GOOD PRACTICE GUIDE

Mobile learning: How mobile technologies can enhance the learning experience

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Introduction

As ownership of smartphones and tablets grows there is increasing interest in how they might be used to support learning and teaching, both in the classroom and beyond. This Best Practice Guide has been put together by the UCISA Digital Skills and Development Group Academic Support sub-group to provide examples of good practice in using mobile technologies to enhance learning. It goes beyond provision of mobile access to existing technologies and focuses on the impact on the student learning experience.

The Guide contains a range of case studies which look at a variety of uses for mobile technology including in field work; to support geographically dispersed medical students; to video practical skills development and for self and peer review and assessment. Some involve institutionally owned and managed devices, others expect students to use their own devices. We learn about the challenges posed, notably by patchy connectivity, but also the great enthusiasm of many learners and teachers.

Each case study describes the activity and the approach taken, provides an evaluation of the activity and discusses future developments and transferability.

We hope you enjoy reading the case studies and find ideas that can be applied in your own institution. If you have any comments regarding the Guide please contact Sue Fells at admin@ucisa.ac.uk.

Acknowledgements

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Learning across contexts – mobile for fieldwork in Environmental Sciences

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Context

The culture, practice and pedagogy of academic disciplines such as geography and environmental sciences are based around in the field activities as well as traditional learning in face to face, online and laboratory scenarios. Downward et al (2008) have argued that environmental scientists are uniquely positioned to pilot mobile technologies, because they work across so many different contexts.

Figure 1 depicts the varied contexts in which environmental students are now expected to work. Within each of these disciplinary contexts learners should have access to all the resources they need, as well as the ability to capture, reflect on, develop and extend their ideas into other contexts.

Figure 1

As Kukulska-Hulme et al (2007) note, mobile learning may offer a solution to this problem, by encouraging students to use “portable tools that support observations, interactions, conversations and reflections, within and across various contexts of use...” (p.53).

With this in mind we wanted to find a solution that could facilitate students’ learning both within and across these contexts.

Why mobile?

Work carried out in the field has previously involved use of paper notebooks. This can be time intensive, weather dependent and limiting in terms of having previous data or other resources (e.g. handouts, maps) to hand. There is much potential for both staff and students to use mobile devices to enhance fieldwork learning, both in gathering and recording data. Mobile devices are multifunctional tools. They combine the roles of what previously required several separate devices, each performing a specific role including the use of digital cameras for capturing visual media, audio recorders and players, laptops or PDAs for processing data and reading emails etc.

We trialled the technology on two field trips. Wicken Fen National Nature Reserve in December 2011 and Stonehenge in February 2012. For both trips the tutor set up a shared blog space in the Virtual Learning Environment (VLE), Blackboard, and asked the students to record their findings on site using their mobile devices, posting directly to the blog to foster discussion on the results.
The intended result of this activity was to encourage and enable students to quickly and easily document discoveries and ideas in the field, to access resources electronically and reuse data in other learning contexts, and to encourage students to develop a collaborative approach to data sharing and discourse. Overall, the aim was to encourage students to create as well as consume data.

The process

The Wicken Fen field trip formed part of a second year module on Habitat Ecology and Management. Students were asked to observe and record details of the wetland habitat, which is one of the most important in Europe, and share their observations with the group. They also planned to use GPS to tag the exact locations of their images and notes, to share with the wider community via Flickr.

The Stonehenge field trip formed part of a Sustainable Development module, focusing on land use, visitor experiences and planning. Students were asked to consider the proposed changes to the landscape, plans for the new visitor centre and to form a case from the perspective of one of a range of stakeholders with interests in how the site is used.

For both trips, students were asked to capture images, audio and video narratives using their own mobile devices where they had them, or by borrowing an iPod Touch from the Learning Technology team if they did not. Students were also given limited access to wifi using mobile wifi hotspot units borrowed from the Learning Technology team, which can connect up to five devices via a 3G signal to upload to their Blackboard blog via the Mobile Blackboard Learn (VLE) app. There was a cost involved for the hotspot units and the data contracts which, for the pilot, the Learning Technology Team covered. In a larger scale scenario the School/Faculty would need to fund the hotspot units.

Students were also given an information sheet with some ideas on how best to use the mobile device with recommendations on which tools to use for recording data. The information sheet addressed notes apps like the standard Notes app that comes with any iOS device, and the Pages app (which is on all the iPod Touches which are loaned out from Learning Technology). It also guided students on how to enter data into spreadsheets using the Numbers app (also on the loan equipment) alongside the Forms tool (Figure 2), and use an audio recorder app to record more detailed observations in the field.

![Figure 2](image-url)

These information sheets were not given to the students until the day of the trips, simply because the advantages of circulating them beforehand were not foreseen. If a longer period of time had been allowed for students to access loan devices, or just the information before the trips, then there might have been better take up of the Forms tool. In addition, the tutor could create forms for the students to use to make sure the correct data is gathered.
Benefits and challenges

Feedback from the students, via paper based evaluation sheets circulated in class, revealed that students enjoyed using the devices, particularly for photography and video, which helped them to record a large amount of data very easily. 80% of the students said that uploading their data into the blog on the VLE through the app was easy or very easy. Students said that it very useful to have the ability to take pictures, make notes and record audio all in one place. There was also very little writing up/editing notes once back from the field trip. Anecdotal feedback was gathered to measure the groups’ thoughts about the general use of mobile in the field and measure the impact of the learning experience – much of which was positive.

One of the main challenges of these activities was connectivity. The Wicken Fen trip was particularly affected by the very limited mobile data signal. This was challenging partly because of students’ expectations of the connectedness of the mobile devices they were using. When handed an internet enabled device, they expected to be able to connect to the internet and start accessing information immediately. The purpose of the trip, however, was for them to record their own data, and be creators and, to a limited extent, consumers of data so expectations needed to be clearly set. One of the points to remember for the next time this exercise takes place is to perhaps place the emphasis less on connectivity in the field, and more on the ability to record data electronically in the field. This places less pressure on the technology to perform tasks like checking the latest updates on Facebook and Twitter! Managing the expectations of students when in the field is important. If they are not aware that they will not be able to access information in a timely fashion, or at all, then the overall experience may be tainted.

Unfortunately, the connectivity issues affected recording information about data that was being gathered. GPS tagging of resources was an ideal feature to identify locations of images, but often proved too time consuming (whilst waiting for data to upload/download) to benefit the experience. Some students tried out the Dragon Dictation app, but this relied on a data connection and so did not work well with the slow or intermittent signal. The same can be said about apps which rely on stored information in the cloud (Google Docs, Dropbox etc) that have not been set up to use offline, pre-field trip.

Evaluation and impact

The relationship between situated and classroom learning is one which is important for environmental scientists. However, they generally take place as separate processes. For example, Laru et al (2012) have emphasised that observations and data collections should take place outside the classroom (on a field trip) with further analysis then carried out inside the classroom, often by using software only available on the computers on campus. Bridging the gap between these situations and the contexts described in Figure 1 can be facilitated by mobile technologies. Having access to resources whilst physically being in the field can help students to recognise the interdependence of theory and practice and, therefore, increase their understanding more spontaneously and in context.

Regrettably the connectivity issues meant that this was not proven in the field for our case examples. Nevertheless, there is still value in gathering data and recording it electronically in the field. What this means is that data can be analysed, discussed and shared (once connected to a data signal) in a more timely manner. Value can also be placed on simply having access to mobile recording equipment, without having to carry the larger bags and accessories that go along with traditional recording equipment.

Future developments

With the anticipated improvements in connectivity (i.e. 4G and more comprehensive coverage of areas in the UK) from service providers, issues caused by connectivity, or lack thereof, should phase out over the coming years. This will significantly improve access to resources at the time of need and in context. It will also enable students to apply that knowledge into other contexts because of the increased understanding of the original context in which it was gathered.

We plan to put more emphasis on pre-field trip work where data gathering will be more structured, but not restrictive. This will require data signals, at least in the preparation stages of the field trip, to access the forms feature (or a similar app/feature) to distribute templates to students for them to gather appropriate data, with suggestions on how they could expand their knowledge outside of the prescribed boundaries of the form or template.

Voice recording and dictation has already moved on from the capabilities when these field trips took place, and tools like Siri on iOS may offer a solution to the issues that students experienced here.
**Transferability**

The same principles of this study can be applied to most fieldwork activities. The better the connectivity within the fieldwork location the richer the experience, but recording and gathering data offline and synchronising once connected still makes for enhanced practice. There needs to be more emphasis on pre-field work in future activities both from a tutor’s and student’s perspective. More students are starting to buy into the Bring Your Own Device (BYOD) culture within their learning environments, so inclusivity will become less of an issue, but we must be careful to make sure that there are no instances of exclusion.

The information sheet that was shared with students can be found here: [http://bit.ly/uonenvsci-mobfw](http://bit.ly/uonenvsci-mobfw) and used under a [Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License](http://creativecommons.org/licenses/by-nc-sa/3.0/).

**References**


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Padding around – using iPads to promote collaborative learning

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Introduction

The purpose of this project was to enhance teaching and learning through the embedding of the use of iPad tablets within the Faculty of Health Psychology and Social Care at Manchester Metropolitan University. The focus was on developing innovative ways of enthusing learners in classroom based settings, to meet the needs of a diverse student population. As such, iPads were used to promote both active engagement with the curriculum and collaborative learning (Kocksman, 1994).

Ongoing student evaluation of class based sessions had indicated that some students needed further support to review their practical skills and promote self-assessment and communication (Hamshire and O’Connor, 2012). New generations of students presume that universities will make use of new resources (Prensky, 2010) and iPads had been identified as having the potential to transform learning in an earlier pilot study (Hamshire and Crumbleholme, 2012). Therefore, we wanted to explore if mobile devices could be used to support the learning process and add value to class based settings in an attempt to address some of the issues that had emerged from student course evaluations.

The majority of the students in the Faculty are studying on health and social care professional degree programmes so the focus was on promoting professional skill development – particularly communication, reflection, practical skills and peer support.

We believe that tablet technology offers a wide variety of applications that have the potential to enrich the learning experience (Hamshire and Crumbleholme, 2012) and could, therefore, be used to encourage learning in a broad range of activities (Mang and Wardley, 2012). The reality is that mobile devices are now a significant part of everyday life (Pettit and Kukulska-Hulme, 2007) and have become more prevalent within healthcare (Royal College of Nursing, 2007); so, by developing students’ digital literacies, we also aimed to enhance their future employability.

Context

The project was developed in line with the Faculty’s values and strategic priorities, in particular:

- To enhance and support students’ learning experience through the delivery of high quality academic programmes, and provision of an excellent learning environment and facilities to ensure added value of our qualifying students to meet employers’ needs.

- To enhance the scholarship of learning and teaching by promoting and building on good practice, evidence based practice and enabling innovations.

Taking into consideration the Faculty strategic priorities we aimed to promote active engagement and opportunities for collaboration. Initially, a range of mobile devices were considered as we acknowledge that the iPad is only one of a new generation of tablet devices that has potential to transform teaching and learning (Mang and Wardley, 2012). However, following careful consideration and discussion, iPads were chosen for this project for two main reasons: there was an extensive range of apps specifically relevant to supporting healthcare education; and local medical students, working within the region, had already been issued with iPad devices to support their clinical practice. It made sense to draw on the experience of the medical students and to use a compatible device.

The Faculty initially purchased a stock of forty iPads with protective cases, a charging and syncing base station, basic cleaning supplies and a stock of iTunes cards that were used to purchase apps using a volume purchase licence. The project was managed by the Faculty E-learning Support Officer (ELSO) who synced and updated the iPads using a MacBook and ensured that the iPads were charged and delivered to the appropriate teaching room.

The iPads were made available through an online booking system to any member of academic staff, each of whom submitted a short proposal outlining details of how they planned to incorporate the devices into their teaching, the number required and the installation of apps as appropriate. The proposals were individually reviewed by the ELSO and faculty Teaching Fellow and, if accepted, a short tutorial with the ELSO on iPad functionality was offered to staff to enable effective use within the teaching sessions.
Description

The overarching aim of the project was to promote active engagement with the curriculum for a diverse range of students. We planned to be flexible and responsive to the needs of both staff and students and, therefore initially, had no set parameters for the potential usage of the devices by academic staff. As such, staff used the devices to support a diverse range of pedagogic enhancements and to promote active engagement with the curriculum. However, this case study will concentrate specifically on how our students used the iPads in practical classes and, in particular, on their use of the iPad’s video functionality.

Previous research had suggested that the use of visual feedback in the form of video offers a unique perspective that enables the student to capture their practice and view it through another lens (Zehry et al, 2011). Consequently, we believed that utilising the iPad video functionality with the capacity for instant feedback would support and develop the students’ practical skills through improved knowledge acquisition and reflective processes. We therefore incorporated the use of iPads into the practical skills sessions of our second year undergraduate Physiotherapy students and asked them to film themselves performing practical skills. In small groups of up to four students they created, reviewed and shared their own student generated short videos in a range of communication and skill based activities to:

- Review and critique their performance of skills and practical techniques to improve both their practical skills and, by working in groups, develop their peer feedback skills.
- Review communication skills by recording samples of interaction and then use these videos to highlight effective communication and good practice.

Once created, these videos were used as a starting point for debrief and reflection sessions with academic staff, to promote both practical skills development and the ability to critique performance and give supportive peer feedback. Each of the students reviewed their own performance to promote reflection on their own skills and then provided feedback on the performance of others. If desired, the videos could then be emailed or uploaded to the VLE for further reflection and review at a later session or to support revision for practical exams.

Evaluation and impact

The motivation for carrying out this study was to explore the students’ learning experiences of using the iPads and the staff perceptions of the value added. With this in mind, the project was evaluated using a mixed methods design carried out via focus groups, individual interviews and comment notes from both staff and students.

Student evaluations were collected via individual interviews and comment notes and a thematic analysis of the data identified three distinct themes:

- Accessibility/usability
- Engagement/collaboration
- Added value
Sample comments from each theme are included in the table one below:

### Table one: Student comments

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<th>Theme</th>
<th>Sample comments</th>
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| Accessibility/usability | Wonderful, quick and easy to use.  
I really enjoyed the opportunity to use one and could see how it would make studying and work easier.  
It’s got a lot of advantages... you’re able to record what you’re doing right now, you’re able to record as you engage.  
It’s so fast and really easy to use... it doesn’t take any time away from our learning. |
| Engagement/collaboration | The use of the iPad makes the classes more interactive and I can see the benefit of using these in the future for further exercises and classes.  
Great to use, good to interact with other students and compare comments and results. Makes you think outside the box when considering others views. Really good session More iPad sessions please.  
You’ll be seeing something and the tutor can see something else and then they can give you feedback on what they’re seeing. |
| Added value        | This is sooooo nice, I love to take it home, this was really helpful and made our day more enjoyable.  
It definitely made us more conscious since we knew we were being filmed... just to be a bit more professional and work together more professionally... |

Staff evaluations were collected via focus group and comment notes and a thematic analysis of the data identified three distinct themes:

- Added value
- New modes of teaching
- Digital literacy

Sample comments from each theme are included in the table two below:

### Table two: Staff comments

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<tr>
<th>Theme</th>
<th>Sample comments</th>
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| Added value        | It’s completely changed the way I teach. I can give more individual support rather than a whole group  
Student interaction increases the pace of lesson |
| New modes of teaching | iPads show us possibilities for learning it blows the lid off traditional way of doing things  
Usually I have to do lots of demos but with video they can watch me as many times as they like  
I let the students discover the information rather than me deliver to them |
| Digital literacy   | My students are mindful of their own digital literacy so would pair up with someone used to using an iPhone so not only are they learning they are improving their own IT skills as well  
We are also developing skills for those who are less au fait with technology |
In summary, feedback to date has been overwhelmingly positive with successes identified as increased student engagement and the promotion of collaborative learning.

**Challenges and lessons learnt**

As with any change in practice, this project has had challenges to its success. The engagement and enthusiasm of staff to embrace these changes was variable and initially many staff were unfamiliar, and thus uncomfortable, with the iPads. This was addressed by a variety of staff development sessions, targeted at introducing specific features and applications within the iPad. In addition, where appropriate, the ELSO provided class based support to ensure that all the students were able to use the iPads.

Other challenges included maintaining charges and apps on all devices and ensuring provision across a large campus split over two sites. This was best managed by the ELSO in order to ensure consistent accessibility. Transporting significant numbers of iPads around a large faculty campus was problematic. There was intermittent wifi access at times, and this caused issues in classrooms where internet access was a requirement of the lesson plan. However, feeding back data from the evaluations to campus IT teams early on meant that this was soon rectified, and within months of the iPad project starting the IT team invested heavily in greater wifi provision for the campus.

**Future developments**

Higher education is undergoing unprecedented change and universities must adjust to meet the evolving needs of students and other stakeholders, within a competitive market. Excellence in teaching and learning is, therefore, fundamental to ensure that we enhance the educational experience of all and make learning more flexible and accessible.

A testament to the success of this project is that we have now developed an effective community of practice of staff using the iPads to support curriculum delivery. Not only do all staff and students involved take care to ensure they look after and maintain the devices, they often exchange ideas about the ways in which they use the device to support their own teaching and learning. In particular, staff on the Physiotherapy programmes are developing workshops to support students’ usage of iPads and the Social Work team are evaluating the use of iPads for recording assessed presentations.

Activities that worked well in this project were those that students could see as being directly transferable to their professional practice and personal development. Future developments will build on this and include greater use of video to promote students’ reflection, communication and peer review skills.

The ELSO continues to provide staff development and training to support the increasing numbers of staff who have invested in their own iPad. We are also planning to invest in more mobile charging and syncing devices to enable transportability as well as ensuring that the device are always ready to use.

**Transferability**

iPads are mobile devices and, so, this approach could be replicated by any institution, given appropriate resources, support and expertise. The role of the ELSO was instrumental in ensuring a consistent approach to maintenance and thus a dedicated staff member should support any project using these devices. When large numbers of students are involved, it will take a significant amount of tutor time and commitment to embed the use of iPads on a regular basis in the classroom. Providing support and training to familiarise staff with unfamiliar technologies is vital to ensure this engagement.

The iPads have been used in some instances to address quite niche pedagogic challenges that have been defined by academic colleagues (Draper, 1998) that, nonetheless, had a big impact on students’ learning experiences. Academic staff typically started small using the iPad for a specific purpose, then returned after a successful experience to try something new or to remedy another problem. As such, the use of the iPads has frequently stimulated unanticipated learning experiences. Students who have used the iPads have enthusiastically contributed ideas of how we can further incorporate them into our teaching and these discussions have been both refreshing and inspiring.
References


Authors

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Warning! Modelling effective mobile learning is infectious. An example from higher education

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**Description and context**

Academic Developers are change agents (Elton, 1995; Roche, 2010). They work with people, in communities and networks (Neame, 2011) and promote innovative practices through active experimentation, modelling and use evidence based approaches to encourage colleagues to reflect on their practice and identify opportunities for change. They extend opportunities for interaction, engagement and learning in and outside the classroom (Land, 2003; Swennen et al, 2008).

Our world is changing. The student body is more diverse than ever and technological advancements are shaping how we live. Learning and teaching are changing too. Increasingly we talk about networked and connectivist pedagogies, the need for more flexibility and openness in our offer as well as lifewide and lifelong learning and professional development. Mobile devices are making it possible to seamlessly integrate learning and teaching supported by technology in and outside the physical classroom in on and off campus based programmes in new and exciting ways (Conole and Alevizou, 2010). However, a deep knowledge and understanding of digital literacies are required to make mobile learning work well for teachers and students to maximise learning (Aviram and Eshet-Alkalai, 2006; Johnson et al, 2013).

Postgraduate Academic Development programmes have been shown to be effective for transforming teachers and practices (Sword, 2011; Parsons et al 2012). The examples shared within this case study are a selection of success stories. The approach presented here has been used and refined over the last three years with approximately 150 students. It highlights mobile learning interventions that infect teachers as learners and transforms them into experimenters who use their curiosity to design learning activities as a result of their own experience as a mobile student. We reflect on the work that has been done with students, who are teachers in HE studying towards the Postgraduate Certificate in Academic Practice (PGCAP) and specifically during the module Learning and Teaching in Higher Education (LTHE). This module provides a safe and supportive environment for experimentation, that has the potential to boost teachers’ confidence in using some of the mobile learning approaches modelled, with their own students.

*Figure 1. A selection of mobile apps used during the PGCAP programme*

Social media applications available on mobile devices, such as Google+ communities, WordPress portfolios, Twitter, Socrative, YouTube and Flickr are used during the LTHE module for media rich expression and creation as well as sharing across virtual and physical spaces. These social media tools support and extend learning and teaching conversations – something that Palmer (2007) emphasises as vital for teachers. Learning through making and
co-creation of artefacts that can easily and instantly be shared with others is a desire that can also be satisfied through available and accessible social media applications (Gauntlett, 2011).

In this case study we investigate the mobile learner experience, the potential impact on teachers’ own professional practice and share lessons learnt which might be useful for other practitioners. We used a Bring Your Own Device (BYOD) approach to develop digital skills and behaviours needed in the 21st century for learning (Hamza & Noordin, 2013) on the go, in and outside the classroom as a more sustainable solution. We focus in this study on the use of social media in the context of mobile learning. Indicatively, 16 out of 17 students on our January 2013 cohort had a mobile device and were using it. We had our mobile devices switched on to explore together the potential of these digital Swiss army tools for learning and teaching, and we did this individually and through group activities. We experimented together and reflected on their use in the context of this module, but also more widely for teaching practices. Once upon a time, the tutor used to carry a digital camera, camcorder, or an iPod to each session. For over a year now all these gadgets have been replaced by a single device, a smartphone. Tasks such as regularly checking students’ portfolios and providing feedback, responding to questions in different social online spaces, taking photographs and videos and sharing these, making announcements and sending out reminders, accessing and sharing resources and generally being connected to students, peers and the wider educational community, can and did happen anywhere, anytime, anyhow.

Figure 2. A sample student portfolio on Wordpress.com

The devices used were owned by the students and the participating tutors. Often devices were shared for classroom and group activities and individuals were encouraged to use these outside the classroom to reflect, connect, share and co-create. Mobile learning is integrated in the design of the module and the PGCAP programme to enable ongoing engagement and collaborative learning and, as such, is part of the tutor’s workload and students’ study time.

Evaluation and impact

Teachers as students on the PGCAP were invited to share their mobile learning stories and explorations as a result of their engagement on the programme via a shared Google Document, which brought different voices together and was used as an asynchronous focus group, but also reflected on their experience in their social media learning portfolios. Their reflection on the opportunities and challenges mobile learning presents for them and their students in the context of formal and informal learning, the formation of learning communities and autonomous learning have been used to provide a qualitative insight into how they experienced mobile learning as students and the impact this had on their own practice as teachers. In the context of this study we wanted to gain a deeper insight into their experience as mobile learners but also identify what works and where the difficulties lie so that we can make further adjustments to the approach used and support mobile learning more effectively.

In this case study we present a preliminary qualitative evaluation based on reflective accounts and observational data (Stake, 2010). Evidence shows that the integrated mobile learning opportunities during the LTHE module have had a positive impact on learning and teaching and enabled extended conversations, feedback, sharing of resources and ideas and playful learning, as well as collaboration and co-creation in and outside the physical classroom.
There were lively and extensive discussions in Google+ and Twitter; we also used our smart devices to capture learning in various spaces as it was happening via still and moving images and uploaded these to Flickr and YouTube, with Socrative we created quizzes for individual and group challenges and the Wordpress portfolios became dynamic spaces for learning and exchange. By connecting learners, resources and ideas, the sense of community was strengthened. Support was not just offered by the tutor but brought peers closer together and gave them the opportunity to reach out and access wider networks and communities as well. All these benefits were highlighted by the students themselves in reflective accounts and are aligned also with the tutor’s observations.

As the PGCAP is a course for teachers it was seen as valuable to be able to experience mobile learning approaches and reflect on these as a student first before embarking on using them with their own students. Some students initially felt overwhelmed as this was a new way of learning and teaching and needed more time to fully understand and appreciate the benefits. For example, one student noted: “Twitter, the big intelligent club that I didn’t feel confident stepping into in those early days. I had an account before starting the PGCAP but wasn’t really using it. Then I was encouraged to on the PGCAP. I wasn’t sure how to... What if I offended someone? What if I was too open? What if I said something wrong? Is what I was trying to say valid? All these questions plus the very new concept of Twitter from a technological and user viewpoint meant that it took me a few months and several attempts to increase my confidence. What helped me most is being accepted into a (local) community of like minded people of whom some are personal friends.”

Another student stated “I’ve been a rather avid Facebook user for years, and frankly, the idea of learning to navigate another social media site felt too tiresome to entertain.”

Also, the switched on or always on nature of mobile learning, highlighted as benefits by the students, needs further examination as it can easily lead to distortion of expectations and demands, both by tutors and students. The use of different platforms can also be confusing for some and requires increased confidence to master. As we all used our own devices, the approach didn’t require specific equipment and is easily scalable for different cohort sizes. The technological barriers were therefore reduced. Peer to peer support worked really well in mastering the use of smart devices and specific apps for individual and group learning tasks. Not having a smart device in the pocket was seen as an opportunity for group work and provided a more inclusive and collaborative way to learn. No training was required and students quickly mastered using their smart devices for learning. For example, one of the students stated: “I found Socrative very simple to set up on my phone even though I am not adept at smart mobile technologies I have never for example, downloaded an app”. It was fascinating, as many of the students on the programme also started using some of these mobile learning approaches with their own students, and from their reflections it becomes clear that they design activities for learning which are progressively student led. One student noted: “they [the students] continued to use it [Twitter] throughout the module and towards the end this resulted in them using it to discuss module related activities without my input”. This is an extremely positive development.
We carried out a preliminary evaluation based on observational and reflective data captured in students' social media portfolios and a collective Google Document which was used as an asynchronous focus group. This indicates that students' experience on the programme helped them gain confidence and a deeper understanding of how the use of mobile devices, based on an informed pedagogical rationale, can enhance and extend learning and teaching opportunities in and outside their own classroom with their own students. It can also make them think about how they can be more resourceful when limited resources are available. The plan was to infect through modelling. This has been achieved as many of our students started integrating mobile learning approaches in their own courses with their own students.

Challenges and lessons learnt

As the use of the smart devices is interwoven into the pedagogic fabric of the LTHE module and based on a clear rationale, students have the opportunity to find out more about these through immersive application and activities. Progressively, students felt more confident with their device and developed the competencies required, mainly through peer to peer support, to effectively use these in a variety of ways for learning and teaching. It was noted that despite the initial reluctance by some and feelings of being overwhelmed, students gradually discovered for themselves what could be achieved through these and how they could be used in their own practice. The biggest bonus for the tutor and students is, in our opinion, more flexible and extended opportunities for connectedness, on the go support and troubleshooting, but also the exchange of ideas and learning opportunities. These are not necessarily led by the tutor, but more through peer to peer learning, a desirable and powerful reciprocal learning motivator that also makes learning more enjoyable (Boud, 2001).
Potential challenges and possible solutions:

- The BYOD approach might be seen as less inclusive if students do not possess smart devices and/or are not willing to use these for learning and teaching. Consider purchasing or using devices provided by the institution. If a limited number is available use these as an opportunity to design and offer collaborative activities that work using one device per group.

- Technological barriers and a lack of understanding of how smart devices could be used effectively for learning and teaching might lead to frustration and disengagement. Provide support sessions from the very beginning. Identify opportunities for peer support and scaffold the integration of mobile learning activities. Avoid overwhelming students by setting up too complicated tasks. Keep it simple!

- Constant connectedness could lead to social media addiction and become an intrusion into private and family time, both for tutors and students. Negotiating and agreeing working practices at the start of a course is really important. Be realistic about expectations and put a mobile peer learning system in place that is lighter on tutors’ involvement. More hands on effort might be required from the tutor at the start of an initiative and when working with a new group who are new to this way of learning.

- Students’ expectations might be magnified and irrational or too demanding and put the tutor under pressure to respond to requests immediately. The same applied for students. Agreeing working practices at the start, as mentioned above, will minimise this. A link to the agreement could be added to their online learning spaces and students could be reminded of this when challenging situations appear on the horizon.
Future developments

The PGCAP Programme Team recognises the importance of working in partnership with students to enhance and shape the curriculum together, to learn with and from each other as well as to strengthen our professional relationships during and after completion of this programme. This collaborative study is evidence of this. We are keen to carry out a more in depth evaluation, and refine the approach further, to make learning on the go even more accessible and inclusive while modelling innovative practices. A programme wide approach would potentially have a bigger impact (Gibbs, 2010; 2012) and we will work towards this as a team. A clearer introduction is required at the start of the programme during which the purpose, aims and desirable pedagogical goals linked to using social media on smart devices are shared with the students. While an initial training session might be useful, together with self study guides, a peer buddy system would be valuable for ongoing support and would provide a sustainable solution while allowing peers the opportunity to share their knowledge and skills with others.

Transferability

We live in challenging and demanding times which require flexibility and resourcefulness. Budgets are shrinking. Maximising opportunities within constraints and thinking creatively in and outside the box will be vital to create meaningful and highly contextualised, flexible learning and teaching situations. BYOD, therefore, represents an attractive and sustainable offer for students and teachers. As mobile technologies continue to evolve there is a concomitant need on the part of educators to update our knowledge, understanding, skills and attitudes on how these could be used effectively with our learners.

We advise teachers to participate in Continuing Professional Development (CPD) activities, courses and programmes, in their institution and/or outside, and use these technologies as learners first. It is recommended that institutions help with the implementation of BYOD interventions by providing pedagogical and technological support and guidance to teachers and students (Hamza & Noordin, 2013). Seizing opportunities to actively experiment and carry out research around mobile learning will deepen understanding, boosting teachers’ confidence and competence in utilising these for learning and teaching based on an informed pedagogical rationale.

Academic developers and learning technologists can help. Teachers’ own students will also be willing to help them overcome technological hurdles.

The approach we currently use on the LTIE module, and the PGCAP Programme more widely, is easily adaptable to any other undergraduate and postgraduate provision. The main purpose of using mobile devices is to bring learning communities together, add flexibility and openness to communication and collaboration, share, co-create, support, actively participate and engage in the learning process. Other academic programmes will be searching for ways to enable similar working and learning practices and could use this case study and lessons learnt to formulate and shape their own mobile learning strategies and approaches.
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Authors

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Implementing mobile learning with iPads in higher education: a large scale case study

Jane Mooney, Lucie Byrne-Davis, Tim Cappelli, Hilary Dexter, Mike Taylor, Lee Moffatt and Colin Lumsden, Manchester Medical School.

Description and context

We report on the findings of the first and largest iPad mobile learning (m-learning) case study that has been conducted in UK higher education.

The study took place in a geographically displaced student community. Manchester Medical School (MMS) is the largest in the UK with around 450 students in each of the course’s five years. During the clinical phases, years three to five, of the curriculum, students are allocated to one of four Health Education Zones, which consists of a large teaching hospital and a number of District General Hospitals; 15 in total across the North West of England. This disparate geography, coupled with inconsistent access to reliable technology and educational resources across these sites, resulted in a limited, disconnected workplace study experience.

Formulating and disseminating an m-learning solution

Only an m-learning based solution could permit more cohesive curriculum delivery with such a distributed student community. The key drivers for mobile device implementation were to:

- facilitate learning irrespective of location
- permit the dissemination of the core curriculum and university communication from a centrally hosted platform
- provide a bespoke learning experience that the students could recognise as emanating from (and identify with) MMS.

The following key questions had to be considered and addressed throughout the implementation of this mobile technology solution:

- what devices to deploy?
- how to configure the security of these devices within clinical environments?
- how to best develop learning packages to support curricular content?
- how to facilitate m-learning with wireless internet access across multiple National Health Service (NHS) sites?
- how to establish support for students; faculty and the NHS partners?

Device choice and configuration

At the time of device selection, in 2011, only Apple provided a reliable tablet device with a critical mass of apps in the form of the iPad2.

The iPads were given to the students as an experiment, as opposed to a prescriptive exercise. Rather than lock down the devices completely, and inhibit their creative use to augment learning, the regulatory measures discussed below were adopted to the satisfaction of all parties.

Governance was addressed via two routes: through prescribed device configuration and MMS agreements with the students and the NHS Trusts.

The devices were configured using the Profile Manager tool within Apple’s Lion Server. This provides a comprehensive set of Mobile Device Management (MDM) functions. This tool was selected following an evaluation of alternatives. The MDM system allows the University to install a configuration profile on the devices, which applies a number of security settings, such as: mandating an eight character passcode; remotely wiping the device if lost and wiping the device if a passcode is incorrectly attempted 10 times. It also applies the Virtual Private Network (VPN) settings on the
iPad, which permits students to connect to the University of Manchester network and services via wifi at the hospital sites. At each Trust, the students are provided with a unique set of credentials which are stored on their iPads for future access. At remote locations there is guest access in the training centres and residences.

Students were loaned devices by the Faculty of Medical and Human Sciences (FMHS) for the duration of their clinical tenure. Ownership of the tablets passes to the students upon graduation, at which point the imposed configuration profiles are removed by IT Services.

Students were provided with a code of conduct and required to sign an agreement upon receipt of their tablet covering the terms and conditions of its use. These are governed by local, university national data protection and information technology guidance. To date, there have been no reports of misuse.

Individual agreements with each NHS Trust and District General Hospital were established regarding information governance and the technological solution to be deployed, again, in line with local and national guidance.

**Developing learning materials to support curricular content**

Over 150 purpose built m-learning packages have been developed to support the curriculum and a video lecture library created, from which students can download content to review in their available study time.

To avoid an exclusive dependence on the iPads, and to facilitate access for tutors without iPads, m-learning materials were developed to be accessible to view and utilise via both iOS and Windows operating systems. The Riverside content authoring tool was used to achieve interactivity while maintaining cross platform accessibility.

These bespoke packages, together with relevant documents and further learning resources, can be accessed by students via their devices using the mobile version of the Learning Management System (BlackBoard mobile), as well via an internet browser on any PC, Mac or internet enabled device.

**Facilitating learning through wifi provision**

Significant technological challenges associated with wifi deployment across multiple NHS sites have been overcome through establishing agreements with our partner Trusts. Figure 1 depicts the status of wifi availability at our partner sites in December 2011.

Connectivity issues at NHS Trusts, base and district general hospitals Trusts were addressed through the aforementioned agreements with MMS; including funding and practical implementation advice. The resulting improvement in the hospital wifi infrastructure is shown in Figure 2. From this, it can be seen that 18 of the 19 NHS Trusts accommodating MMS students now have wifi available and while one has no coverage, following their withdrawal from the implementation, the remaining 18 have full coverage.

As a participating institution in the Eduroam (education roaming) service, secure, roaming internet access is in the process of being implemented across our partnered NHS teaching hospitals.

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**Figure 1**: Hospital wifi pre-iPad implementation in December 2011
Providing ongoing support

Approximately half a day a week of an IT technician’s time remains dedicated to support by the FMHS IT Services. Students have produced videos highlighting how they use their iPads to share best practice and examples of these can be viewed at http://www.mms.manchester.ac.uk/about-us/whymanchester/education/innovativeteaching/ipadusage/. A student peer support network, known as the MMS iPad gurus, has also been established to share practical iPad advice.

MMS faculty members have been invited to open events discussing and demonstrating iPad use in facilitating curriculum delivery.

Evaluation and impact

Following their introduction to our student community, the use of iPads has been evaluated in terms of their usability, acceptability and student perceptions of the impact on their learning processes and experience.

MMS students now have ready access to existing and newly developed, bespoke learning resources. This permits them to:

- make better use of their time – reducing potential dead time while they were waiting for a clinical or other scheduled learning activity
- access resources on the go, providing the opportunity for just in time learning
- immediately capture a record of their learning experiences as they are happening

All of these have contributed to a more connected and better unified clinical student learning experience.

Three surveys have been conducted to evaluate the impact of this implementation on student learning experiences, the results of which will be published in 2014.

Advantages of the mobile technologies

Facilitation of m-learning – Through the provision of supplementary learning resources and improved wifi availability, MMS students can access learning materials during their clinical placements through their own devices.

Improved communication – The deployment of the MDM software has provided the additional advantage of being able to push central notifications and information from MMS to the student population via their devices, augmenting existing communication pathways. This includes the distribution of web clips acting as visual URLs to recommended content, surveys and apps.
**Easier data collection** – Further developments that have evolved through this implementation include the development of new data collection software that is being used by MMS and other faculties within the University (e.g. Manchester Business School). This is freely available to all students as the *UoM eForms* app on the iTunes store and permits the easy collation of data, including compulsory assessments, from our clinical students, wherever they are located.

**Integration throughout curricular delivery** – The use of these mobile technologies has been adopted into all aspects of curricular delivery. Prior to their introduction, students described a more disconnected studying experience, with intermittent access to learning resources and discussions with colleagues, and staff struggled to orchestrate data collection and information management due to unwieldy administrative processes. In addition to facilitating *just in time* learning with students now having instant access to the multiple learning resources described, they are also able to immediately capture and share notes, images and diagrams that contribute daily to their learning and longitudinally to their portfolios demonstrating professional development.

Teaching staff have been invited to training and development sessions explaining how students are utilising mobile technology and how this can be integrated into teaching delivery. The majority of clinical staff have been supportive of this initiative and acknowledged the benefits to curriculum delivery. Indeed, the MMS e-learning team is now being actively approached by clinical staff who wish to produce learning content for students in iBook format, which has seen the creation of further, excellent resources that are freely available through the Apple store.

Additionally, many previously paper based administrative tasks are now completed by students and managed by staff electronically, resulting in a more efficient data collection and management system throughout MMS. This adoption of technology by staff and students has resulted from piloting this system with the target users and refining its functionality based on their feedback, i.e. through the employ of an evolutionary prototyping methodology.

**Disadvantages of the mobile technologies**

The main disadvantages were the cost of the devices and the time taken by IT personnel to configure them. Time was invested in refining and simplifying the configuration process and testing the server, and up to 30 devices per day can now be configured.

**Measuring impact**

Through establishing a programme of research to evaluate how the iPads are being used, how they can be better used and what effects they are having on teaching and learning, we are continuously measuring the impact of this implementation.

There are five studies exploring the impact of iPad use on learning processes, experiences and outcomes. These include:

1. A prospective cohort study from September 2013, which will follow students beyond graduation into the workplace.
2. A study of the use of iPads in problem based learning groups, using screen capture technology to examine how students use their iPads.
3. A vignette based study, using screen capturing to explore how students address novel clinical situations with their iPads.
5. A qualitative study of high, moderate and low iPad users to look at acceptability and adoption issues.

These studies are in various stages of completion and will be published when data is available and analysed. Additionally, since the introduction of the iPad project, MMS has seen a significant and measurable impact on the student experience, with overall student satisfaction increasing from 71% in the last cohort of students not to receive iPads to 85% in the first graduating cohort to have received iPads in the 2013 National Student Survey.
Scalability

This approach is now a composite part of MMS curriculum delivery. We have demonstrated its scalability through a series of iterative roll outs, from an initial pilot of 457 iPads being given to year four students, to now having deployed over 1500 devices to our students.

Through collaborations both within the University of Manchester and with NHS partners, MMS has established a precedent case for the large scale implementation of mobile learning within UK higher education to facilitate the student learning experience.

This approach has also been adopted in Dentistry and the Business School (MBA) and is being trialled within other University of Manchester schools/faculties (e.g. Nursing and Life Sciences).

Additionally, the innovative eForms software, described above, is employed for multiple purposes within MMS. These include its routine use in the following activities: administration; assessment; feedback; placement reviews; student portfolio submissions and research data collection. Future uses will see it being utilised to assist with the admissions process within the medical school.

Challenges

The following issues were initially identified by MMS as significant barriers to the iPad project execution:

- the provision of mobile ready learning resources
- boundaries regarding digital professionalism had to be set with the students
- the variable access to wifi within the hospital workplace environments to support iPad usage

Each of these issues has been managed through the implementation process already discussed. Through this, MMS has addressed learning material production; established student agreements regarding iPad usage and driven the improvement of internet access across the Health Education Zones.

Lessons learnt

The set up and ongoing support by FMHS IT Services has made this initiative possible and sustainable. The time taken to address the wifi availability within the NHS was the most significant single factor that delayed the optimal use of the mobile devices within the clinical workspace. However, it was retrospectively noted, that the deployment of the devices to the students already based within the Health Education Zones became a catalyst, through establishing demand, to improving wifi provision across the sites.

Future developments

Moving forwards, third year students in 2013 will be given iPad mini tablets, to enhance portability in the clinical environment and thereby optimise the usefulness of these devices in the workplace.

Additional evaluation is currently being conducted into how the use of mobile devices can be better integrated with the currently employed core learning methodologies. Particular attention to, and review of, our problem based learning approach is underway to improve the student learning experience. The disruptive nature of technology has changed the problem based learning process with students having ubiquitous access to the internet. The pedagogical approach to curriculum delivery must, therefore, change to address this. A study of clinical PBL tutor perceptions of iPad use has been piloted and is continuing (expected publication in 2014). Additionally, a pilot of using iPads to improve the case close in clinical PBL, by using software that encourages flipping the classroom is planned for early 2014 (expected publication 2014).

The involvement of students has been an invaluable element in the success of the project, with students innovating and discovering new ways of learning to augment and improve their learning. Many of the developments have been student led and also designed as a direct consequence of student feedback.

Rigorous research and evaluation of this implementation is essential to its further, successful progression.
Transferability

Other institutions looking to adopt this approach should note that it took time to implement, particularly regarding the implementation of wifi across the NHS Trusts, but that it was achievable to the benefit of our students. The authors would encourage interested institutions to contact them to discuss how this Manchester model could be tailored to their own student populations.

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Enhancing the formative assessment environment through the use of mobile technologies

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Introduction

This case study, carried out over an eight month period, investigated how mobile technology (iPads in this study) could be used to enhance the formative assessment environment of a second year undergraduate primary Initial Teacher Education (ITE) science module.

The research method used in the study was based on action research. The collaborative, in situ, problem focussed nature of the investigation lent itself to this approach (Cohen et al. 2011). However, the problem under investigation had been identified by both tutors and students and the solutions or improvements were likely to benefit both. In this respect, the method was more participatory in nature and the exploratory approach might more accurately define the methodology as practitioner research (Fuller and Petch, 1995). The final study involved module tutors, students and a Technology Enhanced Learning (TEL) Adviser.

The following research questions were of interest:

- Could the use of mobile technology applications enhance the peer review and feedback process?
- Could a practitioner research approach enhance the students’ pedagogical awareness and engagement with peer review and feedback?

Data was collected and analysed from observations, discussion notes and questionnaires obtained between October 2012 and May 2013.

The investigation was part of an institution wide initiative to explore the potential benefits of using iPads in group work and collaborative learning activities.

Context

Group assessments on the module were assessed formatively using a combination of peer, self and tutor feedback. An overall judgement was derived from a dialogic approach (Alexander, 2008) involving negotiation between all group members and the tutor. This has been shown to be a successful approach impacting positively on students’ own teaching and learning practice.

The opportunity to use mobile technologies was recognised as a potential enhancement to existing good practice in formative dialogic assessment. The students (n=140) studying this module were divided in to five teaching groups and each group further split into five sub-groups of six students. Throughout the delivery of this module each student sub-group was asked to participate in the following learning activities:

- A 10 minute science related assembly – requiring a presentation to the remainder of the teaching group suitable for a specified age range in a primary school.
- A 30 minute mini science lesson with the remainder of the teaching group as participants.
- An interactive science display for a primary classroom on a given topic (for example, exploring the topic Materials).
Each sub-group was required to produce a rationale for their activities explaining relevant educational theory and pedagogy.

Figure 1 shows the peer review and feedback model used throughout the module:

![Diagram](image)

**Figure 1. The formative assessment model used on the second year undergraduate initial teacher education science module.**

Science lessons and science themed assemblies

To provide feedback on the science lessons and assemblies the students used an app called eClicker. Previously, the students had provided written feedback on paper. They were asked to describe two things they liked about the session and one suggestion for improvement (two stars and a wish).

The eClicker product is made up of two separate components: the Presenter and the Audience applications. Teachers and presenters make use of the eClicker Presenter app to author questions and conduct polling, and participants, using either their smartphone, tablet or laptop, use the free eClicker Audience app or web browser to view and answer the questions (Big Nerd Ranch, 2013).

The module tutors designed statements that the student audience could use to feed back their opinions on the quality of the lessons and assemblies. Nine statements relating to the assessment criteria for the group presentations were preloaded into the eClicker Presenter app. Each statement was configured with four response options: strongly agree, agree, disagree and strongly disagree.

The eClicker app allowed students to provide an instant, honest and anonymous critique of the session (assembly or lesson) straight after it had been delivered. As part of the formative assessment process, the module tutor and students reviewed and discussed the feedback at the end of the session. The eClicker Presenter application provides an instant visual analysis of results in the form of a bar chart for each question.

![Screenshot](image)

**Figure 2. A screenshot of eClicker Presenter displaying the results for a question**
The students judged that whilst eClicker was easy to use and enabled clear interpretation of the results, they wanted to be able to justify their selection of a particular statement by adding comments as feedback. After consultation with the students an alternative application called Socrative was acquired and used for the remainder of the investigation (Socrative, 2013).

Similar to eClicker, the Socrative web application enabled question authoring. A distinct advantage of Socrative over eClicker was its ability to create open ended questions. Tutors are able log in through their device and select an activity to control the flow of questions. Students log in through their mobile device and interact directly with the content. Student responses to multiple choice, true/false and short answer questions are displayed. For pre-planned activities a teacher can view reports online as a Google spreadsheet or as an emailed Excel file.

**Science themed classroom display**

The students used Notability (Ginger Labs, 2012), primarily intended as a note taking app, to provide electronic feedback on each group’s science display. The app enabled the students to take a picture of each of the displays using the iPad and then provide detailed comments and feedback (typed or handwritten) about the content of the display by annotating the picture. Figure 3 shows an example of a classroom display produced by a group of students:

![Figure 3. An example classroom displayed created by a group of students.](image)

Visually appealing due to the combination of colours and textures. This makes it age appropriate and would therefore be more engaging to children.

The font and text size are all very large which is appropriate to younger children who would find these easy to read.

The ‘three little pigs’ theme gives the display a relevant context which would appeal to an EYFS class and thus help to extend understanding.

The interactive element is well thought out as it would offer opportunities for the children to explore the concept for themselves and create their own understanding.

![Figure 4. An example Notability file produced by the students – sections of the display have been captured, test boxes inserted for comments and arrows used to emphasise the specific aspect being referred to.](image)
Once feedback was recorded, the students used a function within Notability to upload it (as a PDF file) to a dedicated folder in Dropbox. To ensure anonymity, files containing the feedback were saved with the iPad number (each iPad had a unique reference number) as the filename. Once all the feedback had been submitted the module tutor shared it with the group that created the display. This feedback was then discussed with the tutor during the dialogic discussion.

Resources, management and deployment

The iPads (20 in total) were borrowed from the Learning and Teaching Development unit when required. Due to the requirements of the wider iPad initiative at York St John University, the study adopted the Apple Institutional model for the management and deployment of the devices. This approach to overseeing device ownership meant that the organisers of the study had control and responsibility for managing the devices. Although this option was more resource intensive, it allowed configuration of the devices (using Apple’s Configurator software) to meet the individual requirements of a student or the learning activity. It also meant that the institution retained ownership of the purchased apps and associated content.

The applications (eClicker and Notability) used during this investigation were funded by the wider project and were purchased through Apple’s Education Volume Purchasing Program (VPP). The VPP enables institutions to purchase apps in quantities of 20 or more at discounted rates; typically up to 50% off (Apple, 2013). This approach to deploying and managing iPads could easily be transferred and adopted by other institutions.

Initially, training was required for the students in order to help them become familiar with the devices and applications. This training was delivered at the start of the first session by both the TEL advisor and the module tutors. For subsequent sessions, the TEL advisor was available to respond to support queries regarding the technology.

Evaluation and impact

Throughout the period of the investigation data was collected and analysed from observations, discussion notes and questionnaires.

Towards the end of the study a questionnaire was produced (using Socrative) and students were invited to provide feedback on their experience of using the technology to enhance the formative assessment activities. The questionnaire included a number of Likert type questions with the option to add comments after each question. The questionnaire was completed by all the students who took part in the study (119 in total).

The key findings identified were:

- The students’ level of engagement with peer review and feedback increased significantly when using the iPads (100% engagement when iPads were used).
- The students reflected critically on the use of the technology and the peer assessment process. This was particularly evident when the students shared their concerns and frustrations on using the eClicker application for providing feedback on the science themed assemblies and lessons. The students reported that they would have liked to be able to provide written feedback when answering the questions in order to justify their responses. The group of students also expressed concern over the lack of explanation when they received feedback that was either disagree or strongly disagree. To address this, the Socrative application was used for the remainder of the investigation.
- The students began reflecting on the process of peer feedback as a means of assessment; 87% of students made use of peer assessment and feedback with children during their second year placement.
Figure 5. Results from the questionnaire – 87% of students made use of peer assessment and feedback with children during their second year placement

- The students valued the impact that giving feedback had on their own assessment attitudes and practice. They became more reflexive as their increased awareness of the feedback process through receiving feedback changed the way that they themselves gave feedback.

Figure 6. Results from the questionnaire – students valued the impact that giving feedback had on their own attitudes and practice

- The students felt that receiving peer feedback had less impact on the quality of their own work.
- The quality of the feedback improved over time to become more detailed and focussed. This was indicative of a deeper level of thinking which may have been partly due to the students’ growing confidence in using the iPad and its applications.
- The students appreciated the amount of feedback received (particularly on the science themed display activity where between 15–20 separate feedback files were produced). Initially, the module tutors had some as they felt students might become overwhelmed with the amount of feedback provided, but this proved to be unfounded.
- The students always accessed their peer feedback in advance of the tutor discussion meetings and came ready to discuss it.
- Students downloaded the apps (particularly Socrative and eClicker) on their own devices to interact with the formative assessment activities.

Wider impact

As a result of undertaking this project we have seen the interest in and use of mobile technologies increase, not only within the Initial Teacher Education programme but throughout the institution. Tutors in several other disciplines (Geography, Mathematics and the Professional module) in the ITE programme are now engaging with iPads to enhance learning, teaching and assessment as a result of this investigation.
Challenges and lessons learnt

The most significant challenge throughout the eight month period of investigation was due to the quality of the wifi connection. Its variability had a significant impact on the time it took to provide feedback and, in turn, this impacted on the level of student engagement. The absent or reduced bandwidth (on occasion) impacted on the students' ability to save their feedback files to Dropbox. To manage this problem uploads were subsequently performed by the TEL advisor after each session.

Issues concerning management and deployment of the devices also impacted on the investigation. Although there are clear advantages to an institutional model for managing the iPads it does limit access to them. The need to pre-plan and book sessions constrained possible spontaneous and creative use.

As a result of the lessons learnt whilst undertaking this investigation the following recommendations regarding the use and adoption of mobile technologies can be made:

- In order to foster critical engagement with the technology, it is important that people are given time to explore and investigate the hardware and applications before use in earnest. This was particularly important during the initial sessions.
- The ownership model for management and deployment of the iPads has an impact on usability in the classroom.
- The time taken to provide feedback can impact on other planned activities in the session.
- Although some students became proficient very quickly with the iPad devices and applications, others were much slower to gain confidence and still required reassurance and guidance in using the technology.
- It is important to listen to student feedback about how well they feel the technology is meeting their needs.

Plans for the future

The use of iPads in this study did improve the students’ engagement with formative assessment activities and enhanced already established practice. It also successfully raised the students' awareness of the peer review and feedback process. As a result, we plan to develop this approach further.

Through both observations and student feedback we have identified several aspects of the activities that could be improved and developed.

When providing feedback on the display the students needed to know the rationale for the design of the display. This was generally read out by the tutor before the students started to provide feedback and often had to be read out several times, which slowed the process down (reducing the time set aside for other activities in the teaching session).

In future, when the students create their displays they will be asked to incorporate a Quick Response (QR) code. QR codes are a type of matrix barcode that can be read using smartphones and tablets and can provide links to documents, emails or websites. In this way, students will be able to easily access the document providing the rationale for the display design using the iPads or their own mobile phones. After reading the rationale and interacting with the display, the students will then be required to provide their feedback, using Notability, as before.

Previously, when providing feedback about the student led assemblies and lessons the student answered feedback questions produced by the module tutors. Looking to the future, the students themselves will be encouraged to take ownership for setting these questions. This will allow them to get specific and targeted feedback on their sessions. The Socrative application will again be used for these activities.

Finally, throughout the eight month duration of this investigation the Technology Enhanced Learning Adviser has been present to provide support for students less confident using the technology. In order to reduce the impact on the Technology Enhanced Learning Adviser’s time the aim is to adopt a peer mentoring approach to the activities. This will involve volunteers from each group supporting the tutors and colleagues in their use of the iPads and applications.

Initially, the volunteers will work closely with the TEL advisor to become familiar with the technology being used before becoming the point of contact for support whilst their colleagues are using the iPads. The introduction of this approach will make the activities more sustainable as they will no longer require the expertise and support of the Technology Enhanced Learning Adviser.
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The student experience of using iPads to enhance undergraduate laboratory teaching

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Project background and activity

Mobile devices offer a multiplicity of ways to enhance the learners’ experience (Johnson, Smith et al., 2011) and have been at the centre of numerous studies both in the UK and abroad. Indeed, they have been seen to support medical programmes (Leeds University Press Office; 2010) and to enhance engagement and the assessment process (Manuguerra, 2011). Within graduate science programmes, formal laboratory teaching is core, as well as a requirement for professional recognition by numerous scientific bodies and discussed in the Quality Assurance Agency (QAA) benchmark statements. Students record their data and observations in a laboratory notebook and these data form the basis for a piece of assessment. Following this trend and reviewing existing practice, the School of Science at the University of Greenwich decided to introduce tablet devices into the curriculum by supplying all full and part time first year students with an iPad. This was an internally funded project. The rationale for this activity was threefold: 1. to enhance and support the laboratory experience; 2. to accelerate the transition into a modern work environment through the alignment of teaching with professional practice and; 3. to mediate technological change within the organisation, using the iPad as a vehicle.

To support the iPad rollout, a phased model of development was deployed using the Jisc InfoNet Mobile Learning InfoKit (2012) as a basis. Initial displacement activity was designed to evolve into enrichment and transformation as staff and students developed more confidence and experience. Importantly, academic staff were central to the development of iPad enhanced teaching materials to reinforce the values and ethos of their programmes in the digital age. Specifically, teaching material included the creation of practical schedules, integration of hardware opportunities (camera and video data capture) and documents for recording information. The use of the Virtual Learning Environment (VLE) was also reviewed to ensure that it was iPad friendly and that material was easy to find. The success of the project relied on managing expectations of the various stakeholders and we did not expect to go from no iPads used in the laboratory to iPad enabled laboratory classes within one academic year.

<table>
<thead>
<tr>
<th>Low level (Displacement)</th>
<th>Medium Level (Enrichment)</th>
<th>Advanced level (Transformation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>iPad used as a web browser</td>
<td>iPad integrated into the practical instructions</td>
<td>iPad fully integrated into pedagogy</td>
</tr>
<tr>
<td>Students read information from their iPad – no difference when compared to paper</td>
<td>Tutor led instructions on which applications to use</td>
<td>Students share and recommend applications based on personal experience</td>
</tr>
<tr>
<td>Suggested apps are used in teaching</td>
<td>Apps used to support practical delivery</td>
<td>Apps used to support practical delivery as well as pre and post work</td>
</tr>
<tr>
<td>Hardware features of the iPad are not used (GPS, camera, microphone)</td>
<td>Hardware features of the iPad are used (GPS, camera, microphone)</td>
<td>Students suggest ways iPads can be used to meet the LOs and competences</td>
</tr>
<tr>
<td>iPads used as a silo piece of equipment within the laboratory</td>
<td>iPads are used partially across the curriculum</td>
<td>Evidence of linking practical activities to other learning environments – fully cross the curriculum</td>
</tr>
<tr>
<td>Data collection is by simple input only</td>
<td>Different data entry methods are used as suggested by the tutor</td>
<td>Students choose their own data entry process to meet the outcomes of the session</td>
</tr>
</tbody>
</table>

Table 1 – Model for iPads in the laboratory. Mobile Learning infoKit, (2012), Jisc InfoNet.

As well as creating teaching material to be delivered using the iPad, it was also necessary to develop practice and policy within the School. This activity centred around: 1. the use of mobile apps in teaching; 2. Health and Safety policy and; 3. staff/student support/engagement.
The mobile app toolkit

From the onset of the project we enabled students to choose apps for use in their studies aligned to their own practice and preference. Indeed, research into the personalisation of online learning environments recognises the importance of student choice (Teemu et al., 2012). Conversely, it was also recognised that some students, who perhaps lack the confidence or experience to choose their own apps, may require initial support. Importantly, to support the development of iPad aligned teaching material, we wanted to work upon a baseline with the knowledge that all students would be able to access the same core applications and functions. Therefore, students were provided with an iTunes gift card to fund the purchase of five core applications (Table 2), with the remaining funds to be used for other educational applications. During their first laboratory session, iPads were checked to ensure these apps had been purchased and this was signed off in the student’s record.

<table>
<thead>
<tr>
<th>Application</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>GoodReader</td>
<td>Able to access notes, documents and practical schedules. Ability to annotate documents</td>
</tr>
<tr>
<td>OfficeHD</td>
<td>Able to interact with common document formats. Ability to enter data into a spreadsheet and transfer for later analysis</td>
</tr>
<tr>
<td>Penultimate</td>
<td>Able to draw observations and record visual notes. Students can also sign their work</td>
</tr>
<tr>
<td>Solutions</td>
<td>Used for specific scientific calculations</td>
</tr>
<tr>
<td>Calculator HD</td>
<td>Used for general laboratory calculations</td>
</tr>
</tbody>
</table>

Table 2 The iPad Application toolkit.

Within the laboratory students undertook the validated programme of activities using the iPad instead of paper. This included taking notes, completing tables, constructing graphs and taking photographs of their experiments. Students were advised which App to use for these activities but were permitted to use something different if they preferred.

Laboratory safety compliance

Compliance with Health and Safety was an essential requirement for integrating iPads in the laboratory as well as considerations of how to protect the device itself in laboratory conditions. To this end iPad wrap around covers were sampled and tested against chemical spills. A cover was expected to provide protection against liquids so that following an accidental spill the device may not be damaged. Importantly these covers also helped to protect the end user from cross contaminating their personal environment from laboratory activities. Following testing, a sleeve was chosen and a simple process was adopted. On entering the lab students placed their iPad into a cover, and only took it out upon instruction or when leaving. At the end of a session, the covers were cleaned and never left the laboratory environment.

Figure 1 Testing of iPad covers.

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1 University of Greenwich does not recommend or endorse any particular app
2 University of Greenwich does not recommend or endorse any particular iPad cover for laboratory use
Students as change agents

Following best practice, evidenced through recent work by Jisc and in line with the National Union of Students, QAA and Government agendas, we wanted to involve students to support the development of the project. Therefore, a student iPad team was recruited via competitive selection and awarded a scholarship of £1,500. The task of the iPad team involved promoting activity, developing a web presence, organising a student-centred app reviewing process and supporting research. The iPad team were also tasked with creating support material for the next iteration of students based upon student feedback and personal experience. Through constant engagement with the iPad team, and through their activities, we were in a strong position to deliver an agile project that could quickly adapt as required.

Evaluation and impact

As part of the evaluation student data was collected by questionnaire twice during the project; once after three months and a second time towards the end of the academic year. Surveys were deployed and data imported into Microsoft Excel for analysis. All data are expressed as the percentage response for each question. N= total response number. For questionnaire one (~November 2012) all data are shown (N=66). For questionnaire two (~May 2013) data are drawn from a sample from the total number of questionnaires submitted (N=77).

Initial data show that students engaged positively with the technology and they enjoyed using iPads during lab sessions (Figure 2A) with an increase in student satisfaction over time from 59.1% of students who agreed or strongly agreed to 72.1%. It was encouraging to see that the added features of an iPad were being used: over 90% of students reported using the iPad to capture photographic data by the end of the project (Figure 2B). Fewer students used video initially but this also increased over time (Figure 2C). Interestingly, before starting university, around half of students reported to never having used a tablet device. These data suggest that despite the lack of initial exposure students quickly integrated the technology into their practice.

Students were asked how they used the iPad within the laboratory setting and a selection of free text comments are shown in Table 3. The varieties of comments are interesting to read reporting positive and negative experiences. Overall, the use of the iPad appeared to support student workflows although some students reported issues with some apps and with data being lost. An important part of this project will be to review all student comments, to ensure we are able to address as many of these issues as possible, thus promoting a better experience.

| Finding molecular memos online or using a periodic table app |
| Taking pictures of experiments, writing results in the Notes app. Negative is that if you don’t save your work, it can be lost easily |
| Using iPad to open protocols, take pictures, notes, using graph apps – all positive. Negative – apps sometimes close |
| Use Dropbox to store lab reports and access anywhere. GoodReader app used for lab report material |
| Take Pictures, Record Data, Make Graphs |
| I just follow instructions and do what needs to be done |
| To read the manual and then to record results, take pictures, send results to lecturer at the end. Sometimes search things about the lab |
| Record results from experiments on a word processor. Take pictures of results and make notes |
| I use it for evidence documentation and voice notes I also use the app chemistry to work out theoretical and actual yields and I use graph builder for my results and photo set to write my notes and incorporate my photos and voice notes |
| The iPad is very efficient when working in the lab. The best aspect of it is that I could take photos of my experiment, which was very helpful when I had to write the reports. Also, having the application Calculator I did all my calculations in the lab when all the details were fresh in my mind. I think the most difficult experience with the iPad was at the beginning when I did not know how to use it and writing in Office HD was a real challenge for me. I lost two of my experiment data because I did not know how to save the document, but I managed to recover them. By the end of the year, the iPad turned to be essential for me and now I cannot imagine how hard would have been for me without it |
| Within lab, recording the lecture then being able to take pictures for revision and to support my assignments. Can also download lab books, that we are working through and input our data, this is good as it doesn’t get lost. We are able to also use excel to work out VO_2 max etc. this is something we wouldn’t b able to do straight away if we didn’t have the iPads |
| Take pictures and access the lab instructions |
Table 3 Free text comments on the student laboratory experience

Students took a variety of approaches to using the iPad to support their learning. At the end of the project over 98% of respondents used the device for internet searching and over 95% used it to access the VLE. When asked about how they worked with their peers, there was a pronounced increase in students using collaborative tools (Google Docs, wikis, discussion forum etc.; Figure 3A) for working. Interestingly students also used the iPad for peer communication using non-email tools whereby, at the end of the project, over 80% of students agreed or strongly agreed to engaging in this activity (Figure 3B). It will be a worthwhile future study to explore this practice.
When asked about their use of mobile apps, over 80% of students, in both questionnaires, reported that they searched for apps to support their studies although, interestingly, between 45.5% and 50% reported a neutral experience for using these in an assignment or studying for a course. To support students using iPads, app discovery is important. During the project there appeared to be an increase over time in the students’ ability to learn new apps where those agreeing or strongly agreeing with *learning how new apps work easily* increased from 78.8% to 87% with the biggest shift from 39.4% to 53.2% for strongly agree. Only a small percentage of students solely used the recommended apps (between 25–27.6%; suggesting that most students were actively exploring new ways to learn. Between 68.2% and 74.1% agreed or strongly agreed to engaging in peer app recommendation and interestingly students were also recommending apps to staff. Student to staff app recommendations, measured by agree or strongly agree, increased from 30.7% to 48.0% during the project.

As well as exploring the student experience of using an iPad within the laboratory, we also studied the impact on the general higher education experience. At the end of the project 80.5% of students reported (agree or strongly agree) that using an iPad increased their confidence in using online resources up from 60.6%, and 75.3% reported that it had enhanced their digital skills. At the end of the project 80.7% of students reported that using the iPad made their study more effective (increasing from 66.75) and between 58%–65.2% suggested the iPad required little training. Most students found the iPad enjoyable to use. Finally, it was interesting to note that students reported the iPad enhanced their engagement with their programme (Figure 4A) and supported their transition into university (Figure 4B).

Furthermore, it was encouraging to read that the iPad supported students using more online material for their studies (Figure 4C) and permeated other aspects of the students’ lives (Figure 4D). Combined, these data suggest an increase in student engagement and confidence using digital material, a good indicator for digital literacy.
Figure 4 The impact of the iPad on the student experience
Lessons learnt

When undertaking a project of this size it is important to remember that more than subject delivery will be altered. The project required significant administrative support and infrastructure to ensure sufficient network capacity and that data, paperwork and student queries were handled correctly. Staff buy in was pivotal and involved engagement from academic, technical and administrative staff. Indeed, administrative and laboratory support were essential and, thus, should be involved in the project from the beginning. Adopting this approach helped to ensure the success of the project. The project had a dedicated project manager, which again supported project delivery. In addition, this project worked with the University’s Project Management Office (PMO), whose remit did not specifically cover academic projects/pilots but did use a light touch process to monitor progress. This not only assisted with transparency of activities but allowed the University to understand dependencies, identify synergies and, formally and informally, disseminate information about the project and its challenges and successes.

Within the sector there is a continued debate focusing on the Bring Your Own Device (BYOD) and Bring Your Own Service (BYOS) and models that institutions may wish to consider. Here, it was decided to loan students a device, as this permitted us to deliver a parity of experience with the knowledge that the students have access to, and the same versions of, the technology. Whilst this decision impacts sustainability (as for each academic year new devices are required), this project would argue cost should be offset against the academic gains.

Future developments

From the onset of this project, we realised that the successful integration of iPads into the laboratory required a graduated process (Table 1. Jisc InfoNet Mobile Learning InfoKit 2012). Initial work represented displacement/enhancement activity and over time, following an increase in knowledge and skill and confidence, transition will develop into transformation. Following the successful pilot of iPads in the laboratory, we are now rolling this project out to second year undergraduate students to encompass level four and five. Furthermore, we are now moving the focus beyond the laboratory and into other areas of formal study.

Transferability

This case study has presented activity and data for the use of iPads within the laboratory setting. It has also discussed process and policy and reviewed student experiential data. For those wishing to undertake similar work, we hope that the material presented here will offer support. Please see the table below for specific advice relating to implementing a project involving iPads in the laboratory.

<table>
<thead>
<tr>
<th>Area</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run a project pilot</td>
<td>A project pilot can help identify issue and challenges early on before a project launch. They can also be used to help identify core agents of change. Regarding iPads, Apple is very supportive and to find out more information, contact your Apple Education Account Manager.</td>
</tr>
<tr>
<td>Be explicit in all communications to manage expectations</td>
<td>Keep students informed at all times with clear instructions and notices. Offer student support and training</td>
</tr>
<tr>
<td>Do not expect everything to change immediately</td>
<td>Introducing iPads into the curriculum will impact people in different ways. The speed of change will differ and it is important to ensure quick wins to develop confidence and engagement</td>
</tr>
<tr>
<td>Develop senior manager buy in</td>
<td>This project had a senior university manager as project director. This promoted staff engagement and supported activity. This level of support can significantly enhance project outcomes</td>
</tr>
<tr>
<td>Align the project to specific targets and KPIs</td>
<td>If a project is aligned to institutional KPIs and strategic vision, this can promote buy in and funding</td>
</tr>
</tbody>
</table>

Table 4 Advice for other wishing to engage in this activity.
Summary

The headlong rush, in many countries, to provide tablets to undergraduates reflects the perception of the power of a single device to transform education. Is this a disruptive technology that can impact positively on learning gains, student engagement and the student experience? It may be too soon to say, so it is therefore imperative to research the area as there are significant implications for ensuring sustainability from year to year. Unless projects are well thought through from the start, and are designed to ensure a sense of ownership by staff through consultation and professional development, they can easily flounder and fail to meet expectations of students, staff and the institution. This pilot project has not only informed our thinking about BYOD for the whole university, but, more importantly, is helping us to understand the true benefits of mobile learning for developing the skills and habits of the next generation of scientists.

Acknowledgements

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References


Mobile Learning infoKit, (2012), Jisc InfoNet.