Learning and Teaching Enhancement Fund, Wales

Understanding the potential new roles for mobile computer technologies for teaching Geography fieldwork: using GIS and social networking to enhance learning opportunities

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The project investigated how mobile technology can be used to allow new forms of media, spatial datasets, and social interaction to be used within Geography fieldwork to enhance student learning.

1. Abstract: please provide a brief abstract of the project delivered (maximum 250 words).

There is increasing pressure to make fieldwork more effective, given time and financial limitations. Consequently, a wider variety of learning styles should be used to keep students engaged, and increase the content taken from each session. To achieve this it is vital that students are provided the opportunity to move through the learning Kolb cycle, while also catering for differing learning traits. It was this project's intention to help cater for these learning styles by introducing visual, aural, and tactile approaches. The project conducted a day workshop with five students, both undergraduate and postgraduate, to redo fieldwork that was conducted during the previous academic year, but using an iPad to determine any benefits of using this technology. For the workshop a sample information pack, including multimedia content was developed for use on an iPad through a number of applications, including Google Earth, Twitter and Flipboard. Student feedback was obtained from an online survey and a group discussion. Results have indicated that the applications were easy to use and helped provide information in a more appealing format. All students found the iPad useful in the field, particularly for GIS tasks. It is clear from our small sample, that using technologies in the field ensures students are taught through different mediums, allowing students to interface with a number of different learning styles.

2. Rationale: Please provide background context, such as the research / evidence-informed practice context, which provided impetus for the project.

The rationale for this project stemmed from a field course that was led by the authors in New Zealand, in April 2011, but also other field courses undertaken within the department. During these courses it was felt that the use of mobile technologies might have the potential to enhance learning in the field. Traditionally, geography field teaching has primarily been based on a 'stand and deliver' form of teaching, as a member of staff would talk the students through an exercise or information, with support from a printed field handbook. More recently, field centres have Internet connected computers which allow students to undertake further research and be shown further information through different mediums (e.g. video) either at the start or end of the field day. The increasing availability of digital mapping and remote sensing data and the ability to view spatial information at different scales and angles (i.e., 3D) has become the norm with software
such as Google Earth, and the use of these technologies, alongside traditional teaching methods, can significantly enhance students interaction and access to information. Another recent technology, which has gained wide acceptance and use, is social networking, where individuals form wider groups through the Internet sharing information and opinions. Therefore, introducing digital technologies into fieldwork teaching not only enhances learning, but is becoming increasingly essential as technology plays a larger role in how we understand and view our environment.

Some say a picture is worth a 1000 words. Diagrams, sketches, photographs, and maps are used within the field paper based handbooks to provide pictorial support for the materials being discussed. These handbooks provide important support for the student as background information, exercise instructions and as aids to support different learning styles. Students have different learning styles but broadly fall into the one of three styles, visual (like to ‘see’ the material), aural (like to hear the material) and tactile (like to touch the material). Field courses provide great environments to address all these learning traits but it is thought that the use of new technologies could allow further ways of addressing these learning styles. Particularly as tools such as videos (visual and aural) and interactive materials (visual and tactile) could be incorporated into the learning materials, enhancing the students learning experience.

Geographical Information Systems (GIS; the use of spatial data) and remote sensing (the use of satellite and aerial imagery) are often considered, by many geographers, to be independent subjects within Geography, rather than tools to be used in all disciplines of the subject. In some ways this thinking is correct, there are scientists and specialists in GIS and remote sensing, but the majority of GIS (and remote sensing) users would not consider themselves as remote sensing and GIS specialists. Rather they would consider themselves a specialist in their own field (e.g., glaciology or hydrology etc…) and would apply techniques and datasets from the fields of remote sensing and GIS to their own field and this usage pattern is growing.

The integration of digital spatial data within all fields of geography in becoming more important and students will come to expect (or already do expect, in some cases) this type of teaching in the future as digital spatial data becomes evermore prominent in the technology we use on a daily basis. Additionally, companies will expect graduates to be comfortable with these datasets and devices. Already many mobile phones and tablets have GPS and mapping applications embedded and access to this data is becoming the norm. Traditionally, this type of teaching has been undertaken within a laboratory environment with desktop PC’s where field exercises are undertaken using printed materials from the desktop system. The use of the new range of portable tablet computers, such as the iPad, offers new options for using these data in a more interactive ways while there is also potential to present information to students in a more interesting form to increase engagement and to connect theory and practice.

Social networking is one of the most significant phenomenon to evolve in recent years following the launch of Facebook, Twitter, and MySpace, to name a few. Given the significant impact of these Internet tools in the communication and sharing of ideas, it is unsurprising that social networking is a ‘hot topic’ within academic studies. Out of the top 25 papers downloaded on Sociology from ScienceDirect.com, April to June 2011, 13 explicitly discuss social networking or/and Facebook. Given the significant role that these
tools play in students life, the rationale of this study was to see how social networking can enhance learning prior, during, and post fieldwork.

3. Generation of Evidence: Please describe how the research / evaluation findings were generated, e.g. methods used.

To generate the evidence required for this project a one day workshop was undertaken with a number of undergraduate and postgraduate students, during which time they undertook similar exercises to those that would have been undertaken within the field courses they attended in the previous academic year. The students were then asked, through an online questionnaire and discussion, how they felt the use of the iPad and the social networking applications we used would have affected their learning process, and in the case of the remote sensing and GIS exercises, the quality of their data collection and understanding. The workshop included an introductory session to discuss our aims and how the activities of the day fit in with their prior learning experiences on fieldtrips and excursions.

For the social networking activities, an exercise was created to interact with a number of different applications, and to review their use and application. The applications selected to be part of the exercise were Twitter, Flipboard, and Qwiki. Prior to the workshop the activities were conducted for one of the days on the 2011 New Zealand fieldtrip, to visit Waimangu Thermal Valley, as a demonstration of how social media can be used. Subsequently the students went about doing the same activities but gathering information for a fieldtrip around Aberystwyth town centre.

The first stage of the activity is the use of Twitter to gather and share information. Twitter is an online social networking and microblogging service that enables its users to send and read text-based posts of up to 140 characters, informally known as 'tweets'. An account titled @AberNZFieldtrip was set up, and the students were given the password to login to Twitter and copy in relevant data and web links to information relating to Aberystwyth town centre to form a tweet, such as 'History of Aberystwyth: http://www.aberystwyth.org.uk/more/history.shtml'.

Once 20 minutes had been spent finding information and Tweeting the links, the students had time to review the information that had been posted by the others in the group.

![Twitter Account](image.png)

Figure. Screenshot of the Twitter account set up with tweets.
Once the data was in Twitter, it was possible to use an application called Flipboard, to see the data presented in a different format (Figures 3 and 4). Flipboard is a social magazine application designed to collect the content of social networks and other websites and present them in magazine format on the iPad. Users are able to "flip" through their social networking feeds and feeds from websites that have partnered with Flipboard. Therefore a 'magazine' was set up in Flipboard of the tweets issued under @AberNZFieldtrip. Given Flipboard is not available on Windows computers, and is designed specifically for the iPad, the students used the iPads to view the books created.

Figure 3: Flipboard page created by Tweets on @AberNZFieldtrip

Figure 2: Students using Twitter on the Aberystwyth University computers.
Figure 4: Flipbook page created for the New Zealand fieldtrip day in Waimangu Thermal Valley. Note the easy link to video footage.

Following this activity they then used the Qwiki application to look up some of the areas of interest around Aberystwyth (Figure 5). Qwiki is a platform that creates interactive, on-the-fly, multimedia presentations of information. The students experimented using different locations and key names for places in Aberystwyth. As an interactive media, Qwiki provides a different learning environment that adopts maps, videos, photos, and audio to relay information already available on the internet.

Figure 5. A screenshot taken from a Qwiki on Aberystwyth
There was discussion following these activities about the potential use of blogs or photoblogs, as a method of reflecting on a day’s activities in the field. This is a virtual form of keeping a diary that requires the student to reflect on their experiences, what they have learned, and what they think may be valuable for future uses e.g. dissertation ideas. It was therefore requested that they generate a mini-blog at the end of the day using a mock up of Blipfoto to reflect on the fieldwork component on the GIS exercises. Potential applications that could be used given more time include Blipfoto and Wordpress, both free online tools that enable blogging.

The key aspects of the exercises were to aid the students in the 'abstract conceptualisation' and 'active experimentation' (as per the Kolb cycle) through the use of Twitter and Flipboard in gaining and sharing information, and how this information is presented. Additionally the use of blogs as reflection (i.e. Blipfoto), contribute to 'reflective observations' within the Kolb cycle.

For the remote sensing and GIS examples three exercises were created. The first two were both part of a number of exercises which are undertaken with both undergraduate and postgraduate students as part of their remote sensing modules, where they undertake a digital classification of the Aberystwyth area using a satellite image. This exercise is part of the module assessment and also includes two field trips around the Aberystwyth area; this first surveys the area for the students to connect the information provided in lectures to what they can see in the field and the imagery. The second trip is usually undertaken two week later and is to assess accuracy of their classifications and to allow another iteration of the learn cycle to take place connecting theory and practice. The workshop day recreated part of the first field trip, the aim was to increase the amount of information students retain from exercise and to enhance the connection to remote sensing theory. Within the Kolb learning cycle this corresponds to the ‘Active Experimentation’ and ‘Concrete Experience’ steps and strengthening the links to the ‘Abstract Conceptualisation’ step. To do this Google Earth on the iPad was used where the satellite imagery used for the exercise was imported (see Appendix 3) and further information, including key figures from the lecture, and points of interest were added as a layer (see Appendix 3; Figure 6).
b) Figure 6. Screenshot of Google Earth on the iPad a) with a SPOT satellite image displayed and b) with an example of the type of information which can be added to within Google Earth.

It was thought that the ability of the students to interactively ‘pan and zoom’ across the satellite imagery, alongside the high resolution aerial photography and other mapping information within Google Earth and to use the devices inbuilt GPS to locate themselves, would allow the students to more easily connect the landscape in-front of them with what they can see in the false colour satellite image. In addition, it was also hoped that the extra information layers which were provided would allow the students to link into theory and lecture materials.

The second exercise was to test out the data collection capabilities of the iPad. A significant amount of time in the postgraduate field courses is spent recording information about what can be seen in the imagery with respect to the ground cover. This is typically recorded on paper maps, which are subsequently digitised on a desktop computer, again a time consuming step. With this exercise we wanted to test how easy it was to use the iPad to digitise and record the information they would record in the field on paper within the iPad, merging the two field data collection steps.

A third example shown to the students was based on the work carried out on the New Zealand field course. In this exercise information associated with a field exercise, from the paper handbook, was spatially located onto Google Earth as ‘pins’, where examples of the outputs (in this case, section diagrams) where provided. In many cases it can be difficult for the students to understand what is required of them from a particular exercise and a verbal description of what is required is misunderstood or interpreted. Therefore, it was hoped that easy to find (as they are spatially located) examples of the areas the students were studying put in the wider context of the environment, would help the students make the most these exercises. In this case the example was for one from New Zealand so the students were just shown the example and given time to explore the information and were then asked how helpful they would have found it in the field.
In addition to finding out how useful this technology is for the students the study also considered some of the practical implications for both the staff preparing the materials for the iPad and the usability of the iPad in the field (e.g., screen readability). These were tested though our own experiences and observations and the student questionnaire.

The overall aim of this project was to assess the usefulness of iPads for field teaching within Geography. Specifically, we wanted to answer the following questions:

1) Can iPads be used in place of paper based field handbooks?
2) Can social networking be used to enhance learning and understanding in fieldwork, as well as enhance employability skills?
3) Can remote sensing and GIS data be displayed and manipulated usefully on an iPad in the context of University (undergraduate and postgraduate) fieldwork.
4) Does the use of an iPad enhance the students learning experience?
5) Does the use of an iPad encourage students to connect the theory with practice?

In order to analyse the exercises completed two methods were adopted: the use of an online survey, and a discussion. The online survey was conducted via Qualtrics (subscribed to by Aberystwyth University), which enabled a questionnaire to be designed, be available online for the students to individually complete, and provide full analysis (statistical) and reporting, making it an easy tool to use. The questionnaire was designed into two key sections, using iPads in the field with GIS, and the use of social networking. Questions were designed to establish some background information about the students’ experience of using the technologies experimented with, and included both closed and open questions where the students were able to add comments (see Appendix 1 for the questionnaire questions and analytics). Following the completion of the questionnaire, there was a discussion with the whole group to make sure that issues raised in the survey were discussed so to establish differing viewpoints and experiences. The discussion was led by a number of open questions structured around the day’s activities and comments made throughout the day. Notes were recorded during the discussion. The methods of analysis employed in this study are those typically used within qualitative and quantitative analyses.

4. Existing Evidence: Please provide details of research / evaluation evidence drawn on and reported on in the project.

When considering the student learning experience, it is important to recognize that students learn in many different styles (Riding and Sadler-Smith, 1997) and that simply telling them information is not enough for them to truly learn the materials required. To understand and target these styles of learning (or cognition), academics have devised a number of ‘styles’ or categories which can be used to define the dominant and combinations of characteristics which present individuals. One of the commonly used classification is that of Kolb (1984) who outlines a learn cycle (commonly referred to as the Kolb cycle; Figure 7) and consisting of four parts: ‘concrete experience’ this is to undertake or do something to gain an experience; ‘reflective observation’ which is review and reflect on the experience; ‘abstract conceptualisation’ to conclude and learning something from the exercise; and ‘active experimentation’ which is to apply what has been learned. This is a cyclic process where following application the learner returns to the concrete experience part, through this process the learner refines their knowledge and increases their awareness of the issues surrounding the topic. From this cycle Kolb (1984) defined four
learning styles: 1) ‘Diverging’, which is to feel and watch something, 2) ‘Assimilating’, which is to think and watch something, 3) ‘Converging’, which is to think and do something and 4) ‘Accommodating’, which is to feel and do something. These learning styles are designed to move the learner through the Kolb cycle while also catering for differing person learning traits.

Figure 7. The Kolb cycle.

Honey and Mumford (2010) built on the work of Kolb (1984) in developing their learning styles theory where learners dominantly use one of the following learning styles, although some can use multiple styles in combination:

**Activists** - like to be involved with new experiences and developing new ideas but get board implementing then.

**Reflectors** - like to stand back and look at the situation from different perspectives and collect information before coming to a conclusion.

**Theorists** - like to adapt and integrate observations into complex and logical-sounding theories and think through problems step by step.

**Pragmatists** - like concepts that can be applied to their job and are eager to try things out.

When designing learning activities it is important to bare these traits in mind and to cater for each of these individuals through the presentational material. This is linked to the sensory-based learning considerations which states that learners are fall into one of the following categories:

**Visual** - like to ‘see’ the material. Presentations with diagrams and visual content (e.g., PowerPoint) support these learners.

**Aural** - like to hear the material. Presentations were the material is presented in a spoken form (e.g., lecture) supports these learners.

**Tactile** - like to touch the material. Material which has a physical interaction (e.g., note-taking or laboratories) supports these learners.
Graphical Information Systems

Graphical Information Systems (GIS) are the method by which spatial data is stored and manipulated with a computer system. Within geography GIS represents a key skill students should be gaining from their degrees (Sinton, 2009) and has many applications from visualisation to geo-hazard risk assessments. Additionally, as the world has become ever more computerised, the number of careers within GIS has grown and is expected to continue doing so into the future. Therefore, the integration of GIS into the institutes curriculum and quality of its teaching is an important consideration going into the future.

GIS is inherently a practical subject as students visualise (usually through maps) data they’ve collected, manipulated and interpreted using the GIS software (e.g., ArcGIS). Through this process they develop key skills, such as spatial awareness, problem solving and cartography, but GIS also has a theoretical side relating methods of data storage and data manipulation onto the computer systems. Curricula for GIS and methods for combining and connecting practical and theoretical teaching have been extensively discussed within the literature (e.g., Nyerges and Chrisman, 1989; Kemp et al., 1992; Walsh, 1992; Obermeyer, 1993; Sui, 1995; Wright and DiBiase, 2005). Although, continuing problems have been noted in the preparation of students’ for independent work in research and employment (Montagu, 2001).

Social Media and Networking

There is a growing literature within the Geography, Earth and Environmental Sciences (GEES) communities reviewing the role of using technology in the field including the 'Supporting fieldwork using information technology' conference, held in 2006 at the university of Plymouth (Maskall et al., 2006). However, there was little focus on the role of social media. France and Fletcher (2007) reviewed the role of E-learning in the UK using the perspectives of GEES practitioners. One practitioner stated that e-learning can 'maximise opportunities for offering teaching support to students who may be dispersed in time and place. It increases flexible delivery of teaching and learning, increases opportunities for collaborative working and group work, and widens accessibility' (France and Fletcher, 2007, p.3). These benefits would be particularly applicable during fieldwork, however their findings indicated there were a number of barriers to realising the teaching and learning benefits of e-learning, including concern over the time required to develop new materials, and a limited technological and pedagogic knowledge. It is therefore suggested that social networking sites can be used for e-learning without the need to develop new materials, and using existing software, and also to develop a greater understanding of the pedagogical implications of using social media via numerous recent publications (as discussed above).

The advantage of using social media as a learning tool is that students may already be familiar with it. Consequently they may be able to incorporate new learning styles (via audio, images, video), and by sharing data in groups it is possible to inclusive in the learning process. Social media can be used as a form of assessment. A study by Selby (2009) reviewed the role of Facebook as a support tool for teaching Earth Sciences. Establishing a group on Facebook for his class, findings indicated that this interactive online group can aid in breaking down threshold concepts, and enhance their own learning via posting additional materials. It is therefore implicit that developing Facebook as an e-learning educational support tool for modules that include fieldwork.

Elkins and Elkins (2006) showed that the use of technology in the field cannot only save time out in the field by being used when travelling, but additionally enhanced student
observations, and encourage interdisciplinary learning. With the event of smart phones, and now tablets, there are an increasing number of applications that are used by many students, which are freely accessible, and usable of their mobile phones. This projects aims were to investigate some of the latest applications available for portable and static technologies to understand how they may be used for a fieldwork module. These tools can be used for fieldtrip preparation, during the fieldtrip, or for post analysis.

This project builds upon these studies looking specifically at social networking applications and obtaining feedback from students who use the applications as a method of gauging their value in the teaching cycle.

5. Outcomes of research / evaluation evidence and the implications for policy and practice: Please identify any application or outcomes of research / evaluation evidence and details the implications for policy and practice for different stakeholder groups such as: academics, practitioners, professional developers, senior managers, policy makers, students, sector organizations, employers and professional bodies. Please also use this section to reflect on any lessons learnt and potential of the project’s transferability (eg. to other disciplinary areas).

To assess the effectiveness of the project an online survey was undertaken with the students, the questions and answers of this questionnaire are shown in Appendix 1. The field diaries produced are shown in Appendix 2.

From the questionnaire it is evident that the students felt that the iPads were a real advantage for fieldwork, particular for displaying and manipulating mapping data when compared to paper maps. The students did highlight the problems with sun glare on the screen of the iPad. The workshop was conducted on a particularly sunny day in Aberystwyth, which contributed to the problem, but it certainly requires consideration. One of the iPads had a matt screen protector which helped to reduce this problem but did not completely solve it. In the future with new technologies it is expected that these issues will be resolved, for example the black and white screen of the Amazon kindle is still very readable in daylight but does not allow colour or the multimedia content to be displayed.

The students also felt that the availability of Google Earth while with the field and in terms of planning fieldwork activities was a real advantage, mainly owing to the high resolution imagery which is commonly available. It was also felt that the extra information which was shown through Google Earth was very useful and particularly as it was shown in the context of the local area to where the information is useful so students did not have to search through a handbook to find it. Alongside this they stated in the discussion that the inclusion of a GPS with the iPad was a strong selling point, particularly when trying to interpret the false colour satellite imagery, which to an untrained eye can be difficult to locate yourself.

When ask how they would feel if this information was provided though a mobile phone (such as an iPhone), as individual students were more likely to own one of these personally, the students felt that the restrictions in screen size and display resolution would hold back the usefulness of the applications, particularly for the mapping exercises. They felt that it would be ideal for each student to have individual access to an iPad to make full use of the functionality and features available but said that even if they were only available as one per
group (of 3 or 4 students) they would still provide a very useful addition for their learning experience.

It was also pleasing to see that the students felt that the extra information prompting them on the theory introduced within lectures would help them to connect this material to that which is shown to them with the field. Which, as stated in the educational literature is a significant problem across the fields of remote sensing and GIS.

The postgraduate students in particular felt that the ability to be able to digitise information while in the field would have made their lives much easier while undertaking their fieldwork. They also thought that it would have saved them a significant amount of time on the desktop computer inputting their field notes. When asked whether they thought it would take more time out in the field, when compared to taking notes and drawing on paper, they said it probably would but that with the use of the GPS and being able to manipulate the imagery within the field that the quality of their field observations would probably be higher and more accurate so they felt it would be time well spent. Following discussion we felt it would probably add 20 to 30% more time in the field to digitise the information using the iPad compared to pen and paper.

The online survey established that all students had used social networking prior to the day's activities. All students found Twitter, Facebook, and Flipbook easy to use and a good way of finding, recording, and viewing information. Additionally all of the students felt the activities relating to social networking enhanced their fieldwork learning. This is quite an extraordinary result although it is clear that 'they don't necessary enhance [fieldwork learning] but with good lecturers they could hugely enhance. It needs to be alongside good work documents in whatever format and well planned trips' (student 1). Equally another student stated that social networking 'allows you to find out about an area you are going to visit before going there, and sharing links saves time if everyone is looking for the same information' (student 2). Consequently it is clear that if social media is thoughtfully used by lecturers, students can enhance their learning, plus benefit from the research and collaborative work of other students in the class. In some respects it seemed that the students were surprised that social networking activities like Twitter 'can be a good thing to be incorporated into Flipboard in order to display useful articles and data' (student 3). The Flipboard application was positively received and the students found it potentially a very useful resources 'to summarise a lecture topic' (student 4). Blipfoto seemed a less popular application for some of the students. This may be because they do not understand the value to reviewing a day's activities and making note of what was learnt. It may be that other blogging website would be easier to use.

Feedback on using iPads for social networking indicated that although none of the students had used an iPad before, the students on the whole found it 'really easy to use (seems instinctive)' (student 4) and that applications 'seem interesting and very broad in scope' (student 4). There was concern that there may be 'potential over-reliance on the iPad in terms of less group discussions and less social activity. Additionally students 'who have no use or willingness to try these things, would struggle and be unwilling' (student 1). Additionally student 1 recognises the increasing role that technology is playing in business and consequently they would be learning skills that make them more employable.

There are a number of advantages that the iPad offers, they are a 'very quick way of
displaying data’ (student 4), 'allows access to more information when in the field, which you
may not have thought about beforehand’ (student 5), and provide an 'easy portable and
interactive way to enhance survey work’ (student 2). The iPad offers a greener technology
rather than printing out lots standard field handbooks, and 'can be a good tool for
presentations’ (student 4), particularly in the field when given by a lecturer.

More generally, the students found the iPads easy to use and the user interfaces intuitive, in
fact one student said it 'seems instinctive'. This is a major pull to the iPad as it is very
straightforward to use as its intended and requires minimal user training which means
students can concentrate on learning the materials rather than the devices. Although, one
did highlight that the iPad 'can also be a distraction from work due to the easy accessibility
to internet and other apps' (student 3). As with all devices which have multiple uses (such
as mobile phones) they can also provide a destructive influence to learning when used
inappropriately and this needs to bared in mind if this devices are going be to used with
students.

From the our point of view, as teaching staff, we found the iPads very easy to use and most
of the applications we tested good and intuitive but there are some exceptions within the
appstore and in some cases there is no way to tell which apps are the good ones until you
have bought it. Therefore, research on app review websites and reviews within the
appstore were found to be very useful and relied on to guide the apps which were used for
this study. The problems of using the iPad in strong sunlight is significant and will hold back
some uses of the iPad in the field, particular for many remote sensing and GIS applications.
It is also worth noting that the iPad requires a data connection for many of the applications
to work, some of this data can be cached by the application before hand or stored locally
but where data does need to be download to the iPad in the field this can be expensive,
particularly when outside the UK.

The growing recognition of social networking as a tool for improving teaching and learning
is likely to result in an increasing number of applications for teaching, or adapting current
applications for a wider range of uses. Therefore this study provides some initial ideas on
the use of applications for teaching and learning, but it is expected that the current
limitations may cease to exist in the future. The iPad is increasingly encouraged in academic
environments (see apple links in the links section below), in particular for medical students
and practitioners, given their portability and ease to access information. Therefore it is
feasible that iPads and associate applications could become a key part of fieldwork in future
years.
6. Research findings and new evidence: please describe any new findings or evidence reported on in the project.

The key findings of this study have been:

- The iPad provides a useful tool that the students enjoy using, for disseminating information to the students within the field, catering for multiple learning styles.
- The applications for interacting with social networking services such as twitter are easy to use, and although they have some limitations, are ready to use now.
- Many of the remote sensing and GIS applications are good at displaying data provided by the application developers for consumption but are limited or have significant weaknesses when it comes to putting your own data into the applications or recording information in the field but are still deemed to be highly useful.
- Currently, iPad's provide a very useful addition to the tools which can be used teaching within the field but many of software applications currently available and reviewed in the project are only suitable for specific tasks or exercises and as yet cannot replace the paper field handbooks currently used. Although, with further development applications similar to Flipboard could be used in this way.
- In outdoor environments the readability of the screen is significantly decreased, particularly on a bright day. With matt screen protectors this can be improved but is still not ideal.
- The students found the iPad easy to use with minimal time to learn the user interface even though a number of them had no experience with an iOS device.

7. Impact: Please describe the impact of the project including any evidence collected, if possible.

The project indicated that the use of technology in the field would be worth further investigation. It is intended to use some of the tools employed during this study to enhance student learning during the 2012 Aberystwyth University field trip to New Zealand North Island to further test the application within a group of ~35 students. Feedback on this will be used to further understand the role of iPad technology in the field for future years.

It appears that using an iPad enhances the different medium through which students can learn, enhancing some aspects of moving though the Kolb learning cycle and catering for further learning styles. But caution needs to be taken as the time to prepare these materials can be time consuming at this early development stage. Therefore, although there is clear potential for future use, iPads are still at an early development stage and it is hoped future applications will enable easier and streamlined integration of content for both GIS mapping, and social networking uses.

This research contributes to the growing literature reviewed in this report that supports the role of technology in learning, not just in the field, but in the classroom. Specifically, in the context of this project, iPads and applications were used to increase the number of learning styles supported during fieldwork outside of the classroom, and for fieldwork preparation / reflection. Further testing and implementation is required and further best practices need to be explored before wider adoption is possible. Therefore we feel this research has shown the potential for increasing student learning and engagement within Geography fieldwork using mobile computing while additionally builds on students
employability skills through the familiarity and use of new technologies.

8. Links: Please use this box to include any links to resources.

**Apple resources:**

How the iPad can be used for educational purposes:  
http://www.apple.com/uk/education/ipad

Applications suggested for education purposes:  
http://www.apple.com/education/apps/

Apple in education:  
http://www.apple.com/education/labs/

**iPad Applications:**

**ArcGIS (ESRI):** http://itunes.apple.com/gb/app/arcgis/id379687930?mt=8  
Probably the most popular application on the desktop but on the iPad it uses ERSI provides background layers and to put your own data into the app a WMS (i.e., ArcIMS) is required.

**Blipfoto:** http://itunes.apple.com/gb/app/blipfoto/id320759918?mt=8  
Is a tool that encourages people to create an account and upload a photo every day. This could be a resource for students to upload one photo each day that best represents what they have a learned. They can additionally add text to summarise their day, and reflect on their key thoughts. Blipfoto can be used online or as an iPhone app. See www.blipfoto.com

**Citymaps2go:** http://itunes.apple.com/gb/app/city-maps-2go/id327783342?mt=8  
This app can help provide orientation and help explore larger cities or area offline and can be used with a GPS to aid orientation.

**Facebook:** http://itunes.apple.com/gb/app/facebook/id284882215?mt=8  
Provides an extraordinary communication tool that most students use. Frequently students set up 'groups' to upload photos, links, and videos. This provides a useful method to share information easily. Educational weblinks, videos, and discussion forums, along with voting schemes can be set up making it a valuable additional resource. See www.facebook.com

**Flipboard:** http://itunes.apple.com/gb/app/flipboard/id358801284?mt=8&ls=1  
As social magazine that pulls together information from URLs and photos posted on Twitter and Facebook this is a very beautiful tool, but it can also be highly powerful in encourage students to review information available on the internet. For example if a particular tag is used in Twitter, Flipboard can then generate an attractive interface that is easy for the students to use to view all these resources between students. Additionally students could develop their own tag for their group or individual projects.

**iCMTGIS:** http://itunes.apple.com/gb/app/icmtgis/id409254102?mt=8  
A GIS digitising app but this was found to be difficult to use and to have a poor user interface.
A simple GIS app which allows you to show GIS layers over Google Earth imagery and to digitise ESRI shapefiles.

This app is by the BGS and provides access to their geological mapping of the UK. Very useful for field courses within the UK.

Is an app that can be used to edit video and integrate it with photos and text to review an activity or project. A cheaper alternative is to use Videolicious to compile movies together, but it lacks the range of tools that iMovie offers. See [http://itunes.apple.com/gb/app/videolicious/id400853498?mt=8](http://itunes.apple.com/gb/app/videolicious/id400853498?mt=8)

This app allows digitising to ESRI shapefiles and spatially located images (e.g., satellite images) to be loaded through iTunes and displayed as background imagery, alongside Google Earth imagery. To load your own imagery into this software it has to be first convert using desktop application and an in-app purchase is required to allow external datasets to be imported or exported.

A copy of the desktop application for the iPad/iPhone which presents similar functionality and data. Additional data layers can be presented through the app by uploading to a Google account through the Google maps web pages.

This app provides a 3D view of the Earth and shows the location of many of the satellite orbiting the Earth, including many of those which are used for remote sensing. The app would be more useful if it had a search function.

This app provides a tool to convert between coordinate systems (e.g., UTM to lat, long), including those from the inbuilt GPS.

An app which allows KML files to be displayed (including images) over Google Earth imagery. This can already be done in GoogleEarth but this app allows your data to be stored locally on the device rather than uploaded to a server. The user interface could be improved.

Is an app that can be used during fieldwork and group discussions that is the bestselling handwriting app. It allows sketches and notes to be made without typing. It therefore can enable field sketches and field notes.

This app provides up to date information of the latest earthquakes around the world including links to more information and the ability of display the location over GoogleEarth imagery.

Can be used to share useful links and information as discussed in this project. For example students can post information using an established profile with a common password about the field locations prior to the trip, upload photos taken in the field as well as additional links and information, and then add further information, sketches, links, or useful data uploaded onto websites. See www.twitter.com

Is a multi-media tool that combines thousands of sources to present concise, interactive summaries of millions of people, places and things in an experience optimised for the iPad.

Wikitude is an augmented reality app which shows points of interest overlaid onto the image from the iPad or iPhones camera.

Is an online blog for those students who may want to write more, as well as integrate photos. It can also be used to show location as well. See [http://wordpress.org](http://wordpress.org)

This app generally contains quite basic information but it is nicely presented so maybe useful for some audiences.

Is a private form of twitter that can be used by businesses, or set up to be used within groups. This app is free as a basic version and has a number of advantages over twitter. It is private and thus messages can only be seen by members of the group. There are also additional apps that can be used to run polls, ask questions, and discussing ideas. This could be a useful resource for the students to provide feedback on fieldwork, both within the group and with staff. However it is not possible to use Yammer with apps such as Flipboard yet so there are some limitations. See [www.yammer.com](http://www.yammer.com)

**Journal of Geography:** [http://www.tandfonline.com/toc/rjog20/current](http://www.tandfonline.com/toc/rjog20/current)
The journal of Geography contains numerous useful articles regarding best practice for teaching Geography, including field teaching and GIS.

**Journal of Geography in Higher Education:**
[http://www.tandfonline.com/toc/cjgh20/current](http://www.tandfonline.com/toc/cjgh20/current)
A journal which publishes articles specifically concerned with best practise in teaching geography at University level, including field teaching and GIS.

**Journal of Planning Education and Research:** [http://jpe.sagepub.com/](http://jpe.sagepub.com/)
A journal which publishes articles on best practice across all disciplines.
The Professional Geographer: http://www.tandfonline.com/toc/rtpg20/current
The professional geographer is a journal which publishes articles covering a wide range of topics within the field of geography including teaching practises.

Online Resources (also see reference list):

Designing Effective Fieldwork for the Environmental and Natural Sciences
http://www.gees.ac.uk/pubs/guides/fw2/GEESwGuideCov.pdf

Effective Practice with e-Learning (JISC Report):
http://www.jisc.ac.uk/media/documents/publications/effectivepracticeelearning.pdf

Fieldwork Education Resources Collection: http://www.openfieldwork.org.uk/api/
A directory of field course materials available online.

Facebook: An Educational Support Tool for Teaching Earth Science
http://www.gees.ac.uk/planet/p22/ds.pdf

Improving Student Learning During Travel Time on Field Trips Using an Innovative, Portable Audio/video System

Mobile Devices as ‘Boundary Objects’ on Field Trips:
http://www.rcetj.org/index.php/rcetj/article/viewArticle/84

Supporting Fieldwork using Information Technology:
http://www.gees.ac.uk/planet/p18/jm.pdf

9. Bibliography / references (preferably annotated): Please list any references mentioned in or associated with the project’s topic. Where possible, please annotate the list to enable readers to identify the most relevant materials.


### Appendix 1: Questionnaire and results from Qualtrics

1. **How useful would you find having GoogleEarth as a tool you could use in the field while undertaking fieldwork?**

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<th>Answer</th>
<th>Response</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Very useful</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>Useful</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>3</td>
<td>Not useful</td>
<td>0</td>
<td>0%</td>
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<td><strong>Total</strong></td>
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</table>

2. **What would you use it for?**

<table>
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<th>#</th>
<th>Answer</th>
<th>Response</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Planning independent projects</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>Understanding the wider area</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>Other</td>
<td>1</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>5</strong></td>
<td><strong>100%</strong></td>
</tr>
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</table>

3. **Do you think you would find extra information displayed through GoogleEarth information useful?**

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<thead>
<tr>
<th>#</th>
<th>Answer</th>
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<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td>5</td>
<td>100%</td>
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<tr>
<td>2</td>
<td>No</td>
<td>0</td>
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<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>5</strong></td>
<td><strong>100%</strong></td>
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</tbody>
</table>

4. **Do you think you would use GoogleEarth in the field and help you to connect the theory discussed in lectures to what you can see in the field?**

<table>
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<tr>
<th>#</th>
<th>Answer</th>
<th>Response</th>
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<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td>5</td>
<td>100%</td>
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<tr>
<td>2</td>
<td>No</td>
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<td></td>
<td><strong>Total</strong></td>
<td><strong>5</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

5. **Do you prefer to use satellite imagery on the iPad or paper printouts?**

<table>
<thead>
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<th>#</th>
<th>Answer</th>
<th>Response</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>iPad</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>Paper printouts</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>5</strong></td>
<td><strong>100%</strong></td>
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</table>
6. Is satellite imagery easier to see on the iPad?

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<th>Response</th>
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<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>No</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

7. Is it easier to pan and zoom on a single image rather than flicking between multiple pieces of paper?

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<th>#</th>
<th>Answer</th>
<th>Response</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Pan on an image</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Flick between pieces of paper</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>5</td>
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</table>

8. Is the ability to digitize polygons within the field useful?

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<th>#</th>
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<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>No</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>5</td>
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</tbody>
</table>

9. Would you use the function to digitize polygons or is the user interface too complicated?

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<th>#</th>
<th>Answer</th>
<th>Response</th>
<th>%</th>
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<tbody>
<tr>
<td>1</td>
<td>Would use the function</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Too complicated</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

10. Do you have another feedback regarding activities with the iPad outside in the field? Any concerns, suggestions for uses, potential ideas, other apps?

Text Response
Sun glare makes the iPad hard to see and it could be potentially distracting due to its
other apps, however I think it is a very useful educational tool for the reasons above.

Use cover for reducing glare as it was much better in terms of seeing the data. Good use for researching for group or/and individual projects as well as an effective ‘handout’ for effectively displaying things mentioned in group presentations. Flipboard a good tool for group use.

Would be very useful, especially creating polygons whilst out in a survey. The problem of seeing the screen didn’t matter a great deal whilst looking at the Aberystwyth area, as it was relatively well known to us, but going to a new area could make discerning features difficult. Also they need a strap on them incase you drop them.

Although I have answered yes to finding it easier to see satellite data on the iPad it has limitations, the sun glare on the screen is problematic but hugely easier than paper maps, especially multiple maps which get wet and soggy and blow around in the wind.

On sunny days the glare from the sun makes it difficult to look at maps on the screen, but all the other options are better than flicking between printed maps. Digitising is very useful if the images can be seen clearly enough.

### 11. Have you used social networking before today?

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<th>Answer</th>
<th>Response</th>
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<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td>5</td>
<td>100%</td>
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### 12. How did you find the use of Twitter to share links, from an educational perspective? (both NZ and Aber)

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<tbody>
<tr>
<td>1</td>
<td>Good</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>Indifferent</td>
<td>0</td>
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<tr>
<td>3</td>
<td>Waste of time</td>
<td>0</td>
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### 13. Did you find Twitter easy to use?

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<tr>
<td>1</td>
<td>Yes</td>
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<td>No</td>
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### 14. How did you find the use of Flipboard to view weblinks, from an educational perspective? (both NZ and Aber)
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<tr>
<td>1</td>
<td>Good</td>
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<td>2</td>
<td>Indifferent</td>
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<td>3</td>
<td>Waste of time</td>
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15. Did you find Flipboard easy to use?

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<td>Yes</td>
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<td>Total</td>
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16. How did you find the use of Blipfoto, from an educational perspective? (both NZ and Aber)

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<tbody>
<tr>
<td>1</td>
<td>Good</td>
<td>4</td>
<td>80%</td>
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<tr>
<td>2</td>
<td>Indifferent</td>
<td>1</td>
<td>20%</td>
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<tr>
<td>3</td>
<td>Waste of time</td>
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17. Did you find Blipfoto easy to use?

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<th>Response</th>
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<td>1</td>
<td>Yes</td>
<td>5</td>
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18. Do you think these social activities have enhanced your fieldwork learning?

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<tr>
<td>1</td>
<td>Yes</td>
<td>5</td>
<td>100%</td>
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<tr>
<td>2</td>
<td>No</td>
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<td>Total</td>
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</table>

19. Could you comment on how these social activities have enhanced your fieldwork learning?

Text Response
Learnt that social activities such as tweeting can be a good thing to be incorporated in to flipboard in order to display useful articles and data.

Flipboard was an accessible and easy way of looking at information, and also very easy to upload data onto. It could be very useful to summarise a lecture topic, whereby the references were on one page, rather than looking at a list of references which we are usually presented with. I did not find the blip photo particularly helpful, as it didn’t seem to provide any significant benefits.

They don’t necessarily enhance but with good lecturers they could hugely enhance. It needs to be alongside good work documents in whatever format and well planned field trips.

It allows you to find out about an area you are going to visit before going there, and sharing links saves time if everyone is looking for the same information.

20. Do you have another feedback regarding the activities with the iPad relating to social networking? Any concerns, suggestions for uses, potential ideas, other apps?

Text Response

Potential over-reliance on the iPad in terms of less group discussions and less social activity. Can also be a distraction from work due to the easy accessibility to internet and other apps.

Really easy to use (seems instinctive). Haven’t used one before and don’t use apps at all but they seem interesting and very broad in scope. The flipboard was very useful and definitely was something I would like to see if I had any more lectures!

Some people who have no use or willingness to try these things would struggle and be in willing, however it seems to be from work experience something businesses are considering to use more an so something that a small amount of use for in an educational way would be good to learn the skill of.

Flipboard makes the links look visually pleasing.

21. What advantages do you think using technology, such as an iPad in the field has?

Text Response

Flipboard is a quick and engaging way to show many references and articles concerning one or many subjects, it is also very portable with high adaptability.

Very quick way of displaying data. This kind of technology is much greener than standard fieldwork handbooks which needs a lot of printing work. Can be a good tool for presentations.

Taking paper maps out are a total hassle, can get ruined, and you have to create lots if you want to look at different scales. This again was really easy to use and would save lots of time, whilst also making post-processing much easier to complete.

Tablets would make an easy portable and interactive way to enhance survey work. It also seems to be something which would improve performance, as time spent in the office afterwards would be decreased if data was already input.
Allows access to more information when in the field, which you may not have thought about beforehand, and cannot get access to while in the field with only paper maps.

Appendix 2: Field diaries produced by students

Group 1:

The iPad was useful because:

- effective way of displaying data
- flipboard good for listing references
- easy to flick through data
- interactive display of maps
- good social tool
- greener more effective way of providing handouts

The iPad wasn’t as useful because:

- sun glare spoilt display and made browsing data very difficult
- potential difficulties loading maps due to internet connection
- potentially more distracting than useful

Reflection Photo:
Group 2:

Reflection Photo 1:

We tried using Google Earth whilst looking over Aberystwyth. The iPad was useful but the glare from the sun diminished its use.

We used twitter to insert web page links, which could then be put into flip board, an easier way of looking at information about a topic, e.g. Aberystwyth culture.

Reflection Photo 2:
Appendix 3: Using Google Earth on the iPad.

Most data which can be displayed within the desktop version of Google Earth can be displayed on the iPad but it can only be accessed via the ‘My Places’ feature on the maps.google.co.uk website which requires a Google account, Figure 8.

![Figure 8. Google Maps website and the ‘My Places’ feature.](image_url)
Once data, as KML files, is uploaded into the ‘My Places’ feature via the Google maps website the data can be accessed on the iPad by logging into the associated Google account through Google Earth on the iPad (via Layers > My Maps).

To generate KML data files the desktop Google Earth application can be used to spatially register imagery (i.e., satellite imagery or aerial photography) to create overlays. Google provide a tutorial on how to do this here [http://earth.google.com/outreach/tutorial_earthoverlays.html](http://earth.google.com/outreach/tutorial_earthoverlays.html) and here [http://earth.google.com/support/bin/static.py?page=guide.cs&guide=22373&topic=22376](http://earth.google.com/support/bin/static.py?page=guide.cs&guide=22373&topic=22376).

To put further information onto Google Earth KML files need to be manually created using a text editor, as KML files are simply XML files. Google provide a tutorial and examples for this [http://code.google.com/apis/kml/documentation/kml_tut.html](http://code.google.com/apis/kml/documentation/kml_tut.html).
Appendix 4: Transferring data to GISRoam on the iPad

To load or download data (either shapefiles or imagery) into GISRoam the DataConnect in-app purchase is required. Data can be transferred to and from GISRoam either via iTunes or the free LocalConnect software provided by Cogent3D (the developers of GISRoam). To convert the imagery to be loaded into GISRoam the LocalConnect software is required where a GeoTiff image can be loaded and converted to an intermediate format for use within the GISRoam. Shapefiles can either be created on the device or uploaded via the LocalConnect software DataConnect option.
Appendix 5: Setting up and using Flipboard and Twitter on an iPad.

Instructions

This section provides a step by step guide to setting up Flipboard using Twitter on an iPad, as conducted during our research.

1. Sign up for a Twitter account on www.twitter.com. Feel free to style the page and add any other information relating to the fieldtrip.
2. If you wish to use Twitter on the iPad, download the Twitter app onto the iPad from the app store. It is recommended to use the Twitter app developed by Twitter on http://itunes.apple.com/gb/app/twitter/id333903271?mt=8
4. In Flipboard, go to the 'More' bookmark which takes you to the 'Content' menu. Select the social tab. In the search box type the Twitter account name you have set up. It should find the account and then select. It will display all the tweets, links, multimedia automatically.
5. Click the '+Add' button to keep it as one of the favourite magazines. It may be worth considering following Twitter account by museums or groups established in Facebook that are part of the fieldtrip so the students can see the latest information posted.