The iPad six years on: progress and problems for enhancing mobile learning with special reference to fieldwork education

The iPad six years on: Progress and Problems for Enhancing Mobile Learning with Special Reference to Fieldwork Education

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Abstract
This paper summarises findings from 2010 involving mobile technologies in the Enhancing Fieldwork Learning project. We show, through practical involvement with students and higher education teaching practitioners, that iPads can be used to facilitate innovative pedagogies and promote active learning in various field and out-of-class situations. We also note that iPads and similar smart devices can be useful in Higher Education in general. The acceptance of Bring Your Own Device (BYOD) is far less common in the HE system in the UK than at secondary level despite the range of apps and development of students' individual Personal Learning Environments.

Keywords: Higher Education, iPad, Smartphone, Fieldwork, Personal Learning Environments, Citizen Science, Students, Teachers, Bring Your Own Device, BYOD, Apps.

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Introduction

Fieldwork is an important part of research and educational activities in several disciplines. Geography, geology and bio- and ecological sciences are perhaps the most obvious, but this list can be extended to civil engineering and surveying, archaeology and history. Simply taking students out of the classroom can make their learning more engaging as can being immersed in the environment that they are learning about. However, active learning is more than just being outdoors. Active learning includes any instructional method that engages students in the learning process by doing meaningful learning activities, especially thinking, questioning and problem solving in the field (France, Whalley and Mauchline, 2013). Examples of active learning approaches include problem-based learning, enquiry-based learning, types of peer-to-peer instruction and group/collaborative learning. These are in addition to traditional fieldwork attributes of observing, note-taking, data recording and interpretation.

The advent of the Personal Digital Assistant (PDA) led to the smartphone, in particular Apple's iPhone, from 2007. A new dimension was added to the hardware with the rapid development of a wide variety of apps, some of which could be used for fieldwork enhancement, especially in Higher Education (HE). It was not until the arrival of Apple's iPad in April 2010 that screen sizes became suitable for reading and annotating PDFs as well as other visual academic tasks.

To enable data and information to be recorded in the field, the paper note book has traditionally been a central part of the fieldwork equipment, with waterproof or water-resistant paper, for note-taking and sketching. Users of paper notebooks might also need various other devices for field-orientated tasks; camera, hand lens, compass and clinometer, light meter or sound meter. For the most part, the iPad can incorporate all these functions. Traditional, paper-based methods, can be replaced or supplemented by an iPhone or iPad. Note-taking in the field can be performed or enhanced digitally; photographically or with audio recording. Images of paper notes can be used to back up fieldwork and added to a digital notebook. Additionally, the digital facilities in smartphones and tablets can be used to enhance the accessibility of such notes.

The use of computers in fieldwork is of long-standing. Gardiner and Unwin (1986) extoled the virtues of using computers for fieldwork data analysis and report writing. At that stage however, personal computers were large and even if they could be used in the field were expensive and had a short battery life. Student use of computers tended to be in the laboratory or class room after the day's fieldwork. Even the advent of inexpensive 'netbooks' from about 2007 did not solve many of the difficulties of 'field computing' until the arrival of the iPad and the widespread uptake of apps. The iPad is essentially an upgrade of Alan Kay's 'Dynabook' of 1972

but, with the use of owner-selected apps, it has some of the characteristics of Neal Stephenson's 'Young Lady's Illustrated Primer' (Stephenson, 1995) in that it grows with the owner/user.

The Enhancing Fieldwork Learning Project

The (UK) Higher Education Authority-funded project Enhancing Fieldwork Learning (EFL) started in 2010 with the aim of using mobile devices to help enhance fieldwork learning. This chapter reports some of our investigations, particularly in the areas of biology, geography, earth and environmental Sciences (Bio-GEES) fieldwork. We have used iPads and, to a lesser extent, iPhones as a means of extending student participation in fieldwork, primarily because they were the market leader at the start of the project. We have continued with them in several forms because of the wide number of apps available. Other types of smart devices could equally be used appropriately in the situations we describe. The EFL project has been concerned with developing the use of the iPad from the original function of a media-consuming device to become part of a personal learning environment (PLE) for students. By using an iPad, together with appropriate apps and affordances in pedagogically sound ways, students can benefit from these devices to promote their own active education (McHaney, 2011).

In order to investigate the potential of tablet computers to enhance field teaching and learning we initially purchased six (original) iPads in 2010 but this has since been supplemented by several iPad Mini (versions 2 and 4), increasingly as departmental stock. We loaned these to geography and bioscience fieldwork practitioners for their separate field trips (both one day and residential) to explore how tutors and students could use iPads to develop teaching activities and to gauge how students responded to the use of mobile technologies. Most Bio-GEES student fieldwork is done in small groups. We examined how this class set of 12 iPads was used to support groupwork (usually 4 people per group) in the field for day classes as well as one or two week-long residential trips in the UK at several locations and abroad (New York, Iceland). Students were responsible for taking the iPads to the venue from their home departments.

This progressive-use approach allowed us to explore the breadth of pedagogic possibilities provided by iPads and the use of a selection of education-related apps that we wanted the students to use for particular exercises. Initially, this was practitioner-led and the learning tasks were set prior to the trip. The students were not always able to spend much time familiarising themselves with the devices before the fieldwork but all students had a chance to use them to support their learning in the field. The limited number of iPads did not present a problem because of the groupwork. Some apps were recommended to the students for particular tasks but they were also at liberty to explore and use other apps as required. This also allowed the students to explore the capabilities of iPads and appropriate them for their learning.

Students' Learning Spaces

Students work in a range of educational spaces (Savin-Baden, 2008) and fieldwork provides one such 'learning space'. The notion of 'person plus computer' means that

we can take our cognitive learning spaces around with us (Gärdenfors, 2004). By extension, 'fieldwork' no longer means in remote locations but *anywhere* users are located; home, hospital, lecture theatre or laboratory. A 'Personal Learning Environment' (PLE) can be defined by an individual person, but can be greatly enhanced by the possession of a device such as an iPad (or Stephenson's 'Illustrated Primer') and supplemented by 'the cloud' and Wifi. Not only can digital information be stored but inter-connected repositories can be searched and information retrieved and (re-)transmitted in a manner that is far more cost-effective than in pre-iPhone days. For example, information literacy skills can be developed by students searching electronic databases for additional information to incorporate into reports. The EFL project capitalises on these attributes of information storage, connectedness and sharing data and analysis in any location.

When a student joins a university or college an institutional app may provide information about the local milieu, including maps, social scene as well as lecture theatre locations and perhaps lecture times. The student can use their PLE in this everyday sense and add their academic work to this mobile environment. Academic work might include suggested reading, notes on the reading, bibliographic information and work to be submitted to tutors. The iPad alone is not the PLE but part of the knowledge network, and is probably more useful than the local virtual learning environment (VLE) because it is mobile and can be personalised. Information sharing is of course already highly developed by students at an informal level via social media. Moreover, iPads are highly portable and may well evolve with their owners such that social and academic lives can, with care, be part of any individuals' overall education. We have developed this concept further where we refer to the iPad and apps as a *vade mecum* (Whalley, France, Mauchline, Welsh and Park, 2016). We suggest that these ideas concerned with mobile technologies need to be further developed in all areas of higher education.

Early adopting practitioners; teaching staff

We have examined both student and tutor/lecturing staff ('faculty' in the US) by questionnaires and focus groups on fieldwork events. At an early stage we asked fieldwork practitioners in the Bio-GEES disciplines about their use of mobile technologies to support learning in the field. Participants were surveyed by questionnaire in 2011 to help understand their practical and pedagogic motivations. The majority of the 89 respondents indicated that data processing (including data capture, analysis and sharing) and ICT skills development were their primary motivations (Welsh, Mauchline, Park, Whalley and France, 2013). The main barriers to adoption were the cost and reliability of the equipment as well as concerns over staff and student capabilities. We also noticed (Welsh, France, Whalley and Park, 2012) that students were worried about damaging their own or an institution-provided smartphone, yet rarely voiced the same concerns about very expensive specialist equipment used in the field such as a differential GPS.

The main fieldwork learning tasks teaching staff devised involved the use of iPads to; take photographs and videos, enable web browsing, entering raw data, collect GPS-linked data and geo-reference photographs (Welsh et al., 2012). Other activities included the use of Twitter for communication and the creation of short reflective

videos. However, we concurred with a JISC report (Linsey et al., 2011) that students, 'do not use their personal technologies for learning unprompted'. However, we also found 12% of our practitioner questionnaire responses about emerging technology (in 2010) indicated that devices will become inter-connected in the field. Thus, 'People expect to be able to work, learn and study whenever and wherever they want to' (Johnson, Adams and Cummins, 2012). Our showcase events and publication (France et al., 2015) show how this may be achieved.

Initial student responses

At the beginning of the project, few students had used an iPad. In our mixed-methodology approach, 173 undergraduates on six fieldtrips responded to a questionnaire (Welsh et al., 2015) used to gain some idea of how students used iPads during fieldwork and their perceived benefits and drawbacks of their use. The iPad is designed to be intuitive to use and we found that students were able to adapt to working with these devices very quickly. The students reported that the multi-functionality of the iPad, along with its portability, were the main benefits. There were some misgivings by students at first, that they might break or damage their loaned iPads as well as some issues relating to internet connectivity availability in the field. To obviate damage to iPads we purchased rugged cases for student use. This increases their bulk and weight a little and can be a nuisance when some accessories, such as supplementary lenses, need to be used. In fact, over the project we had no problems with damage and the cases ensured that one iPad survived being submersed in a geothermal pool on a trip to Iceland!

In our survey (Welsh et al., 2015) the students largely focused on the technology aspect of the device with 26% recognizing that the iPad was convenient as an all-in-one or multi-tool device. They did not however, recognize pedagogic benefits such as increased engagement, and their use as a reflective tool. This was a similar finding to that of Woodcock et al. (2012) which suggested that students rely on guidance from their tutors in the use of mobile devices.

Some examples of iPad supported tasks in fieldwork learning

Although we found students took to using iPads with enthusiasm in their fieldwork, they frequently had to be told what facilities were available as affordances of the iPad and the apps that would be useful. We have listed many of these in France et al. (2015). Some other student experiences in using iPads are further discussed in Whalley et al. (2015). Although smartphones provides pedagogic affordances for some mobile devices, the larger screen offered by tablets provides much greater usability than small smartphones as they enhance the 'device aspect' of Koole's (2009) FRAME model.

That an iPad can act as a device for note taking and photography, still and video, is only one aspect of their capabilities. Apps are available for making it easier to accomplish quite complex tasks, such as editing video or still photographs and audio dubbing. For some applications an instructor has to know the capabilities of the iPad as well as the apps available before going into the field. For example, in geological

sciences it is often necessary to take angular measurements and direction of rock strata (dip and strike). The traditional method is to use a separate clinometer and compass, take many measurements in the field and then undertake the data reduction and plot it back at base. Only there was it possible to look at field sampling and the data's statistical significance. Now it is possible to take these measurements with an iPad in the field. Field measurements can be plotted at the site along with notes and a geo-referenced (GPS) location (Figure 1). Not only does this give immediacy, it allows a more involved and active engagement in any field mapping programme. It also saves money on expensive hardware.

Figure 1. An app (*Lambert*) that allows the iPhone (as here) to be used as a clinometer and compass. In the field this is used to measure geological structures but here allows measurement to be practiced by measuring the slope of a book cover. This shows the principles of the measurements to be shown before students venture into the field and that they fully understand the techniques to be used. The inset shows a set of collected data automatically plotted by the app. Both images were taken on an iPad Mini 4. W.B. Whalley 2016, CC BY-SA.

In general then, instructors need to know what can be done with iPads and apps and also to demonstrate these to students and for students to practice data gathering *before* going into the field. This applies to many apps, both general (such as word

processors and spread sheets) and for specific needs such as metadata editing, image processing and sketching aids. Skitch is one such app that can be used for drawing but also annotating images and for practicing observation and supporting field sketching. Other case studies of using mobile technologies in the field can be found in France et al. (2013) and König and Bernsen (2014) provide an overview from history education including field trips.

Computer manufacturers have paid, rightly, attention to 'accessibility' of their devices. The iPad can have different keyboards, both physical and virtual, to aid data entry and writing in the field. Cold wet fingers in the field can be left in gloves if audio notes are taken with the aid of a suitable app and a lapel ('lavalier') microphone. This technique for recording notes could be useful for students with certain impairments as can the use of virtual assistants (Siri), whether in the field or not. Students with specific learning difficulties (SpLD) can use iPads to assist with a variety of tasks (Nuttall and Nuttall, 2013).

Crowdsourcing of data in the field and the concept of Citizen Science

Citizen Science, "*scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions*" (Oxford English Dictionary) is becoming increasingly popular for fieldwork. Members of the public as well as students can use their tablets or smartphones to identify and record a wide variety of plants and animals. Some aids are on-board apps but a website example is iSpot hosted by the Open University via the OPAL (Open Air Laboratories) network. The GPS facility on mobile devices can identify locations (geo-referencing) and thus be used to map occurrences, densities etc. EpiCollect and Open Data Kit are two examples of open source apps that can be customised on both iOS and Android systems to enable field data recording. Not only does this activity provide training for field biologists and ecologists but creates a database for future research. For example, the spread of ash dieback fungus can be tracked via the Living Ash project to produce data of national importance. Crowdsourcing and sharing of data can lead to other novel approach to shared student use of iPads in the field. An example is an institutional 'Twitterscavenge' to locate resources and by using Facebook to record road-kill ('Project Splatter'). Internationally, Zooniverse, 'people powered research', shows that anyone can be a researcher and the project links research and education in a wide variety of projects, many being field-based.

Questionnaires can be used to provide 'citizen data', specifically for urban field surveys in sociology, marketing, human geography. Students from the University of Chester have used iPads in this manner on field courses in New York. For ex-UK locations it is usually advisable to purchase SIM cards locally to avoid high roaming charges from the UK. The advantages of quick data recording also apply to conflating the data and its analysis. Such skills in data management can be seen in a wide variety of tasks for which iPads can be used. For example, data validity and sampling strategy can be examined in the field rather than waiting until the home laboratory is reached. Some apps are designed specifically for data analysis. As well the 'traditional' use of spread sheets, some apps can allow data to be plotted directly or by way of imported data as csv files. Such apps may be as important in the laboratory

as in the field and go some way to support linkages between students, devices such as iPads and data collection as part of a personal learning environment.

Bring your own Device (BYOD)

The BYOD movement has its origins in the constructionist ideas of the late Seymour Papert and Alan Kay and the One Laptop per Child (OLPC) initiative. Although the cost per item was used to criticise OLPC, the same might be said of the iPad. Cheaper tablet versions do now exist and the smartphone revolution has already arrived in the economies of Africa (Goldstuck, 2012). Economics as well as ease of use will probably further drive the move towards the acceptance of iPads and tablet/smartphone technologies and replace the classroom computer. As indicated previously, we have found that there is still some reluctance for many academics to use mobile technologies in their everyday teaching with students. There may be several reasons for this. Perhaps one being that if it is not a laptop then it cannot be a serious contender for student use, despite the entreaties of JISC (2015) to encourage mobile learning.

Some schools in the compulsory education sector have banned the use of smartphones, presumably because students are distracted by checking their social media. Conversely, some schools encourage the use of iPads and even produce guides for their use and suggest the apps to be installed. This is a move towards enlightened BYOD that we have yet to see this in most HE institutions in the UK as they generally lack a BYOD policy. Some individuals have developed use of iPads as a means of transforming education but these need to be encompass within good design principles (Beetham, 2013; Kukulska-Hulme and Traxler, 2013) within higher educational institutions.

Personalizing Learning Environments

All of the features of iPad+apps and the affordances and abilities mentioned above allow a device to become much more than a field notebook. An iPad can act as a calendar, list maker, alarm clock and reminder tool, users can tailor their own devices to monitor their daily activities. This of course is what many people do who are not students in a formal sense, they play games, use e-mail, social media of many types on their smartphones as well as instant payment technologies. We are now in Adam Osborne's vision, 'The future lies in designing and selling computers that people don't realize are computers at all'. iPads and other smart devices have become extensions of our minds and capabilities as indicated by Skyrme (1999) and can include aspects of Karl Popper's 'Three Worlds'; the worlds of physical objects and events, mental objects and events and objective knowledge (Popper, 1999). Not the least of these is World 3; products of the human mind. As such, the iPad provides a personal and personalised link between individuals and local groups (students, work colleagues, family, clubs) as appropriate. We see this trend continuing and supporting mobile learning to counter some of the trends identified by Kukulska-Hulme (2012).

Institutional Advances since 2010

Since 2010, many HE institutions in the UK have started to support the integration of mobile learning into their educational programmes (JISC, 2015). Such support includes staff training, the development of staff-support mechanisms and the expansion of Wi-Fi coverage on campuses. Various possibilities for implementing iPads use and for supporting staff and students are discussed in the Proceedings of the 1st International Conference on the Use of iPads in Higher Education (Souleles and Pillar, 2015).

As well as promoting and investigating iPad use in fieldwork at our own institutions we have run several workshops and six annual two-day 'showcase events' where academic practitioners have demonstrated their innovative pedagogies that utilise specific apps in fieldwork education. These events have been particularly been useful in spreading the word about using iPads and exploring pedagogies for active fieldwork. Students too have been shown the value of the iPad to revolutionise their own learning and have sometimes developed ways to use their devices beyond learning tasks set by their tutors. We found that students, once exposed to mobile technologies, were able to link their use of specific apps to the graduate attributes that are important for employability (Hill, Walkington and France, 2016). Institutional support, the greater availability of mobile devices together with the innovative ideas of practitioners, has led to a drive towards novel pedagogies, especially those involving 'active learning' (Kukulska-Hulme and Traxler, 2013). This activity can be deployed in the lecture theatre as much as in fieldwork (Whalley, 2016).

Conclusions

Our, continuing, project, has shown us the value for students using mobile technologies in their out-of-classroom learning. This enhanced learning is also designed to be 'active' and in the way that HE is situated as being 'research-led'. As with Citizen Science, anyone can participate in scientific investigation, students are part of this and assistance here is not 'what you know' as indicated on an informal level by quiz shows such as 'Mastermind;' but, more formally, by the higher education examination system. Rather, we take the approach of 'Research 3.0: driving the knowledge economy' of Maidment-Otlet and Redfearn (2010) in promoting mobile technologies, especially that of the Personal Learning Environment. The iPad can be used effectively to enhance such education, not only in fieldwork but throughout education. Such breadth allows teaching practitioners and their students to follow the paths suggested by Laurillard (2013), Thomas and Brown (2011) and in Beetham and Sharpe (2013). As mobile smartphone and tablet technologies have developed rapidly over the last six years we believe there is no reason to think that the pace of development will slow. This applies to computing power, screen resolution and the inclusion of haptic devices and links to 'virtual' technologies as well as the apps that will be developed as a consequence. Student-centred learning, associated with the development of a PLE, should be used in most forms of education.

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