Bringing the Classroom into the World: Three Reflective Case Studies of Designing Mobile Technology to Support Blended Learning for the Built and Landscaped Environment

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ABSTRACT

We report and reflect on three projects, carried out by us as educators and technology researchers over a four year period, that explore the use of mobile technologies in the fieldwork of Australian tertiary students of architectural history, landscape history and urban design. Treating these as three case studies, our focus is on the emerging process of designing, developing and deploying different forms of mobile-inspired fieldwork to complement class-based learning. The first two cases involve the development of apps that work as guides for students to explore places of architectural and historical significance in Melbourne, while the third case invited students themselves to create designs for a mobile app intended to communicate the influence of urban design thinkers on a particular place in Sydney. We consider how the iterative development and deployment of the apps and field exercises, over successive semesters, became one of extended co-design between students, tutors and teaching staff.

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INTRODUCTION

Taking learning into the physical world and teaching students how to observe, how to experience and how to record, has long been a significant component of architectural history and theory teaching. As Hardy suggests, observation is important not just in terms of empirical perception, but in the deeper sense of conceptual and imaginative acts of open-ended re-creation and recall. To learn this kind of observation, he suggests, is to learn architectural 'interpretation' (Hardy, 1996: 187-188). But despite learning in the field remaining integral to teaching in the built and natural environments, there is surprisingly little critical discussion of fieldwork and mobility in architecture-related education, in stark contrast to other field-intensive disciplines, for example geography (e.g., Goh et al., 2012).

In this paper, we reflect upon three projects, carried out by us as architectural educators and technology researchers, that explore the use of digital mobile technologies as resources to foster the very skills of observation that Hardy and others advocate. This responds to calls for more case studies of mobile and blended learning applications in architecture (Bedall-Hill, 2011). Adopting a case-study methodology (Yin, 2014), we report and cross-analyse these projects as three distinct cases of designing mobile-technology inspired architectural fieldwork education. Our focus is on the nature of the emerging process of designing, developing and deploying different forms of mobile-inspired fieldwork to complement class-based learning. In each case, we trace the unfolding history of initial motivations and context, through design decisions, and their consequences. As part of this, we briefly report on student reception of the fieldwork exercises as an important aspect of these design histories.

The three case studies (see Table 1) were carried out through one Australian national teaching and learning project in the areas of architectural history, landscape architecture and urban design at the University of Melbourne and the University of Sydney. Each case centred on a particular existing taught subject and involved substantial reworking of learning activities and assessment. As educators, we were interested in the design of more effective learning in the field, especially at designated sites of architectural and historical significance. Further, we believed that mobile technology, if thoughtfully deployed and refined, would allow us to promote the value of history and theory and its relevance to design practice; and to inform the ongoing debate about this relevance that began in the 1960s and remains alive today (e.g., Keyvanian, 2011).

More generally, our investigations were motivated by the broader movement towards blended learning and in particular the use of mobile technology to augment and mediate the way people learn in new places; allowing not only for 'learning on the go' but also opening up new forms of learning that follow from direct experience of the built and natural environment

(Carvalho & Freeman, 2016). Blended learning is typically defined very broadly to encompass all styles of learning that result from 'strategic and systematic approaches to the use of technology combined with the best features of face to face interaction' (Bath and Bourke, 2010:1; Garrison & Vaughan, 2008; Picciano, Dziuban & Graham, 2013). Within this broad spectrum, we were specifically interested to explore how many of the materials of the lecture theatre and activities of the tutorial might be reworked into mobile formats and thereby juxtaposed against field locations. In this way, we aimed to invert the well-worn trope in educational theory of 'bringing the world into the classroom' (e.g., Nichols and Lewi, 2016: 220), to that of taking the classroom into the world.

As noted, our main aim in this paper is to use the three case studies as a focus for reflection on the process of designing and developing uses of mobile technology in teaching that are localised and situated in a particular context. While Cases 1 and 2 (see Table 1), were attempts to create mobile learning apps for students to use in the field, Case 3 inverted this approach and invited students to investigate an uban area and then design a sketch for a mobile app that presented their theory-informed analysis of that site. In all three cases, we followed an approach of research-through-design (e.g., Zimmerman et al, 2010); that is, we sought to better understand the nature of the challenge by designing and conducting real fieldwork activities. We drew a clear contrast with the high-profile on-line and distance course delivery modes that have tended to dominate discussions around e-learning in Australia at least (e.g., Lewi & Smith, 2010). Our highly customised, even 'boutique', uses of digital technology are not typically what university managers and educational technology providers foresee as the future of education, because they do not readily offer economies of scale and portability.

In the rest of the paper, we consider what our highly localised and situated approach to mobile field learning does offer. First, we describe each study in terms of its motivations, context, and observations of the fieldwork. This is followed by a discussion of emerging cross-case themes. A key theme that we return to is the importance of the co-creation of mobile field exercises as a contributor to the learning experience.

	Course	**Mobile Activity**	**Key Learning Aim**
Case 1	Architectural History, undergraduate	Individual and paired walking tour with iPod Touch app providing images and audio commentary.	Interpretation and recording of buildings in historical context.
Case 2	Landscape Architecture, postgraduate	Small group walking tour and extensive field activities, with iPad app providing a map of key locations and integrated resources and field activities.	Experiencing landscape design intentions and their changes over time.
Case 3	Urban Design, postgraduate	Group activity to design a mobile app to express knowledge about urban design.	Understanding and communicating the ideas and influence of key urban thinkers within an urban cityscape.

Table 1. Course context, mobile activities and key learning aims for the three case studies.

CASE 1: TAKING LEARNING TO THE STREETS – AN IPOD WALKING TOUR GUIDE FOR MELBOURNE

Motivation and Context

Case 1 is the development an iPod tour guide for fieldwork in the undergraduate subject 'Formative Histories of Architecture' in the Bachelor of Environments at the University of Melbourne (see Figures 1, 2 and 3). Concurrent with the iPod guide development, this subject was made a core degree requirement and also became available to cognate students across the university, which precipitated a growth in enrolments to over 300. The subject examines ideas and precedents in architecture from the enlightenment to early modernism in Europe and Australasia. An important learning component is the integration of off-campus guided walking tours into the formal lecture and tutorial program to gain first-hand experience of 19th-century architecture and urban history in Melbourne, and to show how international ideas and exemplars were imported and how they were translated.

Figure 1. Case 1: Students undertaking the app-guided walk in Collins Street, Melbourne.
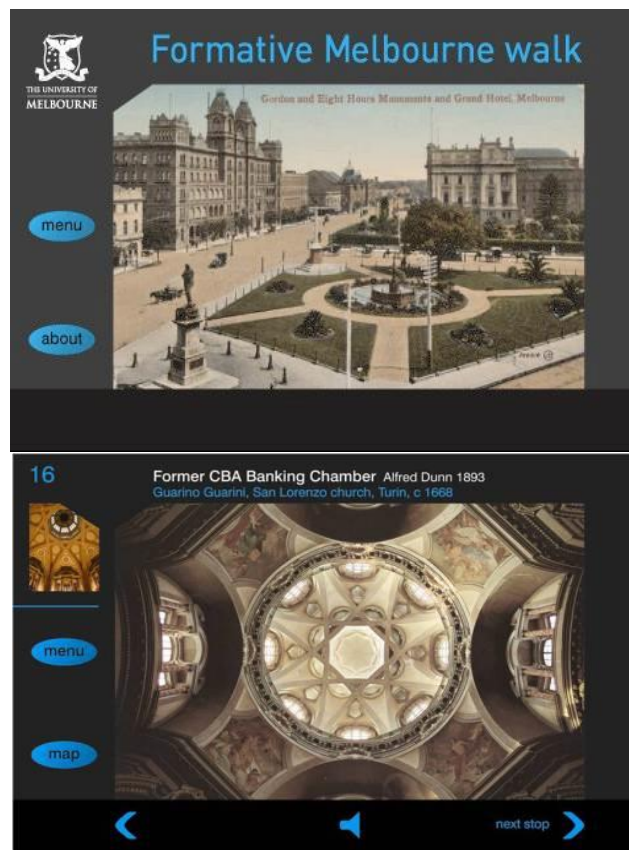

*Figure 2. Case 1: 'Formative Melbourne' app: home screen (upper), and screen for Stop 16 (lower***)**
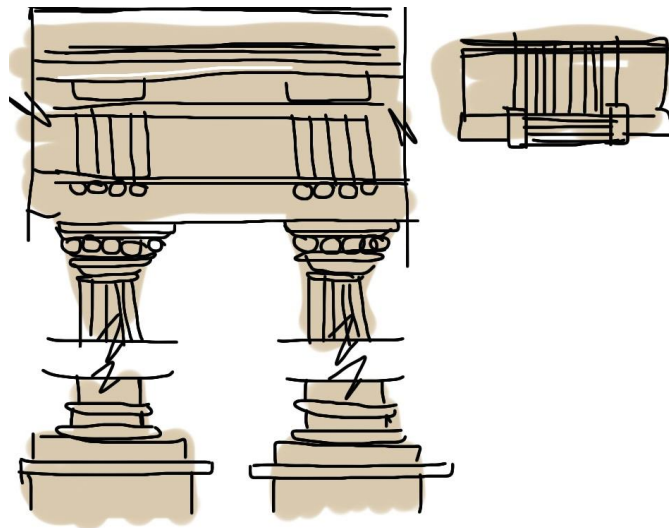
Figure 3. Case 1: Example of a student sketching created on an iPad.

The walking tour of the central city provides a local and vibrant setting for taking learning to the streets and showing the ongoing 'relevance' of history to the contemporary urban context. The development of an iPod App tour in place of a tutor or lecturer led guide was partly a pragmatic response to increased class sizes. Indeed, increased student numbers is a major factor affecting the maintenance of high quality, innovative teaching and learning in the higher education context and has motivated the introduction of blended learning tools into the conventional classroom (e.g., Dyson et al., 2009). Our aim was not to replicate the human tour guide, but to add value to the walking tour learning experience by developing digital visual and audio content, and by including a quiz-style activity that reinforced the learning content explored in lectures and the tour audio, and also to promote more open-ended observation through sketching. Discussion of the tour and quiz in subsequent tutorial groups further cemented this situated learning activity back into the academic setting.

In selecting appropriate technology options, our primary concerns were the need for equitable access and robust delivery. It was decided that the Apple iPod Touch platform was the best option when first launched in 2011. Thirty iPods were purchased for students to borrow, although they could use their own iPhone if they owned one. The interface was designed to be very simple from the offset, in the manner of a 'walk-up and use' interface, and concentrated on content delivery rather than interactive capabilities. The tour navigated a fairly linear walk with 20 stops in close proximity so as not to curate a daunting experience, especially for the many international students unfamiliar with Melbourne. Up to three comparative images and around three minutes of audio commentary, later reduced in length, were included for each stop along with a map and thumbnail photographs of the stops to assist in navigation.

In-the-field observation and interviews with small groups of students using the App and the quiz were conducted in the first two years of running the exercise. All students completed an evaluation questionnaire in the tutorial following the activity. It probed the retention of

information after the tour, the kinds of social interaction students experienced, and the perceived value of the exercise and of the different kinds of content provided.

Observations

Students carried out the activity alone (Year 1, 31%; Year 2, 47%) or in a small group of mostly 2 or 3 people. Most used their own iPhone or that of a peer (90%). Most reported completing all or nearly all stops on the tour (>95%), typically taking 2 or more hours (>85%). From direct observations, student interviews and the questionnaire it was clear that the guided walk fostered productive interactions and sharing amongst students who were encouraged to undertake the tour in pairs, or small groups, rather than as the whole tutorial class previously led by a tutor. Another advantage recognised by students was that the digitally augmented walk provided a flexible yet consistent experience to all (Sharples et al., 2002), where previously many students could often not hear the lecturer-guides due to background city noise.

Table 2 shows student survey ratings on their overall reception of the exercise. By the second year of delivering the guide, over half the students were positive about its value for the learning in the subject (rating 4 on a 5-point scale), while just over one third were neutral (rating 3). Interestingly, a clear majority were positive about its role in helping them to appreciate the city buildings in a new way (rating 5). This suggests that students saw value in the exercise that went beyond its direct contribution to their completion of the current subject. Among our other observations, students also consistently expressed preference more for detailed and focused content and less for general background histories of Melbourne.

Overall dimensions of reception		**Student ratings** (% of respondents shown)				
		1(low)	**2**	**3**	**4**	**5(high)**
Value for learning about the subject	Year 1 (N=295)	0	4.8	39.2	47.1	8.9
	Year 2 (N=153)	0	0	35.9	56.9	7.2
Enabling new ways of appreciating buildings	Year 1 (N=295)	0.3	5.2	4.5	32.8	57.1
	Year 2 (N=153)	0	0.7	1.3	36.6	61.4

Table 2. Case 1: Students' 5-point ratings of the value of the 'Formative Melbourne' history walk for their study of the subject, and its enabling of new appreciation of buildings.

The iPod guide became a tool for delivering what we have termed 'directed looking' (Lewi & Smith, 2011), meaning the close and guided alignment of digital interpretative content with the physical reality as seen by users. For example, the audio might 'point out' a detail high on a building façade and question students to think about its origins or purpose; or might ask students to compare what they saw with a drawing of a direct European precedent displayed by the app. Therefore the overriding pedagogical aim of the iPod tour, following the

sentiment of Hardy above, became for students to learn to look more closely at buildings in their local context and, importantly, to interpret them in the field so as to reinforce connections between architectural precedents and meaning in one particular context with broader international design ideas and histories. The content was therefore seen by students as most valuable when it did indeed direct and guide them to observe and interpret in a manner that resembled a more traditional tour with an expert human guide. The App's simplicity has meant that it has been robust enough to run for the last four years, with minor updates and extension to Android. Using the App-Store has also meant the tour has been available to the general public too. Despite a large investment in time in developing and curating the tour initially, it has been an invaluable addition to this subject.

CASE 2: LANDSCAPES IN TIME - AN IPAD GUIDE TO THE ROYAL BOTANIC GARDENS MELBOURNE

Motivation and Context

Case 2 focused on the design of digitally guided fieldwork for teaching landscape history to postgraduate students enrolled in the subject 'History of Landscape Architecture' also at the University of Melbourne. A pre-existing fieldwork exercise based on a lecturer-led tour of the Royal Botanic Gardens Melbourne (hereafter 'the Gardens') and surrounding parkland was redeveloped through the creation of an iPad app *Landscapes in Time* (see Figures 4 and 5). The app curated audio commentary, current aerial photography, plans, historic images and film footage relating to 13 designated stops on a walk through the gardens. Each stop reveals a different historic aspect, while the walking journey between locations was equally important in communicating larger historic narratives. The intention was to engage the students in aspects of physical change in the shapes and forms that constitute a historic landscape as well as the absences or hybridised forms that would otherwise remain elusive without some directed and conceptual learning. The aim of the iPad tour was therefore to promote new ways of learning in a group field activity conducted over a large land area.

Figure 4. Case Study 2: Students using the 'Landscapes in Time' app to view images and listen to audio in the Royal Botanic Gardens, Melbourne.
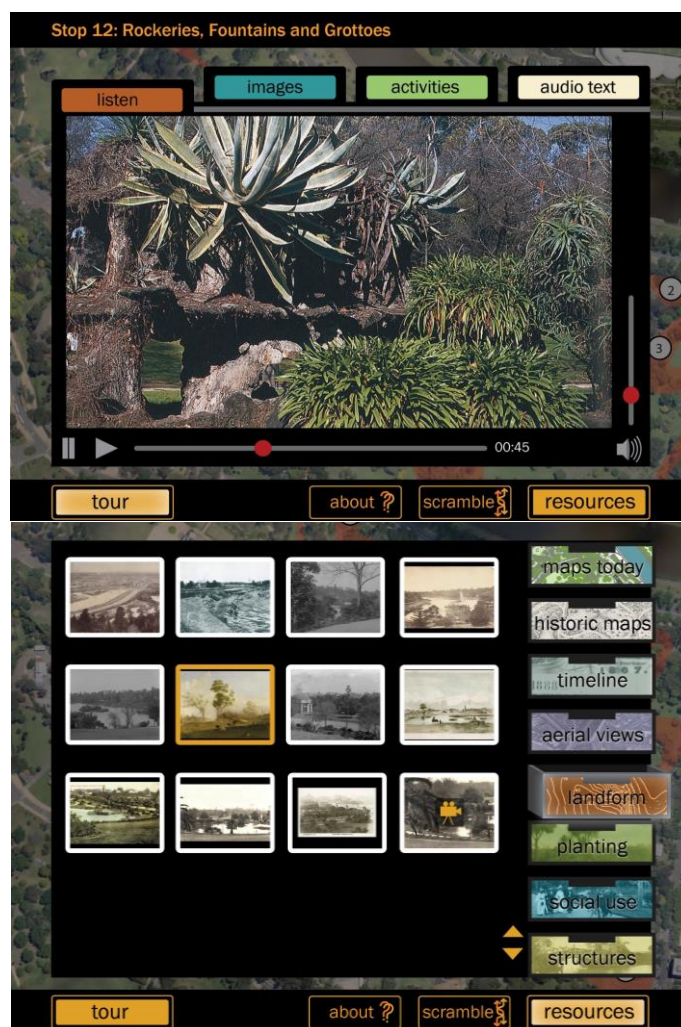
Figure 5. Case 2: Screens of the 'Landscapes in Time' app, showing main view for Stop 12 with tabs to key resources (upper), and supplementary information provided in archive 'drawers'(lower).

The act of walking was identified as of great significance in this learning activity. As has been argued elsewhere (Lewi, Saniga & Smith, 2014), walking through landscape combines physical and sensorial stimuli with way-finding and unexpected experiences. The Gardens are a nineteenth-century picturesque creation, formed around the idea of strolling through a romantic garden. Aspects of foreground, middle ground and distant background that underpin picturesque design principles guided the choice of stop locations; the directing of views and the spatial sequencing of stops attempted to reveal glimpses of garden elements and follies that beckoned students to further seek and explore. This echoed the original design premise for the Gardens. An 'aestheticised navigation' thus became the *modus operandi* for digitally augmented and situated learning that combined an awareness of the history of the design with the students' own experience.

In delivering this mixed–media resource *in situ* and in a historically inspired manner, we also identified the need to create a sensory dialogue rather than an academic monologue, or as Paul

Carter evocatively expressed in another context; 'the need to augment the eye with the ear: the fluctuating air that looks like a mirage may be vibrating with a message…' (Carter, 1992). This required a balancing act between cognition and affect, and an appreciation of the potential for landscape experience to be shaped by an array of natural materials and ephemeral environmental conditions (Knopf, 1987). There was a need to find a balance between harnessing the seemingly boundless content delivery capacity of digital technology while not dropping students in an encyclopaedic abyss, thus we attempted to curate the gradual release of data in line with the choreographed walk. A key aim was therefore to facilitate direct experience grounded in the multi-sensory information of the space, sounds, textures and smells found in the Gardens, whilst also instilling historical information and an appreciation of historical time.

Achieving this balance was a focus of reworking the mobile guide and associated resources over three years, and three deliveries, of the exercise. Central to this was the gradual development of a paper-based workbook of questions and drawing tasks to be used by each student individually in parallel with the group use of the app. Prescriptive instructions and tasks included prompts to aspects of the scene and how to record information in creative ways. This included drawing impressions of objects or materials in the landscape and the making of frottage, alongside more objective (yet equally immersive) tasks such as completing a measured drawing. These assignments were envisaged also as a decoy for chance encounters and serendipitous activities as students explored the picturesque setting. In the final analysis it became difficult to gauge the extent to which the digitised historical environment shaped personal experience or engendered imaginative experience, but students' work certainly indicated reflective appreciation.

Observations

Direct observations of groups of students at work in the Gardens were carried out, supplemented by informal interviews and a comprehensive questionnaire completed after the exercise. Table 3 shows the overall reception of the exercise in student survey ratings. Similar to the findings in Case 1, around half of student found it 'very' valuable while half found it only 'somewhat' valuable. The student focus group suggested that their answers to this question related to the perceived 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 Years 2 and 3, 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.

Overall dimensions of reception		Student ratings (% of respondents shown)				
		1(low)	2	3	4	5(high)
Value for learning about the subject	Year 1 (N=12)	8.3	0	41.7	41.7	8.3
	Years 2 & 3 (N=29)	0	0	40.7	55.6	3.7
Enabling appreciation of the Gardens in new ways	Year 1 (N=12)	0	0	16.7	41.7	41.7
	Years 2 & 3 (N=29)	0	0	6.9	41.4	51.7
Value for completing assignment	Years 2 & 3 (N=29)	0	3.6	14.3	57.1	25.0
Enjoyable	Years 2 & 3 (N=29)	3.6	3.6	32.1	53.6	7.4

Table 3. Case 2: Students' 5-point ratings of the value of the 'Landscape in Time' tour, its enabling of new appreciation of the Gardens, its value for the assignment work, and whether it was enjoyable.

An acute challenge that emerged through student feedback on the first iteration of the iPad guide was the lack of an engaging presence of the lecturer as a guide. This absence contrasted greatly with the lecturer's normal presence and depth of interaction in other class exercises. In response, and after some experimentation, we realised that the problem lay partly in the formal nature of the professionally recorded audio component of the lecturer's narrative. In later version of the guide, this was replaced with intentionally informal and somewhat 'rough' video and audio material at each tour stop, recorded directly in the Gardens by the lecturer, using the iPad. This technique succeeded in better invoking a sense of immediate presence – more so than the polished pre-scripted audio. Each stop's video narration also became a teaching tool for thinking about the variability of incidental on-site conditions, as each student's own personal views and environmental experience was different, and this heightened potential appreciation of the contingency and uniqueness of physical reality in the Gardens.

Ultimately, as with Case 1, the *Landscapes in Time* app succeeded insofar as it provided a key element in a package of resources to guide students' exploration of a landscape. Despite the challenges and difficulties it raised in development and use, it was generally well received by students and provoked a new dynamic mixing of modes of delivery, creatively experimenting and applying historical knowledge within the contemporary situation of the Gardens.

CASE 3: URBAN CONCEPTS IN THE FIELD – AN ACTIVITY FOR DESIGNING AN APP IN THE CITY OF SYDNEY

Motivation and Context

In contrast to Cases 1 and 2, Case 3 involved asking Masters students of urban design at the University of Sydney to conceptualise and propose a sketch design for a mobile app that would serve to express the ideas of a selected key urban thinker; by choreographing visitor activities situated in the city of Sydney (see Figures 6 and 7). This task was part of a larger 'Concept Guide' assignment for their chosen urban protagonist. Complementing the historic emphasis of Studies 1 and 2, the activity aimed to develop student reflection on the interrelationships between theory and its emplacement in the local urban environment. The intention was to foster students' appreciation of the descriptive, analytic and projective possibilities of theory (e.g., Dunphy & Spellman, 2009; Kent, Gilbertson & Hunt, 1997). Further, by asking students to themselves design a mobile app, based on their field investigations of an urban area, was intended to scaffold the ability to recall theoretical models and definitions, and to test student knowledge and critical reflection in real sites; a skill seen as pivotal for the broader field of professional practice education (Lee, Dunston & Fowler, 2012).
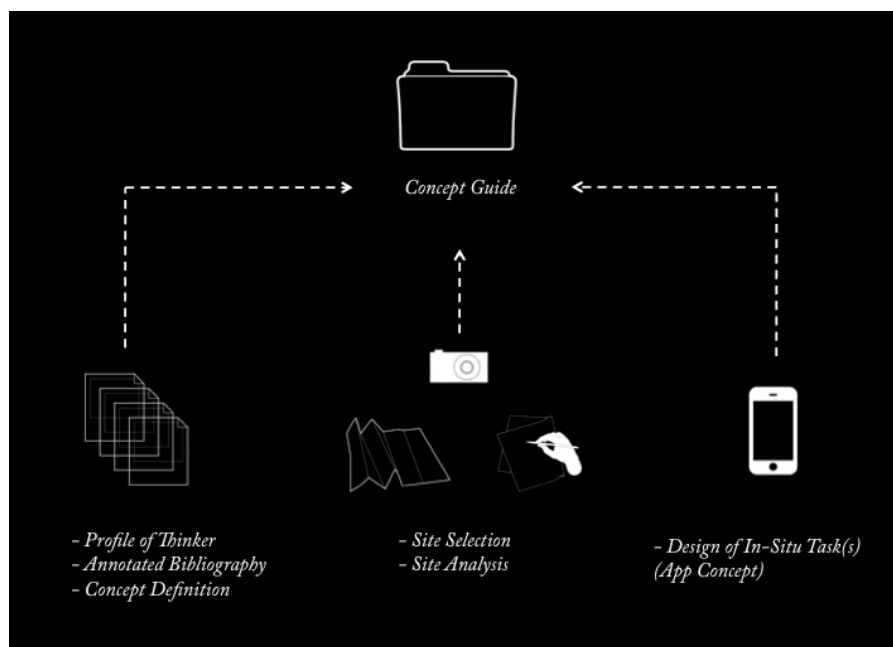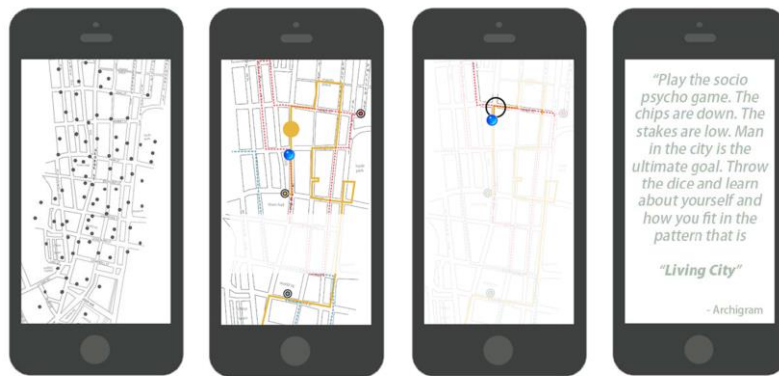

Figure 6. Case 3: Structure of the 'Concept Guide' assessment task.

Figure 7. Case 3: Two examples of student work.

The method of the learning task was for students to create screenshot mock-ups of their proposed mobile app in action, a technique of early prototyping borrowed from the field of interaction design (e.g., Snyder, 2003). Framing students' thinking about content creation in relation to mobile devices, as part of a fieldwork activity, was introduced as a potentially powerful way to inculcate and reinforce the linkages and relevancy of theory, along with exploring new modes of design thinking outside their typical experience. With this in mind, we were particularly interested to explore an alternative to more conventional blended learning modes that deliver mobile technology as an adjunct tool already preconceived by the lecturer (Hall, 2013). Instead, this third case study aimed to develop an innovative technique

for fieldwork using the potential of mobile device design as a context for the development of deep thinking, rather than thinking of technology as simply a mode of delivery or a proxy instructor.

Students were given the task of designing a mobile tool and app that would reinforce a particular theoretical framing around their chosen urban thinker for field observations in Sydney, and build-in a mechanism of reporting their analysis back to the lecturer and peers. Each student conceptualised an app that could guide a user through a set of tasks in order to improve understanding of theoretical concepts in the field. Examples ranged from architects and landscape architects, to sociologists, planners and urban designers. These included Danish architect Jan Gehl whom students associated with concepts such as the categorization of 'necessary, optional or social spaces'; American activist Jane Jacobs, associated with ideas such as 'eyes on the street'; the Japanese architect Kisho Kurokawa's concepts of urban 'symbiosis' and 'flexibility'; and Archigram's speculative proposals for 'Instant and Plug-In Cities'. The fieldwork tasks involved directed observation as well as the production of multimedia interpretive or analytical materials to demonstrate understanding (via methods such as drawing, photography, writing, interviewing). Instructions and, in some cases, schematic designs for an app interface were developed by students that aimed to be readily usable, creative and relevant to the concept. An emphasis was placed on developing and testing text, image and diagram assemblages that would be effective in small-scale digital formats while moving around in the field.

Observations

Evaluation of the study was made through observational diaries, post-field reflections and analyses within a classroom setting, and student surveys and interviews. One of the challenges identified in the conception of a mobile app as part of the 'toolset' for the subject was the significant additional resources required; both expertise and time beyond typical curriculum development. In the focused questionnaire, students overwhelmingly felt that these components were 'quite' or 'very' important (Year 1: 75%, N=18; Year 2: 75%, N=14). 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."

Our observation over the two iterations of the study was that students found developing the "instructions"/app sketch helped improve their understanding of their chosen concept of urban thinking. They saw it as a challenging but compelling exercise. In the focused questionnaire, the majority of students found this part of the assessment task 'helped somewhat', while a small percentage (Year 1: 8%, Year 2: 25%) found it 'helped a lot'. No student reported finding 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 broader evalution of the whole unit of study, one studen's comment about the innovative quality of the exercise expressed a 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".

A key lesson learned was the importance of the activity as augmentation of the learning experienced in lectures and tutorials. Students almost unanimously found the app design and fieldwork to be "most relevant", and they felt strongly that "apps should be used as an additional layer of learning". The results of Case 3 also supported Farman's call for an approach that is 'less about the devices, and more about an activity... which is a practice of embodied space in the digital age' (Farman, 2012). Student feedback and staff observations during the study positively reinforced the assumption that there was great value in the intellectual, affective and physical intensity of engagement generated by imagining apps, rather than using actual devices enabled with data access or tours. The results point to the value of continually and creatively questioning the pedagogical framing of learning activities including those engaging new technologies.

DISCUSSION

We turn now to what our three cases reveal about mobile-inspired fieldwork in architectural education. The findings can be divided into two areas. First, we consider to what extent and in what ways the mobile tools, in the form of mobile guide apps in Cases 1 and 2 and in the form of design concepts in Case 3, enhanced an exchange between the classroom and the field. Second, we consider less anticipated findings about how the very process of designing and re-designing mobile-inspired fieldwork was itself a significant act of learning.

On the first area of findings, in all three of our studies we found that mobile supported fieldwork became, in different ways, a very valuable tool for assisting in the interpretation of the physical environment and the students' experience of it. And, consistent with much previous research (e.g., Sharples et al, 2002), our mobile activities did indeed encourage the sharing of students' interpretations of the environment through different mechanisms. The mobile-learning activities that we created became a 'coordinative glue' that connected formal face-to-face learning on the campus with more informal group and individual field learning activities (Siemens, 2005). In Case 1, this was seen in the adaptation of the traditional format of comparative illustrated lecture, from conventional art history education, to an iPod Touch guided walk that was directed towards interpreting specific places and buildings. In Case 2, the fieldwork notebook assignment that was embedded in the *Landscapes in Time* iPad app created a valued presence of the absent lecturer in the field, as a guide to observing and

experiencing landscape. While in Case 3, the task of designing a mobile tool was given to students themselves to create a theoretical scaffold for field observations and experiences, and to create a mechanism of connecting analysis back to both peers and teachers. On the immediate outcomes for learning, therefore, the overall findings confirmed our belief as teachers that mobile tools, serving as guides to places in Cases 1 and 2 and their use as objects of design in Case 3, can bring positive interventions in the place-based learning of architectural and landscape history, and urban theory and design.

Our second area of findings is more retrospective and contains insights that were more surprising for us. These concern the process of developing the three interventions, or what might be called the process of blending the various learning resources. Particularly in Cases 1 and 2, the development of the tool and related activities became an extended process over a period of three years, over which time both tools and techniques were iteratively evaluated and refined. Conducted as research projects into teaching, we realized in advance that the studies would involve a range of evaluative activities from informal piloting, technical support, impromptu student feedback, and also formal systematic evaluations carried out by us and by our institutions. But we did not anticipate that through all of this, the students, tutors, and teachers would effectively become *co-creators* of the blending learning. So while we had planned Case 3 as our attempt to explore students acting as designers within the frame of mobile technology, in practice students in Case 1 and 2 also took on significant elements of this role. And while this was productive in many ways, it also opened up tensions and differences of viewpoint about the value of the tool, and the value of fieldwork generally, and the learning objectives of the subject itself.

One of our earliest observations was that students got drawn very quickly into co-creation because their support was needed in solving various practical challenges; such as the management of procedures for borrowing and re-charging devices, ensuring consistency of data, and testing across different mobile operating systems. The input of students was not simply in pointing out problems, but was in suggesting fixes with detailed information about what was needed; for example, achieving appropriate audio volumes against background noise, a point that is hard to achieve until tested *in situ* under real fieldwork conditions; and, ensuring the legibility of text and image sizes against the glare of outdoors conditions and the availability of shaded areas in particular field sites.

Having been drawn into this pragmatic level of design, students were then well-positioned to advise on other aspects of the learning process, and thus the mobile technology quickly became a site of exploring not just usability but also pedagogy. For example, mobile devices offer the potential to present encyclopaedic volumes of information to the field task, and students generally expected this, and many in Case 1 were surprised to encounter our approach of providing only a small number of carefully selected images to compare with built realities. Our view was that great volumes of content may seem valuable, but they risk

distraction and over-focus on the technology relative to the field environment. This remained an ongoing difference of viewpoint and although we made adjustments in the volume of content, we retained our position based on observations of student behaviour with the apps; so while the iPad of Case 2 provided 'drawers' of supplementary image and video material (Figure 5), they were not used much by students who concentrated on the primary images that were relevant to the assessment tasks.

Student design input was not just through informally voiced feedback, but also came through the formal evaluations. In Studies 1 and 2, students were clearly most engaged by visual digital content that showed details that they could search for in reality, with intermediate engagement achieved by interior and historic images of the sites, and least engagement with comparison buildings or design plans from elsewhere. Similarly for audio commentaries, content was more engaging when it took the form of directions to look at present features, and less engaging as background historical information. Having observed this effect strongly quite early on, we were able, in subsequent iterations, to reinforce the approach of directed looking and listening through the apps, as opposed to less situated acts of informing.

Another example of co-creation concerned the chosen genre in which material was delivered, which might follow a number of established formation: traditional lecture, guided tour, museum display, heritage interpretation sign, or laboratory note-book. In the first version of the iPad app for Case 2, a formal lecture-style of rehearsed audio delivery was used unintentionally by the teacher who recorded them in a studio. This was received with some surprise and consternation by students who found it incongruous with the immediacy and variability of a field situation, and inconsistent with face-to-face interactions with the teacher. In the next more successful iteration, material was recorded by the same lecturer but now while moving through the field site, speaking in the informal style of a tour guide and recorded directly to the iPad using the video function.

A key area for contesting the form and content of our interventions was around the clarity and guidance for field activities. The experienced teachers in our case studies, who all recognised the need for clarity of instructions, were still surprised by the extent to which students could feel daunted by the perceived open-endedness of field exercises without a member of staff on-hand to clarify. And so the framing of field exercises was continually strengthened across all iterations of our studies. This included more briefings, demonstrations, in-device instructions, and so on. For Case 2, for example, later iterations included detailed instructions around the division of labour in the student teams. Critical also, was the need for debriefing of the field activity as soon as possible afterwards, so that uncertainties could be voiced and discussed. In Case 1, the walking tour was given a dedicated follow up tutorial in which student responses to the quiz were discussed. For Case 2, the debrief was through a focus group discussions held as part of the research, but it was realised that this needed to continue in future normal deliveries of the exercise. In Case 3, a later iteration of the exercise was improved by

providing new and very clear boundaries around what was to be included in the activities through guidelines and resources such as templates.

More significantly, during pre-briefings and demonstrations of the mobile tool and exercises, it became natural and productive to share with students the pedagogical thinking around the use of the mobile technology, including the teacher's beliefs and intentions about the value of the learning experience. In Case 2, the tour guide app was initially and mistakenly 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.

Although not completely prepared for the form of co-creation invoked by our investigation, we had nevertheless expected to learn and revise from student feedback. For this, we adopted a strategy, common in the field of interaction design (e.g., Snyder, 2003), of minimal technology development initially. That is, to start by delivering a form of a mobile tool that is just sufficient to evaluate if the teaching and learning intentions are viable; with simple content and a simple form of the target activity. In first iterations, students were given some materials in paper-based form, such as instructions or answer sheets, thus giving us plasticity to rework our materials. While generally appropriate, this approach had drawbacks and in both Cases 1 and 2 led to a proliferation of separate tools, both digital and physical, that students needed to have with them to complete the exercise. In Case 2, in particular, the use of a digital iPad guide plus a physical workbook was felt cumbersome by some students who called for more integrated digital support for their assignment work.

It was through these exchanges with students that we faced questions that were at once practical and profound, about the blending of activities between lecture theatres, landscapes and cityscapes. What reasons were there to juxtapose lecture-room slides against reality? How should different digital and physical tools be coordinated when documenting a landscape? What interaction style would best communicate urban design concepts to a public audience? And so, through an extended process of co-creation it became evident that the value of the mobile tools and apps was not simply in their function as learning resources, but lay more perhaps in them working to encapsulate and contest approaches to teaching and learning about architectural sensibility.

So, in conclusion, our three case studies confirm the view that digital guides and mobile applications can create valuable opportunities for students and teachers of the built and designed environment to 'explore new modes of interaction' and to extend traditional sources and approaches to learning (Coyne, 2009: 130). But more significantly, to return to the comments of Hardy (1996) reported in the Introduction, these three projects in mobile-inspired fieldwork witnessed deeper forms of 'observation', of awareness and interpretation of these historic and urban landscapes where the fieldwork was staged. This was partly through the intended use of the digital tools in field activities, but even more it was through a sense,

experienced by students, tutors and teachers alike, of participating in a collaborative design effort that led all concerned to confront the deeper issues about what kind of observation and interpretation is demanded when bringing the learning materials of the classroom out into the world.

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