EMPLOYABILITY ISSUES: EQUIPPING GEOGRAPHERS TO LEAD IN A LOCATION-BASED, NEO-GEOGRAPHICAL WORLD

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ABSTRACT

The increasing importance of GPS-enabled devices and spatial technologies creates a need to ensure our geography students are exposed to contemporary spatial matters in society. Further, there are opportunities to equip a minority, either conceptually or technically, to contribute to this mobile, spatially-expressed, future. This paper focuses on a set of pedagogic interventions in which skills with mobile geospatial technologies have been embedded within the curriculum via a series of practical exercises across a range of modules and levels. We look at the benefits and implications of these curriculum changes from the perspectives of both staff and students who have been involved in the developments. In particular, we reflect on our success in seeking to embed change in such a way that mobile technology facilitates and enhance student learning in *both* GIS *and* other strands of the discipline.

Using the model of Riley (2007) to structure our arguments, and using evidence from students' reflective diaries, we conclude that our integrated curriculum strategy has considerable potential. In exposing our students to mobile GIS in an applied setting we do appear to be broadening their GIS training via a mode of active learning that is encouraging engagement and reflection. Further, reflective diary entries show that students are becoming better able to weigh up the pros and cons and future potential of mobile technologies; skills that will contribute to their employability. From a technical perspective however, it still remains the case that working with and communication between multiple technologies creates an overhead that can distract from applied learning tasks for novice students. We remain aware that there is much still to be learned, but see recent and unprompted staff interest as an indication that momentum is increasing towards embedded curriculum change.

Key words: Mobile technologies, GPS, GIS, curriculum change

INTRODUCTION

The emergent geospatial technologies industry

Geospatial technologies, a term that encompasses Geographic Information Systems (GIS), Remote Sensing, Surveying and Global Navigation Satellite Systems, are pivotal to the development of a broad range of vocations and are forecast to be one of the three biggest growth sectors in advanced knowledge economies. For example, the *Nature* article, 'Mapping Opportunities' identified GIS technologies as "*one of the three most important emerging and evolving fields along with biotechnology and nanotechnology*" (Gewin, 2004). Work by Casademont *et al* (2004) that looks to develop commercialised advanced geographical information services specifically targeted to mobile devices, where users rent map fragments that are downloaded to their PDA (rather than own maps) shows the tip of what might be termed GIS e-commerce using Web 2.0 technologies. More recently, with the development of more accurate GPS (Global Positioning System) systems and wireless technologies, has come the suggestion that "*If time equals money ... then so does position*" (Ordnance Survey 2005); further, it is not only national mapping agencies that are adopting this perspective. Companies such as Nokia are also expressing the importance of geospatial technologies with comments such as *"Navigation is one of the foundations of the context-aware mobile phone. We believe it will be as important as voice capability was 20 years ago."* Sales of GPS-equipped mobile phones by Nokia are expected to reach 35 million devices in 2008." (BBC, 2008a). The increasing importance of GPS-enabled devices and spatial technologies are also expressed in critical concerns regarding the potential economic and/or security issues raised by the possibility of GPS jamming, highlighting both their embedded nature and importance (BBC, 2008b). There is thus a need both to ensure our geography students are exposed to contemporary spatial matters in society, and further to equip a minority conceptually or technically to contribute to this mobile, spatially-expressed, future.

Historical teaching & learning responses

In many Geography departments worldwide, GIS is taught at some level within the curriculum, albeit varying in depth and coverage by institutional specialism. In the main however, learning GIS has historically been a lab based experience that relatively rarely engages in a practical sense with mobile technologies beyond basic GPS units such as the Garmin™ series. From the perspective of those closely involved with GIScience, the opportunities for using GIS technologies both to enhance student employability and to enhance active learning approaches are many. In contrast, we note a considerable degree of circumspection on the part of geographical "experts" towards this approach who suggest that the use of digital technologies in the field is merely to engage superficially with "toys". With this dichotomy in mind, it is interesting to reflect on practitioner perspectives within the field teaching literature and our own experiences seeking to implement our integrated field-technology vision.

There is a current discourse that suggests practitioners are using technology in the field because it is available to them, rather than embedding new technologies to improve teaching strategies. Fletcher et al (2003) for example suggest that the *"use of C&IT is driven by technological developments, rather than new pedagogic thoughts generating novel ways of teaching fieldwork".* The reality is that within recent literature, it is possible to find both approaches that are primarily teaching-led (e.g. Manone *et al*. 2006) and those that are perhaps more technology-focused (Armstrong *et al.* 2005). Further, we should argue that the rationale to incorporate practical learning using mobile geospatial devices within the broader curriculum also has pedagogic arguments related both to active learning in addition to employability. Taking a balanced path between these two points of view, the bigger pedagogic question is how we introduce mobile geospatial methodologies and technologies within the curriculum in a manner that shows their relevance to a wide range of applications without compromising student learning in the application domain itself. That is, we concur that technology should not *drive* non-GIS teaching; rather, the teaching goals should dictate the appropriateness of particular technologies in different settings.

This paper reflects on our work so far seeking to investigate how we might best show relevance in the context of other modules in such way that mobile technology facilitates and enhance student learning in *both* GIS *and* other field modules (e.g. biogeography, geomorphology, urban geography).

MOVING FORWARDS: YEAR 2 BSc GEOGRAPHY CASE STUDY

Recently, via HEFCE funding in the form of the Spatial Literacy in Teaching & Learning (SPLINT) CETL, we have been fortunate to acquire a variety of class sets of mobile units varying from iPods (with digital sound recorders and microphones), GPS enabled PDAs and tablets to a variety of digital environmental sensors and data loggers. These sets of hardware are situated in a context where GIS forms an important research and teaching focus of the Department, allowing leverage in terms of software and expertise. In these matters, we are fortunate, and not all institutions will have such resources to hand. However, many Departments or Universities will have some component of these resources; further, as noted above, GPS enabled mobile phones will soon become a common acquisition of many of our students.

We have developed two distinct ways in which skills with geospatial technologies have been embedded within the curriculum via a series of practical exercises across a range of modules and levels; targeted and detailed familiarisation with mobile GIS and GPS at one level **(**Figure 1), the use of simpler devices in conjunction with neo-geographical tools such as Google Earth and MScape being the other. This paper focuses on the first group of pedagogic interventions. We look at the benefits and implications of these curriculum changes from the perspectives of technically focused teaching staff, traditionalists and to the reflections of students who have been involved in these developments.

Mobile location-based services: BSc Year 2 Techniques in Environmental Analysis
The aim of this module is to prepare students for field courses and dissertation work via practical experience of a range of field, laboratory and modelling techniques and exploratory analyses relevant to the study of physical geography.

Figure 1: An exemplar range of mobile technologies in use by students. (a) Student records GIS features & attributes *in situ*, (b) Using PDAs as a platform for Excel data analysis for sampling in the field (c) Students practice wayfinding and navigating on campus using ArcPad™ (d) Students use ArcPad™ on tablets for biogeography in the field and (e) Example iPod video in support of field techniques

Module outcomes are as follows:

- Perform an increased range of practical field techniques, opening up water quality, water flow, soil moisture, GPS location, soil and air temperature, relative humidity and vegetation density as environmental/geographical parameters a student can measure with increased confidence in other subsequent field contexts;

- Report data and field experiences using both digital (PDA, Personal Data Assistant) and traditional paper media and be able to weigh up which of the approaches work best for them under a range of circumstances;
- Report with greater clarity methods and sampling plans adopted in the field and reflect on the strengths and weaknesses of a particular methodological approach and the resultant data;
- Organise and archive field and laboratory data in a manner that supports short-term data sharing and re-use;
- Perform exploratory analyses and synthesise data sets with increased depth, gained largely through practical experience of theoretical constructs taught within Year 1 but also by practical exposure to further spatial methods;
- Perform an increased range of practical laboratory techniques, opening up scope for either pollution or pollen based analyses as part of subsequent modules;
- Summarise the main approaches to modelling, and be able to build and evaluate a simple deterministic model.

As is clear from this brief, no distinction is made between GIS and other techniques. Rather, they are introduced as part of a set of methods with which the students are expected to become familiar with, both in practical terms and as regards critical issues such as data quality and accuracy and fitness for purpose. Following an initial introduction to the module, students undertook a mobile computing unit over two mornings using the campus and the park behind as geographical domain. This unit focuses on teaching and learning regarding the PDA and tablet equipment, and equips students to download and pre-process base mapping to put on the PDA prior to field work and use the PDA as an aid to wayfinding and to record and upload their locational information. Figure 1(a), (c) and (d) show a number of such campus based activities.

Working from this base, students undertake a full day field skills unit in which they receive basic instruction and practice regarding two options from the following four: How to measuring and analysing water quality, measuring and analysing relationships between vegetation, soil moisture & light availability, measurement & spatial analyses of soil & air temperatures plus relative humidity and levelling. Figure 1(b), (e) and (f) show mobile technologies at work in the context of a range of these applied tasks. This foundation leads to further development of the suite of field skills in an applied context during a compulsory physical field course in Almeria and later through dissertation work and 3rd year optional field courses.

REFLECTIONS

In the course of work integrating GIS across the broader Geography to date, we identify two poles between which practitioners range; the “techie” and the “traditionalist”. In general, the teachers’ voices are considerably more bipolar in comparison with the reflections of the students themselves.

Through a number of student focus groups, reflective statements and general observations, we have evaluated the pedagogic benefits and staff/student attitudes towards the use of mobile GIS technologies in different geographical contexts. The main findings are as follows:

- It is important that the complexity of the technology does not affect the focus of the task. Adequate training and familiarisation classes are essential, as the degree to which students are comfortable with technology varies considerably within a cohort; even very basic skills such as wielding a PDA stylus or tablet pen should not be taken for granted.
- There is a *considerable* scaling up of effort required to move from individual to class use of mobile technologies;
- In order for the pedagogic benefits of mobile GIS technologies to be assessed and embedded across the curriculum, ‘exemplar’ practices that have been thoroughly evaluated are needed. Technical problems adversely affected the students’ opinion of the mobile technology, but

nevertheless students showed clearly that they were able to reflect critically on their learning experience and that the difficulties they encountered would inform their own future independent practice.

- Anecdotal evidence suggests that as staff confidence and experience increases, this has a positive effect on student attitude.
- By embedding the use of tools at the start of the students career, as *de facto* options for consideration (subject to context and appropriateness), they are more likely to become established as the 'norm'. Equipping students to make their own choices regarding mobile technologies (in this case via reflective diaries) appears to facilitate future constructivist learning approaches.
- Students got more out of the equipment when using the more complex functions rather than using the equipment as a 'substitution' for simple field methods.

Looking more broadly at the experience of others incorporating mobile technology and change within the curriculum, our experiences reflect the model of Riley et al (2003) (Figure 2). That is, as individuals (whether teacher practitioners or dissertation students), technology-mediated interactions can prove very effective where there is time to develop skills throughout a particular task. On their own, and with supporting documentation, most students were well able to overcome issues such as signal loss or battery decay effects through unharried practice and master the technology. Equally, a number of staff who do not currently use mobile technology in their teaching do use mobile geospatial devices in their own geographical practice. Developing pedagogic practices that support the teaching and learning of both technical and applied subject matter, adapting tactics and embedding the resultant findings in practice operates on a much longer time scale. In our case, we firstly developed our practices within technical modules before rolling these out into the applied setting reported here; a case of developing pedagogic tactics while mindful of the integrated curriculum strategy that was our longer-term goal.

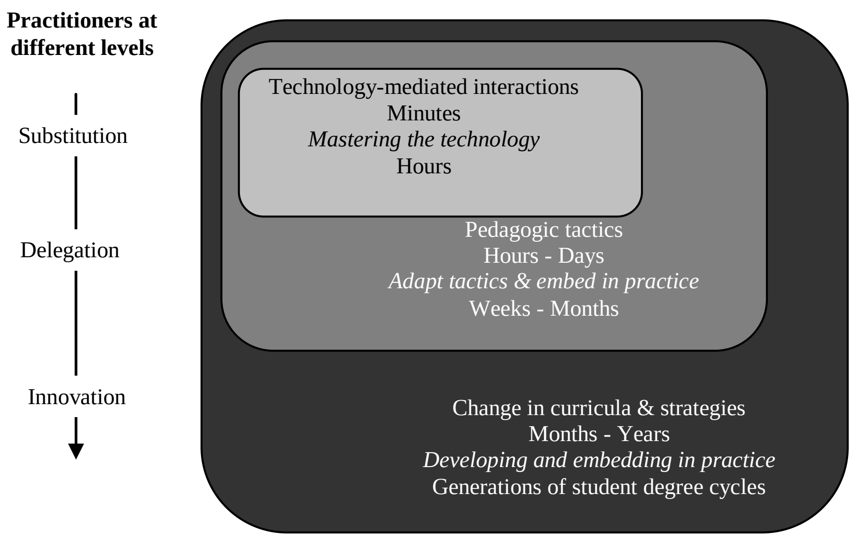

Figure 2: Evolution of change in practice (Adapted from Riley 2007, p86)

Riley's (2007) model suggest that the process of developing new pedagogic tactics operates on a time scale from weeks to months, but in the context we describe here where modules run once per year this span could be regarded as optimistic. For example, scaling issues in the first sessions relating both to Bluetooth interference and the need to support over 40 students at similar stages of technical learning at one time (even with five staff members or demonstrators) proved of a magnitude that was difficult to support to the standard that we aspired to. Building on our experiences with the module described here and commentary from students, and linking with Riley's three levels of operationalisation of change, we adopted a clinic approach to the campus phase of mobile equipment familiarisation for a subsequent exercise with MSc GIS student; a largely well received adaptation of the original approach that allowed students to familiarise themselves with equipment and processes under less pressured conditions than a set practical time. Other adaptations of tactics over the last couple of years have involved logistical matters; a variety of manuals fit for a variety of contexts in addition to targeted practical notes and the development of video podcasts held on iPods designed to encourage the uninitiated or less confident student to try out new equipment or techniques. In some senses, the development of 'pedagogic tactics' is an ongoing, iterative process; a matter of reflective practice.

In summing up, we need to ask ourselves how close to the goal set are we; have we arrived at a place where mobile technology facilitates and enhance student learning in *both* GIS *and* other field modules? That is, have our strategies to change the curricula become embedded? The answer at present is that we believe that the integrated strategy has considerable potential, and that in exposing our students to mobile GIS in an applied setting we are broadening their GIS training beyond the lecture and lab to a mode of active learning that is encouraging engagement and reflection. Further, student reflections show that they are better able to weigh up the pros and cons and future potential of mobile technologies, skills that will contribute to their employability. From a technical perspective however, it still remains the case that working with and communication between multiple technologies (e.g. Bluetooth GPS, compact cameras, PDAs, additional batteries) creates an overhead that can distract from applied contextual tasks in the early stages of learning while the student remains a novice. However, facilitating curriculum changes *across* different aspects of geography in an integrated fashion is considerably more challenging than unitary change. Interest from a wider staff group in our approach is gathering, suggesting that the initial hard work and steep learning curve moving from the early stages of Riley's model is resulting in a trajectory that is genuinely contributing to embedded changes and attitudes in the curriculum. At this point however, we remain aware that there remains much to learn and that keeping up as technologies evolve will require Riley's steps to be performed as a complete cycle, albeit one building deeper understanding with each iteration.

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