided fieldwork evaluation and technology support.



Figure 4.1 Landscapes in Time Tour showing the technique of directed looking using historic images (left) and audio commentary from lecturer delivered in the field (right)

The tour was designed specifically for delivery on a tablet-sized iPad and not the smaller iPhone/iPod format. It was intended to utilise the larger screen format for rich visual content (in particular map reading), and to test student reception and use of the iPad in contrast to the smaller format device, as used in the Case 1 (see Figure 4.1). The tour app was programmed and pre-loaded onto iPads, owned by the Faculty of Architecture, Building and Planning, that could be borrowed by students. At the time of writing, the tour had not been made available on the Apple app-store, which would be the preferable mode of delivery.



Figure 4.2 Landscapes in Time app - main navigation screen

On navigation through the Gardens, careful attention was paid to the direction of students around the extensive grounds so as to delineate an informative route, while also allowing possibilities of self-guided exploration. With this in mind the walking route was designed as a series of 13 sites that can be experienced in any order, although a likely order is indicated by the numbering (Figure 4.2). The route is defined over an aerial map as a flowing area of interest, rather than a linear, one-directional path. Stops are marked as 'active sensors' on the iPad screen. A GPS marker of current location assists students follow their route.



Figure 4.3 Landscapes in Time app - orientation image screen for Stop 12

The extended site of the Gardens is large and historically complex, representing a century and a half of design, engineering and planting. The first key task in developing the digital tour, then, was gaining knowledge about the vast amount of historical resources available, and then creating a focused set of themes through significant editing and selection of content available. Each site stop includes up to eight historical images of interest relating to that site, and a sound/film narration delivered by the subject lecturer (see Figure 4.3). A driving motivation in the designing of content was to select material that was most suitable and revealing when accessed and experienced on site. This followed our emerging notion of directed looking that was evident in Case 1.

Another key motivation in designing the iPad tour delivery was to carefully consider and test how the 'voice' of the subject lecturer could be best captured, so as to simulate their presence in a mediated form and convey a particular mood for exploration. This was trialled in the first iteration of the tour design, and modified in two further iterations. Unlike the first version of narration, which was recorded in a sound studio, the later versions were recorded more casually on site directly on to the iPad. They included the ambient sounds of the site, and a fixed-film image taken at each stop where the narration was intended to be listened to. After student feedback and field observations, the length of narration at each stop was also reduced in later versions to around two minutes, with a maximum of 10 second variations. This degree of regularity and predictability provides a consistent experience for the tourers.

Aside from content delivered at each of the sites, there were other areas of content in the app that were accessible at any time through a menu which simulates 'drawers' of information (Figure 4.4). These drawers include general historical information about the Gardens in the form of a timeline, and reference material organised into media types, including contemporary and historical maps. Other drawers are organised thematically, including information about planting, social use, and structures in the park.



Figure 4.4 Landscapes in Time app - general image, map and film resources

A 'Scramble' function in the app was introduced to promote a more free exploration of the materials. The intention was to provide a kaleidoscope of images, drawn from the content in the guide, that might mimic the various layers and confluents of time and change in the site that the body potentially experiences in the landscape. The 'Scramble' option was also thought to be useful as a tool for reflection once away from the site, perhaps even with background music while students completed their drawing assignments.

An assessment exercise in the form of an on-site workbook accompanies the fieldwork tour, and was used as a tool to draw attention to the most important aspects for students to reflect on and discuss later in the classroom. The workbook required students to listen to the audio, look through the various folders of images, and then to answer short questions, multiple choice questions, or provide drawn responses. The workbook activities for each stop were embedded in the iPad tour guide as identified 'activities' (See Figure 4.5), while students collected and recorded data outside of the iPad app using a camera and sketch material.



Figure 4.5 Landscapes in Time app - activity instructions with integration into assessment

Some activities ask students to use the various historic resource materials in the iPad tour (see Figure 4.6) and compare them across time and between archival images and their experience of the actual site. For example, established trees planted in the 19th century are compared with their current size and form today. Other activities requested students to photograph and draw particular views and elements in the Gardens.

Task 11

After observing the Alexandra Avenue rockery, walk to the neighboring rockery near the intersection of St Kilda Road and Linlithgow Avenue (it is west of STOP 11 and is marked as a small yellow triangle on the 'Structures Map', RESOURCES>MAPS TODAY). TAKE EXTRA CARE CROSSING ROADS IN THIS AREA. This second rockery has a very different appearance but is thought to have been completed at the same time as the rockery at STOP 11. Photograph it and note shape, layout, and detailing. Upload your photographs with annotations or notes into the space below.

[insert here]

Task 12

Observe the degree to which the site can be interpreted as a product of earthworks and introduced land forms. Using the 'Landform' maps (RESOURCES>MAPS TODAY) consider the topography and photograph any areas you could speculate were created by the import of fill to change ground level. Upload your photographs into the space below.

[insert here]

Figure 4.6 Excerpt from workbook used in field exercise showing how detailed directions to use the Landscape in Time app were embedded into the assessment tasks

Evaluation of the fieldwork exercise

As shown in Table 4.1, the exercise was evaluated over three trials in which the tools and techniques were progressively developed. Data from the 2012 and 2013 trials are pooled in the analysis here.

Semester	Tools	N	Evaluation techniques
2011, s2	LIT* app v1 (pilot)	12	direct observation; focus group; questionnaire
2012, s2	LIT app v2 + paper workbook of activities v1	15	focus group; questionnaire
2013, s2	LIT app v2 + paper workbook of activities v2	14	focus group; questionnaire

*Table 4.1 The schedule of deliveries and evaluation of the exercise, showing the different components of tools as they were developed. *LIT is the Landscapes in Time app for Apple's iPad developed by Lewi, Saniga & Smith: v1 prior to this project, v2 developed through this project (not publicly released).*

In the pilot study of 2011, a class of 32 students was divided into two, with half touring with the lecturer and half touring with the iPad guide. Students using the iPad were the focus on evaluation here, but it turned out to be a significant element that the tour with the iPad was framed as being 'instead of' with the lecturer. Those with the app were divided into four groups of four people, each group having an iPad to share. In 2011, the researchers carried out direct observations of the students conducting fieldwork with the mobile guide, with one researcher following and observing each group. Brief and informal, but non-intrusive,

interviews were carried out with students during the exercise which lasted between two to three hours. Later, students were given a questionnaire which probed their understanding of the various tasks, and the perceived value of the exercise (14 students completed it). The pilot led to significant revisions of the content producing a version two app. This was then delivered in 2012 and 2013 to two further cohorts who all used the iPad guide and no lecture-led tour was given, so removing a sense of contrast. A questionnaire given to students later is the main source of data reported here, supplemented and clarified by focus groups. Further direct observations of students were made in the 2013 trial.

How did students carry out the exercise?

As indicated, in the 2011 trial students were assigned to groups and kept to a two to three hour time limit. In 2012/13, students arranged their own group and spent their own time doing the exercise, with some working alone (32%) and the rest in small groups of 2-4, taking between three to 10 hours. Some students made a second or even third visit to the Gardens. The larger tablet-size format of the iPad screen meant that a group of up to four students could comfortably share a single device, listening through the open speaker. Across all trials, about half of the student groups designated one person as the main 'driver' of the iPad, while the other groups shared this role equally.

What did students in groups discuss about the exercise?

For those who completed the exercise as a group, the questionnaire showed that relative emphasis in student discussions was placed on the aspects of the Gardens (2011: a modal response of 50% discussing it at most stops, 2012/13: 73.7%, at every stop). Emphasis was also placed on the images shown on the iPad (2011: 58.3%, at most stops; 2012/13: 47.4% at every stop). In 2012/13, when the tour was more integrated with the assessment task, 73.7% discussed the activities at every stop. Less relative emphasis in discussions was placed on the audio commentaries (2011: a mode of 41.7%, at some stops, 2012/13: 47.4% at only some stops). Reports of discussions continuing between stops were also relatively low (2011: a mode of 50% at some stops, 2012/13: 63.2% at some stops). Direct observations confirmed this pattern.

What forms of content presented in the app did students find most valuable?

In 2011 and 2012/13, modal responses of students indicated that both the volume of images was 'about right' (50%; 65%), and that the length of audio was also 'about right' (67%; 79%). Table 4.2 shows student ratings of the value of the different types of content on the Landscapes in Time app. Images were the most preferred type, confirming direct observations of students in the field using images actively to compare with the present view of the landscape; repeating the 'directed looking' technique of Case 1 and resonating with the intention in the design of Landscapes in Time app.

Overall, the audio commentaries grew in preference from the pilot to the main trials of 2012/13, reflecting the reworking of the audio content by the researchers. In the pilot of 2011, the focus group found poor reception for the style of the audio commentaries which had been written and delivered in a mini 'lecture' genre. For 2012, the lecturer and researchers modified this style significantly, moving towards that of the tour guide: speaking more informally and emphasising points of the immediate viewpoint over abstract points; this further followed the notion of directed looking as a teaching design concept. To achieve this, it was found to be best for the lecturer to record the audio commentaries in the field at the locations of the relevant field activities. Experimenting with various formats, we decided to record the commentaries as the soundtrack of fixed viewpoint videos of a current view that contained minimal movement. This brought a sense of presence to the audio commentary when replayed at the location by students without distracting attention from the current view of the Gardens.

TYPE OF CONTENT OVERALL	mean relative ranking: 1= most valuable; 4 = least valuable	
	2011	2012/13
Images	1.67	1.86
Audio	2.67	2.10
Maps	1.83	2.24
Films	2.67	3.72
TYPE OF IMAGE	mean relative ranking:	
	2011	2012/13
Historic images of gardens	1.42	1.90
Contemporary orientation images	2.33	2.52
Archival maps	2.25	2.62
New maps	2.17	2.83
TYPE OF AUDIO INFORMATION	mean relative ranking:	
	2011	2012/13
About changes from past to present	2.00	1.69
General history of the Gardens	2.08	1.97
Directions about looking and walking	2.67	2.90
Botanical information	2.92	3.41

Table 4.2 Student-rated value of different types of content in the app

When asked about different types of images, student preferences again supported the power of directed looking. Historic images of the Gardens at each stop were preferred, and these invited direct comparison with the current view. Other kinds of images were preferred in roughly similar degrees and variably across the different trials. Maps had moderate preferences, while films were preferred least, probably reflecting their low number and the difficulty of mapping them to the current scene.

The most preferred kind of audio content was about changes from past to present, reflecting the emphasis of this as a learning objective of the subject and exercise. Also preferred was general history of the Gardens, again this being a focal point of learning in the subject. Directions about looking and walking, added to the app in version two, were the next preferred running slightly counter to the directed looking notion. Botanical information was least preferred, reflecting perhaps its lower relevance to the assignment work.

Overall reception of the exercise

Tables 4.3 and 4.4 show two ways the overall reception of the exercise was evaluated. Similar to the findings in Case 1, around half of student found it 'very' valuable while half found it only 'somewhat' valuable. The focus group suggested that their answers to this question focused on the instrumental value of the exercise for completing the subject successfully. Students described finding a few aspects of the field exercise to be low in value in this regard, an inevitable feature of the practicalities of fieldwork. Responses were more positive about the exercise's role in helping them to appreciate the Gardens landscape in a new way, with roughly half of the students giving this the highest rating. Again, this suggests students saw value in the exercise that went beyond the instrumental completion of the

current subject, and that they knew the difference. We tested this more directly in 2012/13, where students were positive about its role for the assignment that had been strongly integrated into the tour and the app design. They were also positive about it being an enjoyable experience, although for 32.1% this was only 'somewhat' enjoyable, underlining the challenge and risks of field exercises.

		(% of students)				
		low		high		
Value for learning about the subject	2011	8.3	0	41.7	41.7	8.3
	2012/3	0	0	40.7	55.6	3.7
Enable to appreciate aspects of the Gardens in new ways	2011	0	0	16.7	41.7	41.7
	2012/13	0	0	6.9	41.4	51.7
Value for completing assignment	2012/13	0	3.6	14.3	57.1	25.0
Enjoyable	2012/13	3.6	3.6	32.1	53.6	7.4

Table 4.3 Student-rated value of Landscape in Time tour, its enabling of new appreciation, its value for the assignment work, and whether it was enjoyable

On preferred format for the tour in future, Table 4.4 shows that most students preferred the experience of working in a small group, but wanted to have their own device. This was preferred over options where a staff member came on the tour with a larger group.

Student preferences 2012/13	2011 (%)	2012/13 (%)
To tour with lecturer AND use iPad at the same time for additional material	33.3	33.3
To tour with lecturer AND use iPad/internet to view material later	33.3	29.6
Rather tour with iPad than with Lecturer	0	25.9
To tour with Lecturer AND tour again later with iPad	25	11.1
Not to tour gardens, but view iPad or internet at home or at uni	0	0
With the lecturer, and never use an iPad	8.3	0

Table 4.4 Student preferences for future field tours, following the Landscape in Time tour

Main findings

- The field exercise based on the Landscapes in Time tour and app was successful in terms of student experience. Most students saw value in the exercise for learning, and a greater proportion believed it helped them to see the landscapes in new ways.
- The framing of the purely app-based tour to students was found to be very important. The app was received less favourably in the pilot study when it was presented as an alternative to a lecturer-led tour. No student reported preferring the app to the lecturer for future tours. Recasting the app-based tour as the only option, and with enhanced design, yielded a more positive reception; indirectly indicated by 25% of students reporting a preference of the app over the lecturer for future tours. The majority of students throughout wanted both lecturer and the iPad.

- Following our pilot study, it was realised that the tour activities and app content needed tight integration with the assessment task, hence the development of the paper workbook. In 2012/2013, even with the tighter focus around assessable tasks, a minority of students still felt daunted by the perceived open-endedness of the visit without a member of staff to clarify goals and activities. While this is not necessarily negative for learning, the effect on student experience is important.
- The Landscape in Time tour again found support for the notion of directed looking as a powerful technique. The most valuable content according to students was images, followed by audio commentaries and maps, with films found least valuable. Changes in the landscape were best appreciated through comparison with historic photographs, while sketching was judged the best way to interact with the environment. Students were most positive about content in the app that reinforced the themes of the subject, and therefore which were most relevant to their assignment task.
- Social interaction between students in the exercise was strong; with most reporting that they listened to audio materials together, and discussed both the activities and the various materials (audio, images, activities) together at most of the 13 designated stops. This contrasts with the finding in Case 1, and reflects the inclusion of open-ended tasks in the mobile app, and the sharing of one larger tablet sized device within a group.
- The use of a digital iPad guide plus a physical paper-based workbook was felt cumbersome by many students who would have preferred integrated digital documentation of their assignment work. This points to a limit of the incremental design strategy advocated in this report of developing and trialling components in paper form before developing new app functionality.

Chapter 5. Case 3 Environmental measurement

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Wally Smith and Dora Constantinidis (Researchers)

Overview

ARC3101 'Technologies and Environments 3' is a core subject of the Bachelor of Architecture at Monash University. It includes the study of environmental design principles and the implications of these in relation to architectural design, construction and sustainability. The subject introduces students to building simulation software, using that as a vehicle for a semester-long project which analyses an existing interior built space in terms of orientation, illumination, solar radiation and thermal comfort. As a way to appreciate the relationship between the simulation and real conditions, students carry out a field exercise in which they measure aspects of light and illumination and consider the intended uses of the space. This case study investigated the use of mobile apps as measuring instruments to conduct this site analysis exercise.

Aims of the fieldwork exercise

Building simulation software offers great potential for architects as a means of designing with the forces and energies of the natural world. But, precisely because it is concerned with the dynamic, ephemeral aspects of our world, one always needs to bring building simulation models back into dialogue with the real world. Because the software uses precise engineering units of heat, light and energy, while our bodies react in terms of “too bright,” “too dark,” “too hot,” and “too cold,” there is a need to get a real world sense of the units and their meaning. Environmental conditions also have to serve a range of activities; conditions that might be “too dark” for making a physical model at a desk may be ideal for viewing the slides of a lecture. In addition, because software is based on databases and statistics, their relationship to real conditions is not straightforward. There is an ongoing need, therefore, for students of architecture to gain the skills of measuring physical dimensions, such as light levels and sun path, while at the same time being able to translate them into meaningful design insights about the use and experience of the space.



Figure 5.1 Students carrying out the exercise

With that in mind, the fieldwork exercise required students working in groups to measure both the illumination levels and sun angle within four designated spaces in a chosen building. The intention was to have students work alone without staff present and to work reflectively through the tasks of collecting real data from a physical site. This involved: immersion in the physical experience of daylight spaces and their comparison with numerically expressed light levels and sun angles; reflection on the relationship between physical data and the psychological experience of the dimensions as affected by other variables like surface qualities; considering the use of spaces in the same moment as physical data; and considering the validity, reliability and value of data measurements.

Designing and developing the tools and techniques

For this case study, we set out to use existing apps as far as possible as an investigation of a 'lightweight' development path relative to Cases 1 and 2, which used custom-built software. A simple techniques of uploading digital instructions in the form of packages of images was also used for the same reason. Table 5.1 provides a summary of the various tools used in the exercise. As explained in the Evaluation section below, the study was run as two trials in successive years, 2012 and 2013. The first trial encountered difficulties with the procedure of the exercise and with equipment, and especially student perception of them. The second trial attempted to rectify these problems through more detailed prescriptive field instructions and through new technologies. In this section, we explain the basic tools students used and the tasks they were asked to carry out.

Tools	Associated activities
'LuxMeter Pro' –existing iPhone app	Allows students to measure light levels in a surface (used in 2012 trial)
'Solmetric' –existing iPhone app	Allows students to measure the sun angle at a given point (used in 2012 trial)
Navigation pack and instructions presented on iPod/iPhone	Presented a set of way-finding annotated images, reminders to reflect on uses of the space
'LightMeter' - existing iPhone app	Allows students to measure light levels in a surface (used in 2013 trial)
'Pyranometer' - existing iPhone app	Allows students to measure solar radiation (used in 2013)
A paper-based instruction document	Presented students with detailed instructions about how the student group should share the tasks.

Table 5.1 Summary of fieldwork tools

The 2012 trial

In 2012, spaces within the University campus were designated for measurement and analysis. Students worked in groups of four and were given written instructions to collect and record light readings at every point on an imaginary grid of 1m by 1m in each designated space. Students were also instructed to take sun angle readings at selected points near windows in each designated space. Together this required a large volume of readings and the full exercise was estimated to take the teams nine hours. Students were instructed to compare the data with that derived from a building simulation of the same spaces.

Three Apple iPads were loaned to students for the exercise on which they could run the iPhone apps. In addition, many students used their own iPads, iPhones or iPod Touches.

Three software tools were provided to students for the exercise (see Figure 5.2 for examples). LuxMeter Pro – an existing app that measures light levels - was loaded onto the iPads borrowed by students. It could also be downloaded and used on their own iPhones. Solmetric – an existing app that measures sun angle – was also loaded onto the iPads borrowed by students. It could also be used on students' own iPhones.

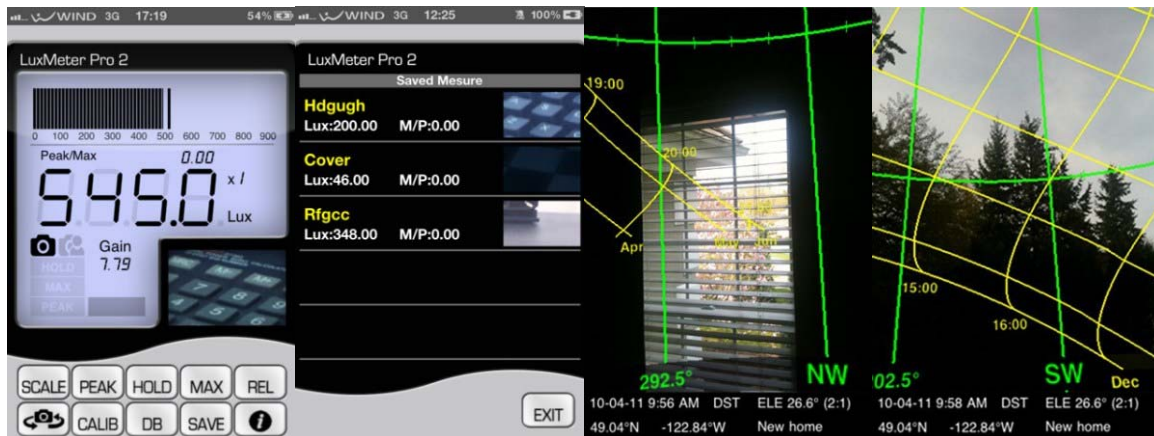


Figure 5.2 Examples of measurement apps used (Luxmeter left, Solmetric right)

An instruction pack of images (Figure 5.3) was prepared and loaded into the photo gallery of the iPod Touches borrowed by students. The images were in sequence and provided a simple 'guide tour' through the designated spaces for the exercise. Some images showed points of access to different rooms. Throughout this instruction pack, a prompter slide appeared many times to remind students to think about the possible uses of the space before collecting measurements. It asked: What is this space used for? Is the natural light suitable?

Measure light (with LuxMeter) at 1m intervals from front of open 2.27-2.28



Figure 5.3 An image from the instruction pack

Although found to be usable, these tools had critical limitations. The Luxmeter app readings turned out not measure ambient light; it measured luminance rather than illuminance. The Solmetric app functioned as desired, but on an overcast day finding the sun angle was difficult. Access to the designated spaces was limited and so ideal conditions were not always available.

The 2013 trial

For 2013, we investigated a range of new apps and tested them against dedicated sensor hardware and considered their value as teaching tools. Based on this we chose two new apps. 'LightMeter' by Whitegoods produced valid readings and it had an advantage for teaching by suggesting possible activities in an area for a given light level. Instructions were prepared to teach students how to calibrate the app which itself is an important learning task. 'Pyranometer' by Hukseflux, used for measuring solar radiation, was field tested and produced adequate data for a learning environment. Instructions to students on how to use this app were also prepared.

Also in 2013, the task was modified so that students now worked as a group six people to carry out and comparing three different forms of site analysis or data gathering:

- *Instrument measurement.* 2 students in each group used the Lightmeter and Pyranometer readings in a similar way to the 2012 trial.
- *Camera measurement.* 2 students used the light level measurement of a standard camera.
- *Sketching.* 2 students made manual sketches of selected scenes in the site to explore and record light patterns.

The six students of each group then worked together to enter data into the building simulation software and to produce a report of all findings, with a comparison being made between data sources (Lightmeter, Pyranometer, camera, sketching). A new package of instructional materials was developed to provide greater directions, requesting more student group reflection and active decision-making about the potential uses of the field site based on light and solar radiation readings.

Evaluation of the fieldwork exercise

Table 5.2 shows how the study was carried out through two iterations of developing and delivering the field exercise. In both deliveries, about 60 students were assigned to teams to complete the exercise and they carried out the task over a two week period in their own time.

semester	tools & techniques	N students	evaluation techniques
2012, s1	Luxmeter Pro app Solmetric app Navigation instruction pack	29	direct observation; questionnaire
2013, s1	LightMeter app Pyranometer app Camera Sketchbook	30	questionnaire

Table 5.2 The schedule of deliveries and evaluation of the exercise, showing the tools used, number of students completed the final survey, and evaluation techniques used

In 2012, direct observations were made by researchers watching the teams in field and through brief interviews in situ. 13 of the 15 groups of students were observed directly by at least one of the researchers who was introduced to them as an observer and stayed with the group through much of the exercise taking field notes. During the exercise, the observers conducted brief informal interviews with several students to learn about their experience in situ. This was judged to be non-intrusive and students were aware that it was not part of their assessment. In both 2012 and 2013, a questionnaire was completed in a later tutorial by about half of the students providing the main data reported here. The questionnaire probed the way the exercise was carried out and its reception by students.

How was the task carried out?

In the 2011 trial direct observations revealed that teams typically organised themselves with well-defined role divisions. This meant that some students did the data capture with the mobile tools, while others entered data in the simulation. While this was not intended, it was an important observation that team field exercises are open to being redesigned by students in this way. The division of roles was a faster more efficient method of completing the task, but possibly reduced the intended learning effects of the exercise.

In the second trial (2013), through the introduction of multiple measurement tasks (meters, camera, sketching), effort was made to ensure all students gained experience with data collection. Those who did not were eliminated from the analysis.

What did student teams discuss?

Table 5.3 shows students ratings of how much their group discussions had focused on different elements. These data show that relatively less emphasis was placed on the mechanical aspects of how the tools worked and how to carry out the task. Greater emphasis was placed on evaluating the validity and meaning of the data measurement process by discussing the consistency of patterns in the data, and how good the two main measurement tools were. This supported the direct observation that students did not carry out the task mechanically but were constantly reflective about the soundness of the activity. Along with the issue of improvisation, this points to another general issue about the confidence of students in an activity without reassurance from a present teacher.

Elements discussed, 2011	mean rating 1 (low) to 5 (high)
Differences or patterns in the data	3.97
How good the Luxmeter App readings are	3.83
The suitability of natural light levels	3.72
How good the Solmetric App readings are	3.31
Where to take the light readings	3.10
The uses of the spaces being measured	3.10
Where to take the sunpath readings	2.93
How to use the Luxmeter App	2.72
How to use the Solmetric App	2.72

Table 5.3 Elements discussed in exercise rated by students

Ease of the tools and activities and confidence in them

In 2012, most students found understanding what they needed to do for the exercise 'quite easy' (51.7%) or 'somewhat easy' (31%). Students were quite positive about the ease of use of the tools (modal responses on 5-pt likert scale of 4, agree: 53.6% and 35.7% of students for luxmeter and solmetric respectively). But they showed little confidence in the tools (modal response of 2, disagree: 50% for luxmeter, and 3 neutral: 46.4% for solmetric.).

In 2013, we asked students about their confidence in the particular measurement task they had carried out. This showed relatively lower confidence with the measurement apps (with a neutral modal responses of 33.3% for LightMeter and 75% for Pyranometer). Confidence was higher for those who used the camera (modal response of agree/strongly agree, for

85% of respondents) and for the Sketching task (modal response of agree, 50%). These data point to the persistence of low confidence in the app-based tools used on a smartphone relative to the special-purpose light-measuring functions of a camera. This was despite the efforts of teachers to establish and communicate their validity.

Overall reception and outcomes of the exercise

In 2012, the overall perception of the value of the exercise for learning about the subject had a neutral modal response of 'some value' (46.4% of students); on a scale of no value to extremely valuable). On whether the exercise had allowed them to appreciate more about what is involved in taking light and sun readings, the modal response (46.4%) was 'a little' (out of: definitely, sometimes, no sure, a little, not at all).

In 2013, following the efforts of the researcher to introduce new tools and to establish their reliability and validity, student rating of whether the exercise enabled appreciation of measurement had improved to a modal response of 'sometimes' (57.1% students). However, the overall value of the exercise for learning about the subject remained neutral, drawing a modal response (53.6%) of 'some value'.

In 2013, Students were asked two questions that required an answer in lux units, and two questions about light theory, and for all questions they rated their confidence in their own answers. As it turned out, most students knew or could guess the right answer to all four questions and so scores were compressed against a ceiling. But confidence ratings applied to each question separately, on a 5-point scale, showed more confidence for students who had carried out the exercise using LightMeter (3.94) or Pyranometer (3.87) compared to those who used the camera (3.33) or sketched (3.39). This final result suggests that even though students expressed lower confidence in the app-based tools used on smartphones than camera or sketching, nevertheless those students who had used the apps finished the exercise with more confidence about their knowledge of the light measurement units. Although caution must be taken in over-interpreting these descriptive data, they nevertheless illustrate a broader point: the experience of uncertainty during the exercise may lead to a perception of reduced value to students, while at the same time it may be a catalyst for greater learning.

Main findings

- An unanticipated finding from this study was that student confidence in the tools used, particularly measuring instruments, is an important consideration in fieldwork design and that it may not always reflect the objective soundness of those tools. In the 2012 trial, through direct observation and survey, it was clear that many students were not confident in the validity and reliability of the app-based tools. This was justified to some extent by limits in those tools. In the 2013 trial, even though the tools had been tested and reassurances given to students, a lack of confidence persisted and was evident in lower confidence relative to a more familiar camera lightmeter.
- A positive consequence of the above was that student groups were observed to be collectively reflective about the validity of the tools. This was clear in direct observations and in the topics they later reported as discussing more often. Questioning the validity of the tools may, therefore, have been a positive learning experience. In the 2013 trials, students who had used the LightMeter and Pyranometer apps (as opposed to camera and sketching) were more confident later in answering questions about units of light levels.
- A further unplanned finding was that, in practice, students modified the fieldwork exercise in attempts to work more efficiently. Most significantly, in the 2012 trial they divided their roles so that some students gathered data while others entered it into the desktop simulation. Most students gained some experience with the

apps, but it was uneven within the groups. This changes the learning potential of the exercise. The general point is that a field exercise that is not directly supervised by staff is likely to undergo such changes which are hard to anticipate in full. In the 2013 trial, this problem was reduced by more prescriptive instructions about the division of team labour.

- By using existing apps and simple image based instructional packs, this study explored 'lightweight' development of mobile-supported fieldwork. The viability of this approach was demonstrated, as this study was implemented in a much shorter time-frame relative to Cases 1 and 2 that used custom-built software. However, the problems of tool validity and reliability required resource-intensive surveying and validation testing of various apps against dedicated measuring instruments. This illustrates how the lightweight path to developing based on existing tools may bring hidden costs and challenges.
- An unintended but positive effect of the field exercise was that it became a rich source of insight for the lecturer about student understanding of some basic concepts of lighting measurement: illuminance vis-à-vis luminance. These had been discussed in three of the lectures in the subject. But the exercise revealed uncertainty amongst the students on this point in practice, prompting further lecture-room discussion.
- The field exercise was planned to be well integrated with the wider subject, drawing directly on concepts from lectures and being central to a major piece of assessment. However, it was seen that many elements of lectures did not carry over well to the field activity. For example, students were asked to note the materials the light meter was pointing at when they took their readings, and to reflect on sudden changes in values relative to those materials (e.g. black felt vs white plastic laminate). Few did this, illustrating the need for a more directive instructional materials, and the need to have prior demonstrations and hands-on practice with equipment and activities before the field exercise.

Chapter 6. Case 4 Situating urban theorists

Lee Stickells (Subject Coordinator) and Melissa Pearson (Tutor/Research assistant)

Overview

Case 4 is distinct from the other three studies in that it examines the learning potential of framing students' thinking about content creation in relation to mobile devices. ARCH9062 'Urban Design Ideas and Methods' is a subject in the Master of Urban Design and Master of Architecture at The University of Sydney. It familiarises students with key conceptual models and theories that have influenced urban design practice. As a professionally oriented discipline with a focus on the production of our built environment, theory in urban design is often of an applied nature. With this tendency in mind, beyond a critical history of theory and concepts in urban design, the unit helps students understand how such theory can be seen at work in the formation of familiar urban environments. The fieldwork exercise in Case 4 was a new initiative in the teaching of the subject that aimed to facilitate the latter understanding through enabling students to explore and interrogate urban design concepts in situ. Students undertook the production of a glossary of urban design concepts with a focus on how this can be incorporated into a mobile device application. The exercise examined how students develop text and graphical materials, for a mobile medium, that define key urban design concepts and theories, and link those concepts with local environments that manifest their qualities. The study exercise particularly considered the use of mobile technologies as a context of thought. It concentrated on how framing students' thinking about content creation in relation to mobile devices could be a potentially powerful way to reinforce the linkages and relevancy of theory to situated fieldwork experiences.

Aims of the exercise

The exercise assigned students a key thinker in the development of urban design theory and asked them to create content about that thinker and their ideas. Students were given the task of creating a 'Concept Guide.' This involved the production of a brief profile of the thinker and a short guide to one of the thinker's key concepts. The Concept Guide also included an analysis of an area within the City of Sydney demonstrating the deployment of the concept, and the description of a task that another student could undertake within the city to better understand the concept. Students were asked to frame their content within the context of making this available to a subsequent cohort of students as a mobile app.

The thinker profiles and urban analysis components were more straightforward information dissemination (however, formatted to suit access in the field). More emphasis within the unit of study was placed on the creation of interesting and informative tasks for an app user to engage with in the field. Students had to imaginatively frame tasks that could help the user understand a concept more clearly, and somehow experience its effects or opportunities in the field.

Designing and developing the fieldwork exercise

The primary aim for the exercise was to link the exploration of theory (and its history) in urban design with the actual formation of urban environments. For professionally oriented disciplines such as urban design, architecture and planning, this was seen as an important interrelationship to explore, in order to foster a better understanding of theory as well as its relevancy. Framing students' thinking about content creation in relation to mobile devices was seen as a potentially powerful way to reinforce those linkages and relevancy.

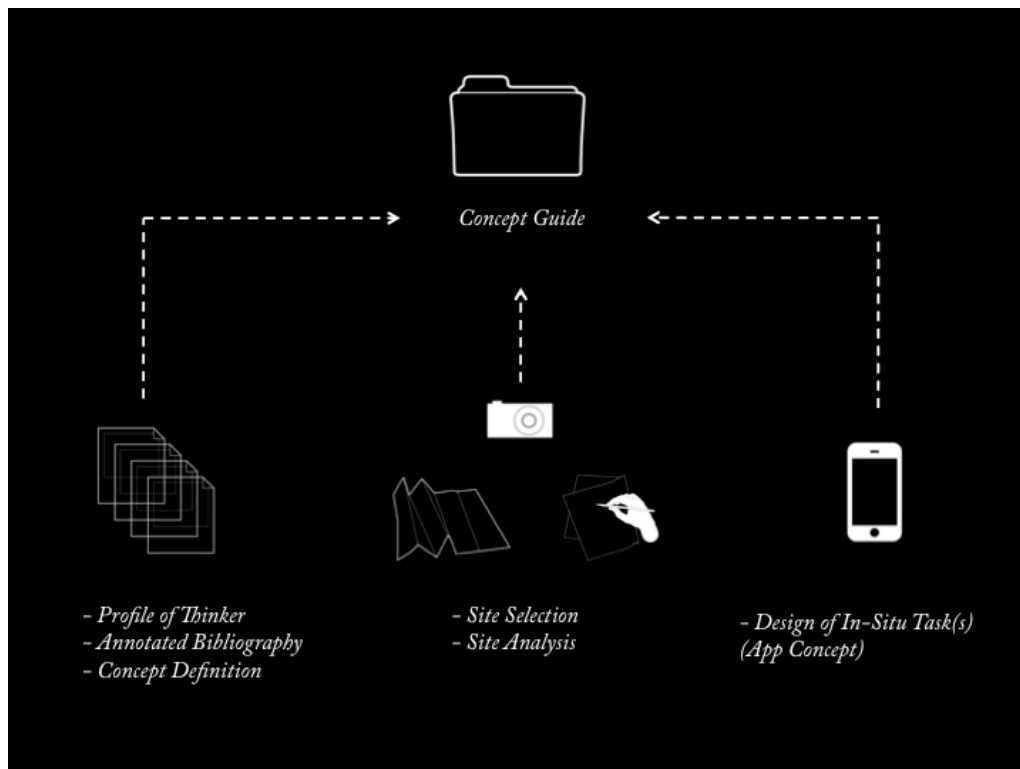


Figure 6.1 The structure of the Concept Guide assessment task

The examination of the learning potential encompassed in students themselves producing content for mobile devices made Study 2 distinctive. The exercise developed for the study thus examined how students develop text and graphical materials, for a mobile medium, that define key urban design concepts and theories, and link those concepts with local environments that manifest their qualities. It hypothesised that a mobile design prototyping activity for students could be a powerful learning exercise. The results of the collation and assessment of student assignments were also anticipated as enabling an academic forum for discussing and critiquing the relatively new forms of ‘mobile media guides’ – audio tours, self-guided GPS tours, multi-media maps, and so on – and assessing their value in University-based education from the perspective of what students consider to be important content provision.

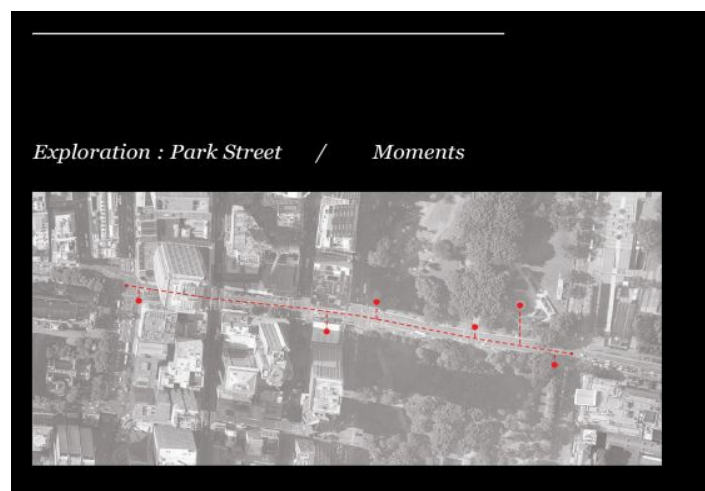


Figure 6.2 An example of student work (app design) by Thomas Sidford (2012)

The Task

Students were clustered in small groups and each group was allocated an urban design thinker, with each student selecting a key concept from the writings of that thinker. The major work for the semester, worth 70% of the mark, was a Concept Guide that included a site analysis applying their thinker's theory, and the app activity. For the app, students were directed to describe a task or set of tasks that someone should carry out to better understand the concept 'in-situ', as opposed to sitting in a classroom or library. The instructions were to be written with an urban design student in mind, and be able to be carried out in an identified location within the City of Sydney (i.e. site-specific) or any urban location (i.e. generic). It was essential that the tasks involved exploring the city, and they were left open insofar as they were to be user-friendly, relevant to the concept, and creative. An emphasis was placed on developing and testing text, image and diagram assemblages readable in small-scale digital formats that can be analysed while moving around in the field

For the first delivery of the exercise (Semester 1, 2012), the focus was the assessment of the feasibility and effectiveness of students producing, as an assessment exercise, a package of content for a mobile device. Over the semester, students produced and gathered raw digital content (text, images) for a mobile guide to urban design concepts. Students were aware that the content they provide would eventually be incorporated into a mobile device. The assessment task integrated the pedagogical aims of increasing students' familiarity with key urban design thinkers and concepts, and developing their recognition of theoretical impacts on the production of urban environments, with the production of digital content for an a The three key components of the Concept Guide are described in Table 6.1.

Task	Relation to fieldwork and Digital Content Production
A critical summary of the concept	Concise, illustrated text. Access via mobile device in the field to be considered when developing structure and style.
Critical Site Analysis	Required fieldwork to identify, analyse and explain relationship between site and concept (whether as analytical, design or interpretative models for instance).
Task Design	Description of task(s) to be undertaken as fieldwork. Encouraged testing and site(s) selection <i>in situ</i> . Task instructions to be written with access via mobile device in mind.

Table 6.1 Fieldwork and digital content production (2012)

The original plan was for students in the first delivery of the exercise (2012) to produce digital content and generate field observations that would aid the development of a mobile application for the second delivery (2013). The idea was that the second delivery would test and develop a mobile app using the data and insights. However, it was discovered in the first iteration of exercise that the mobile design prototyping proved to be a powerful learning exercise in combination with students' own field observations about the way urban concepts shaped urban sites. To retain this positive learning aspect, and to produce an exercise that is repeatable and more portable to other situations, we decided to conduct the second delivery of the exercise as an enhance repetition of the first, rather than as a different exercise. Students in second delivery again collected their own field data and observations and conducted a prototype design task. For this delivery, one of the researchers with expertise in interaction design, Wally Smith, travelled to Sydney to present a lecture/tutorial to students on screen-shot prototyping, and evaluation with surrogate users.

The second delivery in 2013 continued to examine the effectiveness of framing students' thinking about content creation in relation to mobile devices as a means to guide and develop students' understanding of urban design concepts and selected landscapes in situ. The three key components of the Concept Guide are described below in Table 6.2 (showing the modification in the emphasis of the Task Design from the first delivery).

Evaluating the fieldwork exercise

As shown in Table 6.2, the exercise was evaluated over two trials in which the task was progressively developed.

delivery	Key Task	N students	Evaluation techniques
2012, s1	Concept Guide (production of digital content for mobile app)	18	questionnaire (Unit of Study Evaluation); direct observation; discussion forum; questionnaire
2013, s1	Concept Guide (prototype mobile app)	14	questionnaire (Unit of Study Evaluation); direct observation; questionnaire

Table 6.2 The two iterations of the exercise

Delivery of the subject involved weekly briefing on the steps of the task and guidance for each student's project. The main form of evaluation was a set of field notes compiled by the researchers on how students progressed. The field notes focused on the key problems that students faced in operationalising concepts, and our own reflections on students' issues and responses. The notes for the first delivery (2012) included documentation of a discussion forum held with students.

The Unit of Study Evaluation administered by the university was also used to garner anonymous student reflection on the task. An additional online questionnaire (via Survey Monkey) was given to students at each semester's close, focussing on the effectiveness of the Concept Guide as a learning tool.



Figure 6.3 An example of student work (app design) by Zoya Kuptsova (2013) Engaging with Theory

Our observation over the two iterations of the study was that students found that developing the "instructions"/app concept helped improve their understanding of their chosen concept. They saw it as a challenging but compelling exercise. In the focused (Survey Monkey) questionnaire the majority of students found this part of the assessment task 'helped somewhat'. A small percentage (2012: 8%, 2013: 25%) found it 'helped a lot'. No students found the task unhelpful.

One student observed that *"The site analysis gave you the ability to assess whether the theory is appropriate/useful in Sydney."* Another suggested that this aspect helped with *"gaining an understanding of how the concept works as a whole, serving as a eye opener to analysing parts of Sydney."* In the Unit of Study Evaluation a student comment on the innovative quality of the exercise encapsulates the reaction we observed more generally: *"the final project was different and challenging – instead of another boring essay, we were challenged to produce an app – showing the digital and visual age we live in".*

Taken together, the student submissions over the two iterations of the study reflected the common uses of apps for guided tours, data collection, mapping, speculating, visualising, locating, positioning and gaming. At the same time, the work of designing the app successfully incorporated the complex pedagogical purpose of demonstrating urban design thinking. In going beyond simple instruction in their app designs, students often created activities that drew on well-developed understandings of the (various) kinds of knowledge and modes of inquiry that the thinkers developed. Students showed they could get to grips with differences between empirical approaches of environmental psychology (e.g., conducting pedestrian counts as taught by Jan Gehl) and the post-structural philosophy of Gilles Deleuze (e.g., an idea of the virtual).

The importance of fieldwork

Students tended to find the fieldwork components of the unit (i.e. the site analysis and instructions) were very important to developing their appreciation of urban design ideas and methods. In the focused questionnaire students overwhelmingly felt that these components were 'quite' or 'very' important (2012: 75%, 2013: 75%). One student commented: *"the concept guide forced us to go beyond books and be involved in the project."* Reinforcing this response, another student suggested that the most important aspect of the subject for developing a situated understanding of theory was: *"The urban analysis and linking it back to today and how urban designers works."*

In analysing the student submissions over two iterations of the study, we observed that the tasks and prototypical app concepts developed by students ranged in their functionality from simple data collection or reflection (gathering data on a site to demonstrate its realisation of a concept), to mapping, observation, sketching, and designing (doing these activities as ways of demonstrating the concept). All required urban exploration, were dependent on receptiveness to real-time activity and incorporated, to varying degrees, attention to sensory urban experience. The more sophisticated student proposals went beyond a yes/no binary chain of instructions and included percentages, indexes, and point-scoring through multiple choice questions. We observed that, on the whole, students went beyond simple instructions to conceptualise quite complex digital interfaces, based on their own experience of smart devices and apps and the examples they were exposed to in class.

Integrating fieldwork into assessment

Two open questions were asked in the focused questionnaire regarding student perception of the most relevant parts of the assessment tasks and what aspect of the subject was most helpful in developing understanding of urban design theory. Interestingly, student responses showed that they almost unanimously found the Concept Guide and its fieldwork component to be 'most relevant' while seeing the lectures as the 'most helpful'. In discussions and feedback documented in our filed notes, students prioritised contact with the lecturer and felt strongly that *"apps should be used as an additional layer of learning"* (notes 2012).

Commenting on the relevance of the assessment tasks one student responded:

I was initially somewhat sceptical of the site analysis. However, this proved far more informative and engaging than typical precedent studies, which are almost always detached and distant - physically, historically and otherwise. Assigning specific figures to groups of students is certainly a more focused approach than more generalised

studies of each thinker. The brief for site instructions was fun and engaging.

A typical comment regarding the most helpful aspect of the subject was: *“The lectures and tutorials were the best in developing the history and theory.”* Our observation, garnered through discussions and forums with students over the two iterations of the study, was that while students saw the fieldwork as important they understood it as augmenting the classroom delivery of teaching materials.

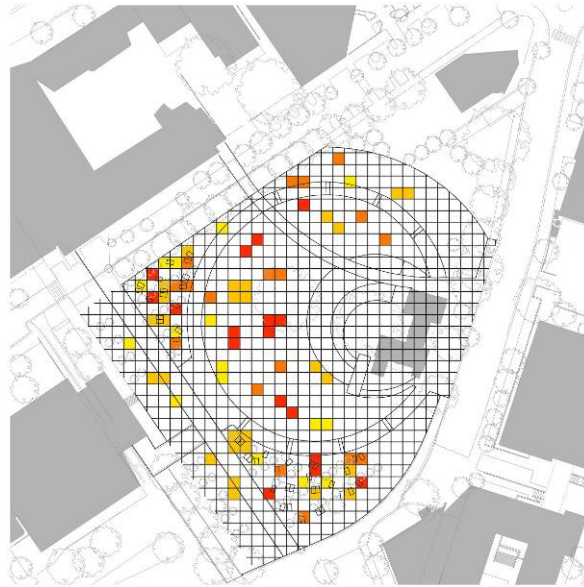


Figure 6.4 An example of student work (site analysis) by Rachel Yabsley (2012)

Main findings

- The relatively small numbers of students in each iteration of Study 2 meant that the findings should be treated with some caution. However, the main observations made, based on the field notes, Unit of Study Evaluations, focused questionnaires, and the student submissions are:
- The Concept Guide task, including its mobile app design activity, was successful overall in creating a positive student experience. Although it was an unusual assessment task and some aspects were unclear to some students, overall reception was positive about its overall value for learning and students found that it enabled new ways of understanding urban design theory in the city.
- The mobile app design task was itself an effective technique for learning – in a situated manner – about urban concepts and the way they shaped urban sites. Students appreciated the assessment task, saw it as a successful means of engaging with the situated nature of urban design theory and, importantly, were not worried that it was not actually the design or realisation of an a We suggest this shows the positive possibilities for the use of mobile technologies as a context of thought in fieldwork – inflecting motivations and approach to understanding relationships between theory and actual constructed environments.
- Students were ambivalent about the introduction of mobile devices in teaching and learning contexts. While they appreciated the innovative way that the task prompted them to approach urban design theory in a situated manner, they were suspicious of mobile technologies being used as a proxy for engaged, face-to-face teaching.

Chapter 7. Guidelines for mobile-supported fieldwork

In this section, we now offer some general guidelines for teachers and educational designers embarking on fieldwork involving mobile technology. These are not comprehensive, but nevertheless reflect the collective findings of the project team based on their experience and evaluation of several deliveries of mobile-supported exercises. The guidelines are organised into five areas of consideration: *the potential uses of mobile devices; development paths for acquiring and creating tools and learning materials; designing field activities; designing learning materials for use in situ; and the framing of exercises through briefing and debriefing*. These five considerations are intended to occur in parallel and their order below does not imply a linear process of design. The guidelines assume a situation in which a teacher endeavours to achieve overall subject and course objectives, and that practical costs are weighed against the value to be gained.

The potential uses of mobile devices

One area of consideration is to review the possible roles that mobile technologies might play in a fieldwork exercise. Note that once technology is introduced, it can serve many different purposes, and so this consideration might not be limited to the original motivating reason to adopt mobiles. Further, we observed that many students bring and use their own devices, so alternative uses are likely to become a part of an exercise whether designed for or not.

Task instructions and navigation. This entails the provision of instructions or demonstrations on how to carry out the field exercise. Likely examples are navigational directions and resources to explore the site, existing maps, compass applications, and in-built GPS features. As illustration in the current project, we used a range of forms of instructions including: full listing of field activities (Case 2); a quiz (both paper-based and app-based) with implicit instructions for the task; reminder prompts about what to pay attention to (Case 3). On navigation, we used a variety of hi and lo tech options, including simple static maps built into packages of content (Case 3); GPS location and special-purpose zoom-able maps with subject-specific content of contours and land features (Case 2); sequences of labelled photographs that gave directions and showed landmarks (Case 3).

Rich content delivery. This implies the provision of text, audio and film materials to be used as part of the field exercise. This has special implications for fieldwork and requires a special form of content. For engagement with their environment, mobile content should promote greater *interaction* with the objects under observation, to 'look with intention' (Sanders 2007, p. 181; cited in Welsh et al, 2012) to make better sense of the field situation. As illustration, this was a point of emphasis in two of our case studies, involving images with audio narration (Case 1) and a mixture of images, text, film, audio narration (Case 2)

Data capture. The measurement and recording of the environment for analysis in the field or later. With suitable apps, a mobile device becomes a measuring instrument. As illustration, this was the emphasis in our Case 3 where student were given lightmeter and sun path measuring apps to survey a particular site. It also figured strongly in Case 2, where students were instructed to take photographs and produce sketches on site.

Field recording. Mobile devices might take the form of a field note-book for students to log their activities. Herrington (2009: 60) states that: 'Gathering data in the form of pictures, videos and sound recordings and note taking all appeared valuable activities that supported constructivist based activities set in contexts outside the classroom and lecture theatre.' This was not a point of focus in the present case studies. Yet students, often using their own devices, took and shared many photographs to record their performance of the activities.

Collaboration between students and/or teachers. Mobile tools might facilitate collaboration between students through tasks that require sharing data, or through simple

communication and coordination of activities. For example, peer to peer coordination and shared experience can be enhanced in the field through the full range of social media as suggested by Hamid et al (2010). Student collaboration was important in all of the present cases, especially Cases 2 and 3, but it was not intentionally supported through our use of mobile technology.

Designing content for mobile platforms. A different kind of use of mobile technology, is to set learning activities around the design of content to be delivered on a mobile platform. Here mobile technology becomes a conceptual and practical framing device for thinking about environments, their meaning and their communication to others. As illustration, this was the focus of Case 4 in which studies developed mock-up screen storyboards of mobile apps to present information about urban designer and the application of their concepts to urban environments.

Development paths: acquiring and creating tools and learning materials

The choice of mobile technologies for fieldwork is affected by rapidly changing factors, including cost and emerging operating system standards (Apple iOS, Android, and so on). However, it is possible to make some general observations about the approach and conditions under which it is acquired and deployed.

Student access to tools. The first hurdle is to ensure that all students can get access to suitable hardware tools. It must either be provided by the institution or rely on students' own devices. Both options present a cost. Having students use their own machines requires the development of content and materials that can work across many operating systems and platforms. Use of student-provided equipment might also raise an equity issue. Institutional support for hardware tools is likely to be a desirable option. The cost of handheld machines capable of delivering high quality materials is less where ongoing connectivity is not required, as with Apple's iPod devices. In the cases here, costs were reduced by sharing machines within groups of students and running exercises over extended periods so that groups could book out the limited machines at different times. The cases typically started out by providing devices for students to use, but then found increasing use of student technologies was unavoidable.

Practical challenges of digital technology in the wild. The delivery of field exercises with mobile tools face special practical challenges. Prominent of these are: the robustness of devices, the management of procedures for borrowing, the usability of software applications, consistency of data formats, battery life, and screen glare. All of these factors affected the studies here (especially Cases 1, 2 and 3) in that they consumed considerable care and resources to address. While these issues are often anticipated, they can nevertheless combine to create new challenges at the time of delivery.

Custom-built apps. The two basic approaches to acquiring apps for fieldwork are custom-built apps or using existing apps. The cost of a custom-built app, although significant can be supported by small development grants and should be weighed against the great value they can bring (as in Cases 1 and 2). The costs can be divided into the design of content (both materials and the navigation structure to access them) and the programming work to implement these as a publicly releasable app. In our cases, the far greater cost is in content development but this could be carried out by teachers and researchers using conventional desktop tools (drawing packages, PowerPoint, etc) within the respective institutions as part of their normal duties. Where content could be sufficiently developed and given to a programmer, the cost can be relatively low.

Use of existing apps. It is possible to use existing apps, most of which are inexpensive or even free. Note though, that existing apps need to be tested to ensure that they serve the intended purpose and are reliable. An example of this being a significant issue occurred in Case 3 where an extensive validation testing phase was needed. Existing apps or standard functions on smartphone or tablet (like

the Photo gallery) can be used to present home-grown content in a simple format. For example, in Case 3 we developed a linear set of instruction slides with text and images (using PowerPoint) and presented them in the standard photo gallery function of an iPod.

Minimal and iterative development paths. Whichever development path is used, we recommend a minimal and iterative approach to the introduction of mobile tools into fieldwork. That is, to start by delivering a simple form of the tool, simple content and a simple form of the activity. Through successive iterations, the tools, its content and the activities can then be refined and advanced. Not everything needs to be presented digitally in early iterations. Students can be given some materials in paper-based form, such as instructions or answer sheets, especially in the first iteration. From evaluations of these paper-based 'prototypes' much can be learned for future digital versions. This approach to development reduces the risk of wasted cost in developments that do not work effectively. It is a standard approach in the field of interaction design and there are good instructional resources in the associated evaluation techniques, (e.g., Snyder (2003)). Further, a simple approach to functionality, content and activities, reduces the risks overwhelming complexity and excess attention given to technology during the exercise.

Proliferation of tools. The converse of the previous guideline, is that teachers should avoid a proliferation of the tools that students need to have with them to complete the exercise. For example, in Case 2, the use of a digital iPad guide plus a physical workbook was felt cumbersome by some students who stated that they would prefer integrated digital documentation of their assignment work. Reducing the number of tools is thus an aim to work towards where possible.

Designing field activities

Directedness of field activities. While teachers see great benefits in open-ended learning activities made possible by the rich content that can be delivered on mobile devices, these can produce uncertainty for students in the context of fieldwork where there is no immediate presence a teacher to clarify and re-focus learning. This was experienced in all four of the present cases. In successive iterations of exercise we found it desirable to tighten the instructions and response templates given to students. In Case 3, in particular, it was observed how student improvised to re-structure the exercise from that envisaged by the teachers, with negative consequences for learning it afforded.

Strength of links to assessment. It was a premise of the current project that the field exercises developed should be well integrated into subject assessment. We therefore did not investigate a situation where it was not integrated. However, observation and focus groups clearly showed that this was a significant part of the success of the exercises. The challenge of completing field exercises were seen as considerable by many students, and the incentive of assessment appeared to be necessary. A field activity can be designed with varying links to assessment and mobile technologies can play a role in establishing and confirming such links. Further the assessment task can be designed to require certain uses of the tools, a technique used in later iterations of Case 2's exercise. More generally the way the field activity is framed and communicated through mobile tools can strengthen or relax a direct connection to assessment.

Engaging supplementary activities. A field exercise can be continually improved by adding alternative or extra activities that lead students to interact more productively with the environment. The building tour of Case 1 was enhanced by adding in digital sketching task, and an app-based quiz. In Case 2, the exercise was improved through a workbook of activities including photographing, sketching and identifying targets on a map.

Influences of social interaction. The design of mobile technologies can subtly affect the extent of social interaction between students. In Case 1, the smartphone-sized screen that was only comfortably viewable by one person limited social interaction and discussion. This is not necessarily a problem for limited durations, but complementary tasks demanding

social interaction may be needed to compensate. In contrast, for Case 2 a tablet-sized screen allowed comfortable co-viewing by groups of four students. Social interaction then became a strong feature of the activities. We also observed that difficulties in the use of tools could have a positive effect of initiating social interaction. The problem in Case 3 of invalid tools became a discussion point among students and was possibly a strong learning experience. Similarly in Case 2, the more open-ended workbook activities led to greater discussion.

Designing learning materials for use *in situ*

Legibility of materials. Content materials need to be tested for outdoors consumption where constraints arise that are not evident at the desktop. In particular, audio volumes need to be high against background noise, a point that cannot be realised until tested *in situ*. Similarly text and image sizes need to be tested to establish that they are visible against the glare of outdoors conditions.

Lean servings of content. Mobile devices offer the potential to present encyclopaedic volumes of information. The designer of the field activity must decide whether to provide a great depth and breadth of content or whether to serve more lean activity-oriented material. Great volumes of content may seem valuable, but they risk distraction and over-focus on the technology relative to the field environment. Our cases favoured very lean servings of content. In particular, the number of images should be few and audio segments should be as short as possible, preferably not more than 2 minutes. Focused looking or listening in the field is demanding.

Support for directed looking. Materials should attempt to avoid conflicts between attention given to the field setting and that given to the mobile tools. An effective mobile tool should support ongoing interaction between the learner and the physical site. This is a technique that we have called 'directed looking' and involves 'mirroring' content in the mobile guide with the evidence of the field site. In Case 1, students were most engaged by visual digital content showing details that they could search for in reality; with intermediate engagement achieved by interior and historic images of the site, and least engagement found with comparison buildings from elsewhere. Similarly for audio commentaries, content was more engaging when it took the form of directions to look at features, and less engaging as background historical information.

Genres of delivery. Content can be framed and delivered under different genres. For example, it might be in the genre of a traditional lecture, or a guided tour, or a museum display, heritage interpretation sign, or a laboratory note-book. This genre needs to be made explicit and considered when designing content. In the first version of the app for Case 2, a lecture-style of audio delivery was used unintentionally by the subject coordinator who wrote out audio commentaries and then recorded them in a studio. This was not received well by students who found it incongruous with field situation. A later more successful version of the same material was recorded by the lecturer while in the field site, speaking in the style of a tour guide and recorded directly to the iPad using the video function.

Instructions and templates. Related to our finding in favour of more prescriptive instructions to students, materials should express a clear purpose for the field activity. Instructive and activity-oriented materials assist greatly. In Case 4, the later iteration of the exercise was improved by providing very clear boundaries around activities through guidelines and resources like templates. In Case 2, later iterations included instructions around the desired division of labour in the teams.

Exercise framing: briefing and debriefing

Framing the exercise. Many students feel daunted by the perceived open-endedness of field exercises without a member of staff to clarify goals and activities. This remains true even when clear instructions are provided. Field exercise need to be 'framed' well through connected activities in surrounding lectures. In particular, students need to be *briefed* in a tutorial or lecture session, ideally with hands on demonstrations of equipment. It is also desirable that they are *debriefed* as soon as practically possible after the exercise so that uncertainties can be voiced and addressed. In Case 1, the walking tour has a dedicated follow up tutorial in which student responses to a quiz were discussed. For Case 2, the debrief function was also partly served by the focus group discussions held as part of the research, but which should be used in future normal delivery of the exercise. In Case 3, extra discussion of the field exercise was found necessary in lectures to address points arising.

Framing the role of mobile technology. A particular point related to the above concerns the way items of mobile technology are presented. In briefing students, it was found helpful to explain the thinking around the use of the technology and the teacher's intentions for the learning experience. In Case 2, the tour guide app was presented as an 'alternative' to touring with lecturer, and this created a more negative reception than subsequent deliveries where it was presented as the only option.

Chapter 8. Outcomes & future directions

The project has led to the following recommendations.

1. *Institutional support is needed to capitalise on the great potential of mobile-supported fieldwork.* Fieldwork offers a kind of learning that is vital to many disciplines, and may enhance many others. The four case studies in this project demonstrate the strong and varied potential of mobile technologies to create new learning opportunities in the field. These cases illustrate how digital technologies may be used to strengthen and enhance traditional forms of teaching as a complementary path alongside the more publicised approach of transforming teaching through Massive Open Online Courses and similar. To develop these opportunities for mobile-supported fieldwork, institutions need to provide support through small development grants and through continued recognition of the value of staff time spent in extended contact with students.
2. *Developers of fieldwork must recognise and manage the risks involved.* The delivery of mobile-supported fieldwork is not without risk. Across all of the cases, it was evident that new technologies introduced significant obstacles and practical difficulties. Attention could be consumed by the technology and taken away from the environment. Some forms of mobile content could be alien and ineffective, and the complexities of tasks enabled by the technology could become unmanageable. Our studies showed that overall reception of a field exercise, including the relationship between teacher and student, is dynamic and complex and may be both positively and negatively impacted by the introduction of mobile technology. But it was found that positive outcomes could be improved with successive iterations. The development of fieldwork therefore needs to occur in an environment that accepts the short-term risks and has capacity for ongoing development and support.
3. *Technology support for fieldwork should be created through a targeted, minimal and iterative development path.* The introduction of technology into fieldworks should occur as one component in the design of a fieldwork exercise intended to serve local learning objectives. The technology should be highly targeted, initially at least, towards a specific purpose in the field exercise. An effective strategy is to start with minimal uses of digital tools, including minimal digital content, alongside traditional paper-based materials. This avoids the problem of distracting complexity in the field task, and allows ongoing evaluation of how students receive and experience the exercise in practice. Successive iterations of the exercise can then progressively refine or add new uses and content for the tools as appropriate. The four cases all demonstrated the value of feeding early experiences into reflection and redesign for later iterations.
4. *The design of mobile-supported field activities can be enhanced by other exercises serving as models for development.* Although any field exercise is heavily embedded in its local learning context, the development of supporting tools is likely to face recurring design issues. Development should therefore attempt to learn from existing exercises. The four cases reported here are presented in a format intended to serve this purpose. In tandem, we offer more general guidelines of the major dimensions to be considered: the potential uses of mobile devices; development paths for acquiring and creating tools and learning materials; designing field activities; designing learning materials for use *in situ*; and the framing of exercises through briefing and debriefing.

The project has produced the following outputs.

Four field mobile-supported exercises. The four case studies conducted in the project have established four successful mobile-supported fieldwork exercises that will continue after the lifetime of the project.

Project Website. A website provides access to the four demonstration cases and the guidelines developed: <http://mobilefieldworklearning.wordpress.com>

Conference Proceedings. Three presentations of the project were made at conferences:

- Lewi, H., Saniga, A. & Smith, W. (2012) 'Presenting Historic Landscapes: a mobile digital guide to the Botanic Gardens Melbourne' In *Proceedings of the Annual Conference of the Society of Architectural Historians of Australia and New Zealand* (SAHANZ).
- Lewi, H. & Smith, W. (2013) 'Designing mobile guides for student field trips'. In *Proceedings of the International Conference on the Future of Education*, Florence.
- Constantinidis, D., Smith, W., Chang, S., Lewi, H., Saniga, A. & Sadar, J. (2013) 'Designing Fieldwork with Mobile Devices for Students of the Urban Environment', in *Proceedings of the Annual Conference of the Australasian Society for Computer is Learning in Tertiary Education* (ASCILITE), Sydney.

Journal Articles. A journal article has been published for architectural researchers and educators, and a second one accepted for publication:

- Lewi, H. & Smith, W. (2011) 'Hand-held histories: using digital archival documents on architectural tours. *Architectural Research Quarterly*, 15(1), 69-77.
- Lewi, H., Saniga, A. & Smith, W. 'New Tools for Historic Landscapes: a mobile digital guide to the Royal Botanic Gardens Melbourne' Accepted for *Landscape Review* journal.

Seminars about the project findings. A number of seminars have been held to report and discuss the findings of the project and to promote how they might be applied:

- 2011, November. Hannah Lewi and Wally Smith: Seminar for Faculty Architecture, Building and Planning, The University of Melbourne
- 2012, October. Dora Constantinidis: Seminar for the Centre for the Study of Higher Education., The University of Melbourne for staff undertaking Graduate Certificate in Tertiary Teaching.
- 2012, October. Wally Smith and Dora Constantinidis: Interaction Design Lab seminar, The University of Melbourne.
- 2013, July. Dora Constantinidis: Seminar for Monash Excellence in Education Research Group
- 2013, October. Hannah Lewi: Invited seminar to School of Built Environment at Curtin University.

National Workshop. In November 2013, a workshop was held as a forum to present the project cases with similar work by other teachers and researchers, with an audience of 30 people from seven institutions. The presentations at the workshop were:

- Hannah Lewi (The University of Melbourne) 'Formative Histories Walk Melbourne'
- Andrew Saniga (The University of Melbourne) 'Landscapes in Time: an iPad guide to the Royal Botanic Gardens'
- John Rayner and Jenny Bear (Burnley Institute) 'The Burnley Plant Guide App'
- Sophie Sturup 'Mobile Map-reading in the Field'
- John Sadar (Monash University) & Dora Constantinidis (The University of Melbourne)- 'Environmental Measurement and Intuition'
- Diane De St Leger (The University of Melbourne) 'Podtour: A l'écoute de Melbourne'
- Lee Stickells and Ann Deslandes (The University of Sydney) 'Teaching and Learning for Chance: Mobile applications of urban history'
- Laurel Dyson (University of Technology, Sydney) 'Mobile-Supported Fieldwork for Information Systems and IT Students: Two Case Studies'

Technology development. The project developed a web-app for the delivery of quizzes to students in the field that allowed a range of question styles, some with immediate feedback. The team are working to have a stand-alone version of the app made available through Apple's AppStore.

Future directions

We see the significance of mobile-supported fieldwork growing in the immediate future. One of our observations has been that, in addition to planned uses of mobile technology, students bring and use their own devices to make recordings and to coordinate with each other. In this sense, many learning activities outside of the classroom are becoming mobile-supported, and the issue is whether they are designed effectively to exploit this opportunity.

The most important future direction for the continuation of this work lies in enabling educators and institutions to embrace the benefits of student learning carried out in the field, and to see the development of mobile-supported materials and exercises as a viable and valuable investment. This represents an approach to digital technology in education that is complementary to, but distinct from, its more high-profile role in enabling forms of online course delivery.

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