Mobile and Wireless Technologies Review

Doug Belshaw, JISC infoNet
Acknowledgements

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Given the importance of 'context' and 'affordances' highlighted in this review, the following should be noted. The review was researched and written with the help of lengthy phone conversations with interviewees, the unique typing position afforded by the beanbags at JISC infoNet towers, Jaffa cakes, an incredibly quick turnaround of comments by contributors, the legendary remixes of the artist ‘Fake Blood’, an extraordinarily helpful Twitter network, and subtle and interesting digressions into related areas.

Although this review has received input from a wide range of academics and practitioners, with every care taken to check the review for accuracy, any errors remain the responsibility of the author.
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Interviewees

The following people kindly agreed to be interviewed for the purposes of this review:

- Black, Andy (Becta)
- Book, Chris (CEO, Bardowl)
- Brown-Martin, Graham (Founder and Chief Executive at Learning Without Frontiers)
- Clay, James (Gloucestershire College, MoLeNet)
- Cook, John (Professor of Technology Enhanced Learning, Learning Technologies Research Institute)
- Ellis, Mike (EduServ)
- FitzGerald, Elizabeth (Nottingham LSRI)
- Hillicks, Janette (JISC infoNet)
- Hume, Tom (Managing Director, Future Platforms)
- Jukes, Matt (Open University, formerly at JISC)
- Kelly, Jacqui (JISC infoNet)
- Kukulska-Hulme, Agnes (Professor of Learning Technology & Communication, Open University)
- Malik, Manish (Senior Lecturer, University of Portsmouth)
- McAndrew, Patrick (Associate Director, Learning & Teaching, Open University)
- Middleton, Andrew (Sheffield Hallam University)
- Mitchell, Ron (Consultant, MoLeNet)
- Mullane, Mick (Network/Learning Resources Manager, Yorkshire Coast College)
- Pachler, Norbert (Professor of Education, Institute of Education)
- Ramsden, Andy (Head of e-Learning, University of Bath)
- Sharples, Mike (Professor of Learning Sciences, University of Nottingham)
- Short, Mike (VP of Telefonica Europe, Head of Education for O2)
- Singleton, Ian (Director, icanplayit)
- Soon, Lilian (xlearn, MoLeNet)
- Stead, Geoff (Technology Director, Tribal)
- Sugden, David (Consultant, MoLeNet)
- Sutch, Dan (Head of Development, Futurelab)
- Traxler, John (Professor of Mobile Learning, University of Wolverhampton)
- Trinder, Jon (PhD student and programmer, University of Glasgow)
- Vavoula, Giasemi (Leicester University)
- Winters, Niall (Senior Lecturer in Learning Technologies for Development, London Knowledge Lab)
- Wishart, Jocelyn (Senior Lecturer in Education, Bristol University)
Executive Summary

Scope
This review has been commissioned by JISC to review the literature on the use of mobile and wireless technologies for learning and teaching in UK further and higher education. It shall inform the development of a new ‘Innovative Practice’ publication to build upon earlier e-Learning publications (www.elearning.ac.uk/innoprac & www.jisc.ac.uk/publications/programmerelated/2006/pub_innovativepe).

Practice from the past three years, current practice, future trends and opportunities, and international comparisons make up the bulk of the review. Cost/benefit considerations are highlighted where appropriate.

Approach/Methodology
Previous JISC publications and resources were used as a starting point for this review, in addition to interviews with leading researchers and practitioners in the field, performed via telephone, email and videoconference. These individuals recommended other publications and individuals with relevant experience, knowledge and insight. Most of the latter also agreed to be interviewed. The focus of the interviews and discussions was upon the past three years in the mobile and wireless technologies landscape, current good practice, and future affordances/inhibitors. Finally, those with experience of wider international trends were asked to reflect upon these in comparison with the UK. Where no date or page is given alongside an attributed quotation this has been gathered from these interviews and email conversations (with the author’s permission).

Publications by UK bodies and projects such as Becta, MoLeNET and ALT were then explored to provide a further evidence base for the review, with these in turn referencing publications by other organizations of relevance. The review has therefore grown organically in a ‘grounded theory’ approach with no pre-conceived agenda or assumptions made about the role of mobile learning in educational institutions.

Principal Findings
Both interviewees and the literature reflected ‘silos’ of research and practice in the mobile and wireless technologies landscape. These can be defined, broadly, as:

1. Technocentric (technology for technology’s sake)
2. e-Learning related (mobile as part of the wider picture)
3. Augmentation of formal processes
4. Learner-centred

Whilst there is nominal referencing of academic literature by practitioners there is a reasonably clear demarcation between the two. It is clear that some projects have not learned from previous research and experience well-documented in the literature.

In many cases, and much like conversations surrounding ‘digital literacy’ and ‘cloud computing’, discussion of mobile learning within and between institutions is used as a proxy to consider the bigger picture of changes happening within education. With a greater focus on learners as customers and institutions being run very much as businesses, both publications and interviewees were at pains to point out how mobile learning can help improve retention, engagement and outcomes.

There may be nothing particularly ‘special’ about e-learning to many students, but ‘m-learning’ (as it is sometimes known) still retains some glamour and can inspire awe. Learners who know how to use mobile technologies for personal entertainment and communication do not necessarily know how to use the same technologies to aid their studies.

At the turn of the century Prensky’s ‘digital native/immigrant’ dichotomy caused many educators to advocate a ‘hands-off’ approach when it came to directing learners with technology. The theory was that ‘Millennials’ or the ‘Google Generation’ not only had access to more personally owned technology than any previous generation, but that they naturally knew what to do with it. This has been widely debunked in favour of a more nuanced ‘digital visitors/residents’ metaphor (White, 2008) that brings the experience and expertise of educators back into focus. Failing to place pedagogy at the heart of change management initiatives has led to many mobile learning failures.

Three things that learners do expect, however, are:

1. To be able to use their own devices with corporately-owned IT infrastructure.
2. For technology not to be used as a crutch for poor learning and teaching experiences.
3. Unhampered digital communication with their peers, tutors and administrators.

In addition, it would appear that learners’ study habits are changing. They expect learning resources and relevant information to be available as and when required. Increasingly they are expecting to connect their social networks - through Facebook, Twitter and the like - to their studies. With social networking driving sales of smartphones a spectrum of ways
exists in which institutions can embrace such functionalities, including altering filtering protocols and enabling sign-in to services through 3rd-party authentication system.

Although much is made of the ‘revolutionary’ nature of mobile learning, it is those institutions with a clear digital strategy that have been successful. For these institutions, the affordances of mobile learning allow an evolution towards a shared vision of a further or higher education institution in the twenty-first century.

There is, and never will be the ‘perfect’ mobile learning device. The fast-paced nature of change coupled with the business and/or entertainment focus of mobile devices means that education is likely only ever to be able to appropriate them for learning activities. So long as institutions place pedagogy first as part of a wider digital strategy, this should not pose a barrier to adoption.
Outline and Scope

This review was carried out at a time of unprecedented public sector cuts and in the toughest economic climate for over 70 years. Whilst institutions will inevitably look towards technology as a cost-saving measure it is important to remember: (i) that any major change management process should prioritise pedagogy, and (ii) that such processes will inevitably involve an upfront cost. Despite this, a move towards the use of student-owned technologies for learning can and will save institutions money in the medium to long-term if planned appropriately.

What follows is a review of mobile and wireless devices to promote new models of learning. The context within which current mobile initiatives operate is outlined first, followed by an overview of previous work in the area. Discussion of the salient issues and recommendations from interviewees and the literature includes both looking back and looking forwards at trends, barriers and opportunities for mobile learning.

The scope, then, as set out in the brief, is upon the past three years, current practice, future trends/opportunities, and international comparisons. Where possible, allusion to cost/benefit considerations have been made.

What is ‘mobile learning’?

What is ‘mobile learning’? Despite over ten years of research into mobile and wireless technologies and numerous projects, the concept of what comes under its auspices remains problematic. Advocates are keen to point out that ‘m-learning’ is not simply an impoverished version of ‘e-learning’. As Traxler (2007, p.14) puts it, ‘mobile’ is not a qualifying adjective but instead a whole new approach to learning: “just-in-time, just enough, and just-for-me”.

This leaves those interested in mobile learning initiatives in a quandry: how should mobile learning be considered in relation to e-learning and how does it change pedagogies? Winters (2006) identifies four dominant perspectives:

1. Technocentric (mobile learning means using mobile devices)
2. Relationship to e-learning (mobile learning as an extension of e-learning)
3. Augmenting formal education (adding something to face-to-face teaching)
4. Learner-centred (mobile learning as learning by a mobile individual)
Traxler’s 2009 article expands on his 2007 paper, explaining that ‘mobile learning’ means more than the conjunction of the phrase’s constituent words:

"[Mobile learning] has always implicitly meant 'mobile e-learning' and its history and development have to be understood as both a continuation of 'conventional' e-learning and a reaction to this 'conventional' e-learning and to its perceived inadequacies and limitations."

In a sense, mobile learning is a proxy for wider changes in the educational landscape. Individuals and publications involved in this review have cited everything from social constructivism to cloud computing in their justifications of the importance of mobile learning. Given the fragmented nature of the current mobile learning environment, there are multiple definitions of mobile learning; however, most of these definitions recognise the importance of context, access and conversation - a widely-accepted definition being that mobile learning involves:

“the processes (both personal and public) of coming to know through exploration and conversation across multiple contexts amongst people and interactive technologies” (Sharples, M., et al, 2007)

It is not the mobility of the technology that is important in mobile learning, but the mobility and flexibility of the user. The difference is explained well by Sharples, et al. (2007) in the example given of a tourist who enjoys a ‘mobile lifestyle’ and learns about a destination from both non-technological sources (e.g. her friend, a magazine) and technological sources (e.g. a web search, multimedia guides on her mobile device). Focusing on the learner in mobile learning ensures the emphasis is placed upon pedagogy rather than hardware/software.

The Mobile Learning Network (MoLeNET) is one of the largest mobile learning initiatives in the world. The definition of mobile learning they use is a broad one as, although influenced by academic research, MoLeNet is focused on innovation and implementation:

"[Mobile learning involves the] exploitation of ubiquitous handheld hardware, wireless networking and mobile telephony to facilitate, support enhance and extend the reach of teaching and learning” (www.molenet.org.uk/about)

This is the definition of ‘mobile learning’ that we shall assume for the purposes of this review (unless otherwise stated).
There is no one, homogeneous mobile learning landscape. Whilst this is true of most disciplines, subjects and areas of research, this is particularly true with mobile learning. Due to funding arrangements, which sector is involved, and country-specific contexts, mobile learning means different things to different communities.

In addition, what has been deemed to be important in mobile learning has shifted over the last decade. “Ten years ago mobile learning was about displaying e-learning on a small screen” (Woodill, 2011, p.12). The focus moved from the mobile device to the use of the device in a non-classroom setting - in other words, allowing a device to be used on-the-go. Our current understanding of the ‘mobile’ element is that mobile learning applies to the learner and involves not only mobility but connectivity. “Learning is interwoven with every life,” writes Sharples (2007, quoted in Woodill, 2011, p.12), “Mobile learning can both complement and conflict with formal education.”

Ultimately, as Richard Hall states, “We need to ask what is it for? M-learning should be seen within a broader TEL/learning and teaching focus.” Kukulska-Hulme (2010) adds, “Mobile learning is here to stay, even if in a few years' time it may no longer be distinguishable from 'just learning'.” John Traxler, however, sounds a note of caution,

"[Learning in future will] be learning transformed by the near-universal capacity to generate, discuss, store, transform, broadcast and consume ideas, information, ideas ... In ways not defined, constrained, imagined by institutions."

In other words, it may be ‘just learning’ - but not learning as we currently know it.

Given that institutions need to deal with their own survival and with business models, an emerging metaphor worth watching is that of the ‘new nomadism’ (Economist, 2008). This marks the decline of the ‘road warrior’ and the normalisation of mobile technologies for work and learning:

“Today, we are all nomads. For many people... being mobile is the very essence of their work environments. And, for most of us, commuting to work is an unavoidable fact of life and takes up a significant part of the day” (Woodill, 2011, p.3).

Mobile learning, then, is more than simply the use of a certain class of technologies. Instead, it is a “philosophical approach to the possibility of learning anytime anywhere - knowing that you can find information when you need it” (Woodill, 2011, p.184)
Mobile and Wireless Overview

There are, at the last estimate by Mike Short, Vice-President of Telefonica Europe, currently 82 million mobile phones in the UK (a penetration rate of 130%). This is due not only to the phenomenon of many people have both work and personal mobile phones, but the increasing use of specialist mobile phones in certain sectors and machine-to-machine communication by devices such as ‘smart meters’.

Mobile devices are changing societal discourse and knowledge (Traxler, 2007, p.10), providing advantages not only for work but for learning. Some are predicting mobile phone ownership to rise to 20 billion by the year 2020 (Mike Short), some 50 billion (GSMA) with their networked nature comprising an ‘Internet of things’.

When researchers talk of the ‘affordances’ of a mobile device they refer not to cost implications but to its quality or ability to perform an action. An advantage of a mobile phone, for example, might be its inbuilt Global Positioning System (GPS). An associated affordance would be the user’s navigation to a desired location. Affordances are experiential.

Woodill (2010:53) identifies seven main affordances of mobile learning:

1. Mobility
2. Ubiquity
3. Accessibility
4. Connectivity
5. Context sensitivity
6. Individuality
7. Creativity

These affordances permeate the review and discussion elements of what follows. Each should not be taken as independent of the others, but seen as overlapping and being influenced by other elements. For example, is the notion of ‘privacy’ assumed in ‘Individuality’ - indeed what does privacy mean in this context?

This mobile and wireless review is concerned with only one of the following three categories:

- Mobile NOT wireless
- Wireless NOT mobile
- Mobile AND wireless
Examples of the first type are devices such as the Personal Digital Assistants (PDAs) that allowed so much of the earlier work in the mobile learning landscape to take place. They include some form of technology that enables students to learn ‘on-the-go’ but no wireless functionality. The second type include devices such as fixed wifi-enabled LCD projectors or various types of sensors. Whilst information can be sent to and from these devices, the device itself is immobile.

It is the third category that we are concerned with primarily here: devices such as mobile phones, PDAs, laptops and tablets. These devices are mobile and wireless as they can be moved whilst connecting wirelessly, providing functionality that would not otherwise be available. For the sake of convenience and reading ease this review shall assume that devices referred to under the term ‘mobile learning’ are both mobile AND wireless.

There is much overlap between games-based learning, mobile learning, cloud computing and other new education-related technologies. Where it is useful to do so, these differences shall be spelled out. As will become clear, however, it is very difficult to consider mobile technologies and mobile learning in isolation.

Finally, before proceeding, this review is but a lens through which one can view the mobile learning. There is such a plethora of writing on the subject from all kinds of angles, a “bubbling of research activity” as John Traxler puts it, that this will only ever be a partial snapshot of the current state of play.
Contexts and Rationale

This section analyses the contexts within which UK educational institutions have (and will) initiate mobile learning initiatives. ‘Context’ as defined by Brown (2010, p.7) is:

“the formal or informal setting in which a situation occurs; it can include many aspects or dimensions, such as environment, social activity, goals or tasks of groups and individuals; time (year/month/day).”

More specifically in the mobile learning research, ‘context’ is used to the context of learning, supported by the mobile technology. Instead of fixed contexts, therefore, they become dynamic, “encompassing interactions between learners and their goals, artefacts and learning materials, physical and social settings, and technologies” (Mike Sharples). The importance of context is emphasised by Wingkvist & Ericsson (2010, p.184) who state that those mobile learning initiatives that have not understood the context well enough “will not survive beyond the scope of the initiative and the project’s enddate.”

Three contexts are presented here as of relevance to UK institutions. The European context is also, to a great extent, the Western context as Europe has historically been at the forefront of mobile learning initiatives. The research context comprises a brief overview of some of the most important literature, providing theoretical underpinnings for mobile learning initiatives. Finally, the pedagogical context attempts to situate mobile learning initiatives within practical student-focused learning theories.

European Context

The MOBIlearn project (www.mobilearn.org), which ran from July 2002 to March 2005, was the first European large-scale mobile learning project. The 33-month project included organisation from nine European countries as well as the USA and Australia and focused upon education outside the traditional classroom. Thirteen work packages were identified with the focus being upon basic skills and workplace learning (Kukulska-Hulme, et al., 2010).

With partners including Nokia, Compaq, Deutsche Telecom and Telecom Italia, the focus was inevitably upon the device, with explicit aims including the development of:

- “Theoretically-supported and empirically-validated models”
- “A reference mobile learning architecture”
• “A business model”

This, as some projects before and after, was funded by the vocational learning-focused Leonardo Da Vinci programme of the European Union. Further details about the projects that aimed to move from “distance learning (d-Learning) and electronic learning (e-Learning) to mobile learning (m-Learning)” can be found at: http://learning.ericsson.net/mlearning2/project_one/index.html

One of the consequences of the MOBIlearn project was a “shift in focus from learning with handheld devices, towards support for the mobility of learning”. The recognition was that the challenge in mobile learning is to “connect the learning across contexts and life transitions” (Kukulska, Hulme, et al., 2009, p.6)

At the same time, but stemming from a project through the University of Birmingham, the UK hosted the first international conference on mobile and contextual learning (www.eee.bham.ac.uk/mlearn). This led to the international mLearn conference which is now held in a different country each year. The first IEEE International Workshop on Wireless and Mobile Technologies in Education (http://lttf.ieee.org/wmte2002) was held at Växjö University in Sweden in the same year.

An ‘M-Learning’ project, funded by the European Fifth Framework programme and co-ordinated by the UK Learning and Skills Development Agency ran from 2001 to 2004. This 3-year project focused on “young adults aged 16 to 24, who were considered most at risk of social exclusion in Europe” (www.m-learning.org). This project proved the case for mobile learning, encouraging practice-led experimentation with mobile devices.

Kukulska-Hulme, et al. (2009:7) note that “there is little to connect delivery of location-based content on mobile phones with group learning through handheld computers in the classroom” which meant that “early definitions of mobile learning were anchored on the use of mobile technology”. Research attention started to be directed at “those simple things that technology does extremely and uniquely well” (Roschelle, 2003, p.268).

The ‘mobile’ element of mobile learning began to be viewed as “an emergent property of the interactions between people and technologies” (Kukulska-Hulme, et al., 2009, p.8). The work of Kakihara and Sørensen (2002) was taken up by researchers as a framework for further research into mobile learning. This framework, looking at the physical, conceptual, social and time-related elements of has informed further projects.

Whilst there have been many mobile learning projects inspired and funded as a result of major European projects (such as Learning2Go, MoLeNET, and work by Learning &
many of these have involved schools and Further Education institutions. As Kukulska-Hulme, et al. (2009, p.11) comment:

“[T]ertiary education projects do not seem to be overly concerned with connecting the lecture theatre with the outside world and bringing students out into it. The approach is more focused on supporting students' learning wherever they are rather than displacing them somewhere to learn.”

The terms of discourse for European mobile learning projects seem to be bounded by work within the basic skills and vocational learning arena. Many successful projects have involved extending the formal learning environment (e.g. Knowmobile, MeduMobile, Flex-Learn) or impart basic skills by repetition via an always-available device. As such, there remains somewhat of a disconnect between academic research and practice.

In ‘The Role of Mobile Learning in European Education’, a European Socrates programme-funded project ([www.ericsson.com/ericsson/corpinfo/programs/the_role_of_mobile_learning_in_european_education/products.shtml](http://www.ericsson.com/ericsson/corpinfo/programs/the_role_of_mobile_learning_in_european_education/products.shtml)) the UK is ranked top of a league table of countries in terms of mobile learning. It cites, amongst other things, the Open University’s continued innovation, exemplified by it’s Mobile Learning Support blog ([www.open.ac.uk/blogs/mLearn](http://www.open.ac.uk/blogs/mLearn)) making the important point that,

“It is not technologies with inherent pedagogical characteristics which succeed in distance education, but technologies that are generally available to its citizens.” (p.5)

This publication also makes reference to a rarely-cited methodology named Internet-based Performance Support System with Educational Elements (IPSS_EE). Workpackage 4: The Role of Mobile Learning in European Education, for example, explains that IPSS_EE is a “performance-based action learning environment” in which “students learn small amounts of discrete information at one time and slowly build a network of these information chunks” (p.58). Students tie together these discrete pieces to understand larger ideas. This is a deeply constructivist learning methodology that seems perfectly suited to mobile learning as it “minimises the lag between the content presentation (or learning the content) and execution of the learned information” (p.51).

One of the key messages from the ‘The Role of Mobile Learning in European Education’ is the importance of mass-adoption of a device. Citing 12-inch laserdiscs in the 1990s the authors explain that although fantastic pedagogical content and possibilities were created, not enough people owned laserdisc players. Mobile phones, on the other hand, with 3G connections, are hitting critical mass. The authors (p.7-13) believe there to be four levels or ‘stages’ of mobile adoption:
1. Administration (preventing student drop-out, checking assessment deadlines, getting feedback from tutors)
2. Study help (communication from and with institution, browsing course material, multiple-choice tests)
3. Course modules (accreditation of mobile learning modules, part of formal assessment)
4. Location/context-sensitive information (rich and collaborative activities, use of established technologies like GPS, RFID and SCORM)

Quoting with approval Futurelab’s report ‘Towards New Learning Networks’, the authors explain that most discussions around learner choice focus upon providing a plethora of routes through predefined subjects and curriculum content. A “truly personalised system,” however, “requires that learners… are also supported to become active partners in developing their own educational pathways and experiences” (p.55)

Another European project worth mentioning is MOTILL (Mobile Technologies in Lifelong Learning). This one-year project ([http://motill.eu](http://motill.eu)) began in early 2009 with the results of the project being:

- “An up-to-date survey on the use of mobile technologies in learning and training projects” in the partners’ countries; this survey takes into account also the policies set up in the various countries by the relevant institutions;
- “A methodological framework to analyse and highlight best practices”
- “An open space for public discussions, involving public and private institutions, research centres, educators, and trainers”

The collection of ‘best practices’ for Mobile Lifelong Learning is available from the MOTILL website ([http://motill.eu/images/stories/motillbooklet_en.pdf](http://motill.eu/images/stories/motillbooklet_en.pdf)) and features an evaluation grid was applied to the projects featured in the publication:
The European Consortium for the Learning Organisation (www.eclo.org) is actively involved in many European-funded projects. Although focused primarily on lifelong learning initiatives these often include mobile technologies. The “well-established infrastructure” of ECLO means that their publications provide a useful method of dissemination.

Finally, IAMLearn (http://mlearning.noe-kaleidoscope.org), the International Association for Mobile Learning, aims to “promote excellence in research, development and application of mobile and contextual learning”. It organises the annual mLearn conference with its website forming a community hub for news, research papers, links and vacancies related to mobile learning.

Research Context
Trends come and go in all disciplines and mobile learning research is no different. Recent work has talked of learning ‘in’ and ‘across’ contexts with these contexts being ‘learner-
generated’ (Cochrane, 2010) and intentional ‘Communities of Practice’ models being adopted.

The focus of current research is upon the learner rather than the device, with Norbert Pachler, for example, talking of the importance of ‘appropriation’ as a way of linking curricular practices with the development of a learner (Pachler, Bachmair & Cook, 2010). This, as Jon Trinder explains, is more than simply ‘ownership’. It is about the agency of the user rather than the pre-given world of cultural products (Nobert Pachler). Appropriation in the context of mobile learning is the purposeful adoption and assimilation of a device by a learner. When a student learning using an mobile device they have appropriated is compared to a non-mobile learner, says Vavoula (2005), there are,

“indications that mobile learning is more interactive, involves more ‘bustle’, more contact, communication and collaboration with people” (cited by Kukulska-Hulme & Pettit, 2010, p. 138)

One of the holy grails for mobile learning researchers is to come up with models and categorisations that enable widespread acceptance and uptake of mobile learning; models that can be contextualised but serve as an accepted framework. These range from the very general - for example, “‘permanently online’, ‘frequently online’ and offline” (Shrestha, et al, 2010, p.341), conceiving of the mobile phone as a ‘terminal’ (Ford & Leinonen, 2010, p.196-7), or the detailed:
One of the most promising models recently developed is that of Wingkvist & Ericsson (2010) who propose a four-stage model. Their studies of small-scale trials suggest that their framework “could be offered to funding agencies to serve as an aid to help decide what to fund and when to evaluate”. It could, they suggest, “serve as an indicator as to when the evaluation of a funded mobile learning initiative should take place” and “help to decide which initiatives to continue to fund” (p.190-1).

The four stages outlined by Wingkvist & Ericsson are:

1. Idea (establish soundness of idea, establish technical platform)
2. Trial (test the idea, elaborate the learning)
3. Project (large-scale testing, formalise resources and outcomes)
4. Release (hand over control, remove reliance on initiators)

At the same time as providing a framework within which mobile learning initiatives can be organised, the focus very clearly moves from the technology, to learning, to social elements and only finally to whole-organisation considerations. Adopting a model similar to
this could provide a sustainable model to answer John Traxler’s earlier ‘bubbling of research activity’ criticism.

In addition, individuals and institutions need to be able to learn from the mistakes of others. FAILFaire (http://failfaire.org) is a method of sharing what failed in mobile-related projects, organised by MobileActive.org. Their website provides details of how to organise events and discussion where people can talk frankly about initiatives that did not scale, were not sustainable, could not get around bureaucratic hoops, or faced unanticipated barriers. Sharing of practice and experiences can protect against a celebratory technological determinism.

The danger is that useful predictions within future-gazing documents such as the Horizon Report (http://wp.nmc.org/horizon2010) result in a reification of trends and guesses and lead to a conservatism based on evolution, not revolution. We tend to judge, as Laurillard (2007) points out, technologies by our current standards, norms and expectations. Laurillard suggests a ‘conversational framework’ to define the “minimal requirements for supporting learning in formal education” (2007, p.161) in a way that takes into account learner motivation and agency. Pachler, Bachmair & Cook, however, question Laurillard’s framework, as “whilst [being] of merit, the dominant frame, Activity Theory (AT), is characterised by a number of features and weaknesses, which make it unsuitable for our purposes” (2010, p.155).

The difference between learning via mobile devices and the mobility of the learner is brought out in the following quotation from John Dewey in a time when mobile phones were only dreamed of:

“A society which is mobile, which is full of channels for the distribution of a change occurring anywhere, must see to it that its members are educated to personal initiative and adaptability. Otherwise, they will be overwhelmed by the changes in which they are caught and whose significance or connections they do not perceive.” (Dewey, 1916:88, quoted in Sharples, Taylor & Vavoula, 2007, p.1)

One of the major affordances of mobile devices is that they allow for much greater (and much quicker) access to these ‘channels for the distribution of change’. Hence, rapid evolution in cultural, pedagogical and societal norms can feel like a revolution. A rapid “shift in philosophical, theoretical and professional understanding” has been identified by Herrington & Herrington, who present the following table synthesising their findings (2007, p.2)
At a time when a ‘canon’ of knowledge to teach young people is almost impossible to define, and when the boundaries of subjects are increasingly blurred, mobile learning allows for collaboration, community and criticality in a way never before possible (Vavoula, et al., 2007).

Jones & Issroff (2007) group the advantages of mobile learning under the headings ‘technology appropriation’ and ‘coping strategies’. They add that “control over learners’ goals, ownership, fun, communication, learning-in-context and continuity between contexts” are the motivational factors that help fuse the informal and formal in mobile learning. A sense of ‘ownership’ over mobile devices, they argue can help learners develop a greater sense of ownership over their own learning (2007, p.248).

This ownership, as Traxler points out, is a result of mobile devices being part of the ‘real life’ of the learner:

“Students no longer need to engage with information and discussion at the expense of real life but can do so as part of real life as they move about the world, using their own devices

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Table 1: Shift in philosophical, theoretical and professional dimensions of learning

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Moving from</th>
<th>Moving to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philosophy</td>
<td>Instructivist</td>
<td>Constructivist</td>
</tr>
<tr>
<td>Theory</td>
<td>Behaviorist, cognitivist</td>
<td>Situated, socio-constructivist, andragogical</td>
</tr>
<tr>
<td>Course design</td>
<td>Bounded scope and sequence</td>
<td>Open-ended learning environment, flexible content</td>
</tr>
<tr>
<td>Time and place</td>
<td>Fixed in educational institutions</td>
<td>Distributed, to suit the contexts of the learners</td>
</tr>
<tr>
<td>Knowledge base</td>
<td>‘Objective’ knowledge, largely determined by experts</td>
<td>Knowledge built and shared among the community</td>
</tr>
<tr>
<td>Tasks</td>
<td>Decontextualized, concise, self-contained</td>
<td>Authentic, reflective, complex and sustained</td>
</tr>
<tr>
<td>Resources</td>
<td>Fixed, chosen by teacher</td>
<td>Open, chosen by learners with access to search tools</td>
</tr>
<tr>
<td>Support</td>
<td>Teacher</td>
<td>Community of learners</td>
</tr>
<tr>
<td>Mode</td>
<td>Individual, competitive</td>
<td>Collaborative, networked</td>
</tr>
<tr>
<td>Technology tools</td>
<td>Fixed, located in learning spaces</td>
<td>Mobile, portable, ubiquitous, available</td>
</tr>
<tr>
<td>Knowledge outcomes</td>
<td>Facts, skills, information</td>
<td>Conceptual understanding, higher order learning</td>
</tr>
<tr>
<td>Products</td>
<td>Academic essays, exercises, or no tangible product</td>
<td>Authentic artifacts and digital products</td>
</tr>
<tr>
<td>Assessment</td>
<td>Standardized tests, examinations</td>
<td>Performance-based, integrated and authentic assessment</td>
</tr>
<tr>
<td>Transfer of knowledge</td>
<td>Stable knowledge adapted to different contexts</td>
<td>New and changing knowledge acquired when required</td>
</tr>
<tr>
<td>Professional learning</td>
<td>Courses, group events, workshops</td>
<td>Personal, just-in-time, community-based</td>
</tr>
</tbody>
</table>
to connect them to people and ideas, ideas and information of their own choosing, perhaps using their own devices to generate and produce content and conversation as well as store and consume them." (Traxler, 2009, p. 70)

The wider mobility of society has led to ‘approx-meetings’ and ‘socially negotiated time’ (2009: 73) which, although mobile devices have not been designed specifically for educational purposes, has a knock-on effect upon formal education. This disruptive effect has both a strong and a weak element, argues Traxler. The ‘weak’ element of the disruption due to mobile devices in formal education is at the level of nuisance - such as ‘cheating’ during examinations, inappropriate photographs, devices beeping during class time. The ‘strong’ element of disruption, on the other hand, “challenge[s] the authority of the curriculum and the institutions of formal learning” (2009, p. 77); students can effectively become gatekeepers and organisers of learning for other students in a way institutions have only been able to do previously. Whilst institutions struggle to co-ordinate people, time and spaces, mobile devices allow learners to self-organise via ‘affinity spaces’ that allow for “absent presence” and “simultaneity of space” rather than place (Traxler, 2008, p. 127).

At a time when a learner can organise any other element of their life independently of their location or context, many institutions insist on the Virtual Learning Environments (VLE) as the only method by which students can access learning resources and course-related information. Whilst providers such as Blackboard have a mobile offering (http://blackboard.com/Mobile/Overview.aspx) many VLEs are difficult or, indeed, inaccessible, via mobile device.

An example of a system featuring a VLE as a scaffold on which to use a whole host of related technologies, comes in Cochrane (2010, p. 137). Communication is key, with mobile devices playing a central role:
Such a system, implemented at Unitec, Auckland (New Zealand) demonstrates that a ‘small pieces, loosely joined’ approach can empower learners to take control of their learning rather than be passive users of predefined content and structures. Key to the initiatives outlined in Cochrane’s paper is that spaces are created by learners, with peers and methors invited in afterwards. This shifts the locus of control and supports the shift from instructivist to constructivist philosophy and pedagogy outlined in Herrington & Herrington’s earlier table.

Much of the various contexts for, and elements of, mobile learning are collated in the London Mobile Learning Group’s ([www.londonmobilelearning.net](http://www.londonmobilelearning.net)) freely-accessible literature database. Given the rather fragmented and diverse environment in which mobile learning research takes place, this is a valuable resource. The ‘Key Readings’ section is of particular use to those new to the field.

To conclude, the research context for mobile learning is varied and, as many proponents argue, depends itself on the context within which individuals and institutions operate. One clear message is that mobile learning is about much more than simply learning via mobile devices, with an emerging picture of mobile learning initiatives as being ‘trojan horses’ for wider changes within the education sector.
Pedagogical Context

Used effectively, mobile devices can help change and refocus pedagogies. Unlike interactive whiteboards, which perpetuate a ‘stand-and-deliver’, transmission model of education, the affordances of even commonplace mobile devices allow for a transformation in learning activities.

This ‘pedagogic shift’ has a decidedly social element. Whilst learning remains an individual activity, the context in which it happens is, and always has been, based around ‘conversations’, loosely defined. Indeed, “the processes of coming to know through conversations across multiple contexts amongst people and personal interactive technologies” is another definition of mobile learning (Sharples, 2005 - quoted by Wingkvist & Ericsson, 2010, p.185)

The idea that learning is created through interaction is the central tenet of a learning theory called ‘Constructivism’, based on the work of Jean Piaget. Some, such as Seymour Papert, took this further into ‘Constructionism’ which stresses the importance experiential learning and of creating learning objects.

More recently, Connectivism, “a learning theory for the digital age” has been developed by its two main proponents, George Siemens and Stephen Downes. Using the metaphor of a network, Connectivist theory states that, “knowledge is distributed across a network of connections, and therefore… learning consists of the ability to construct and traverse those networks” (Downes, 2007). Constructivism, Constructionism and Connectivism have important consequences for mobile learning as they reveal that, not only is our learning augmented by interactions with other people, but that it is, in fact, predicated upon them.

Another metaphor for learning is that of situated learning and the ‘cognitive apprenticeship’. Rendered easier by mobile devices, “the idea of cognitive apprenticeship [is] where teachers (the experts) work alongside students (the apprentices) to create situations where the students can begin to work on problems even before they fully understand them.” (Naismith et al., 2004 - quoted in Woodill, 2011, p.66). In the field of vocational and work-based learning particularly, ‘cognitive apprentices’ can have their contexts transformed by the use of mobile devices for learning. The idea of a ‘mobilography’, where reflection is prompted by the earlier capturing of images or videos on a mobile device, is an emerging example of at least the modification of learning, as defined by Puontedura’s SAMR model:
The above model is gaining traction, especially by more pragmatically-informed mobile learning projects, as a holistic method of combining technology, content and pedagogy. Combining these approaches, it becomes clear that educational institutions need to shift their attention from being focused solely on the individual learner towards the wider ecosystem in which learning takes place. As Woodill (2011, p.32) puts it, “a mobile learning ‘ecosystem’ [is] made up of people embedded in a particular cultural context using mobile technologies on a network to access or store information as part of a learning experience.”

Unfortunately, much of the small-scale, experimental work being carried out by practitioners in Higher Education is hampered by a combination of institutional caution, elements of insouciance, and taking for granted the results of (often) transformational, innovative projects.

In schools and Further Education, however, a different picture emerges. Becta have commissioned research into the next generation of university students, finding that they have not been learning in environments where ICT is seen as important:

Source: www.hippasus.com/rrpweblog
As the researchers note:

“School is increasingly the place where the next generation meets face to face. They then go home and text, phone or go online to contact their social group.” (Becta, 2009, p.29)

Another Becta report found the role of the teacher to be ‘critical’ in the appropriate and transformational use of student-owned devices for learning. Where teachers can use devices effectively, so young people also use them more effectively (Becta, 2010, p.1). The two main benefits in a school-based context were seen to be “increased motivation and engagement” and “improved learning continuity”, the latter due to devices being used both at home and at school, meaning “learners take advantage of new opportunities for learning outside the classroom” with “increased family involvement” Becta (2010, p.2).

Motivating learners is also a key theme in reports from MoLeNET, an LSN-funded programme, providing “technical and pedagogic advice and support, materials development, continuing professional development, mentoring, facilitation of peer-to-peer support, networking and resource sharing, research and evaluation” (www.molenet.org.uk). Running over three years, MoLeNET has found mobile
learning to encourage “a safe, private and non-judgemental environment for learners to try out ideas and make mistakes in order to progress” MoLeNET (2010a, p.4). Truro College, in particular, found that a mobile learning initiative engaged learners to the extent that not one student dropped out of a course with a traditionally high turnover rate (MoLeNET, 2010a, p.5)

This is not to say, however, that the mobile learning has been a panacea for the ills of chalk-and-talk. As a representative from Stoke on Trent College pointed out:

“Relationships between tutors, learners and IT staff need to be further developed so that productive debates can be had over issues such as security, curriculum planning and delivery, resource development, establishing authenticity of work and fitness for purpose of IT infrastructure.” (MoLeNET, 2010a, p.8)

This has been echoed by many institutions, including Wirral Metropolitan College who found:

“The main barrier to sustaining mobile teaching and learning [to be] the amount of time involved in training and supporting staff and for teachers themselves to develop their delivery to include effective mobile learning.” (MoLeNET, 2010a, p.8)

There is a wealth of research outputs and publications on the MoLeNET website (www.molenet.org.uk/pubs) to inform future mobile learning initiatives. Perhaps the key findings were summed up in another MoLeNET report (2010b:3) which found that over and above increased flexibility and learner retention, mobile learning initiatives led to improvements surrounding:

- Efficiency of assessment
- Standard of evidence
- Management of portfolios
- Personalisation of assessment processes
- Access to assessors and teachers

Those wishing to replicate the success of MoLeNET-funded initiatives may wish to explore a new ‘ITQ for Mobile Learning’ qualification developed by LSN in collaboration with City & Guilds (http://itq.e-skills.com/Framework/ITQ-Mobile). These Level 2 and 3 qualifications are available for both staff and students and may serve as a solid, recognised basis on which to base initiatives and related staff training.
Finally, mobile learning is already with us. Whilst not all formal learning providers have launched initiatives or have started embedding mobile learning into their curricula, many are experimenting. The Horizon Report 2010 (http://wp.nmc.org/horizon2010) backs this up, with ‘Mobile Computing’ being in the ‘One year or less’ section of their ‘Key Trends’. Cloud-based, location-independent, collaborative work and learning is on the rise.
Review of Relevant JISC Publications

JISC has long been an advocate of mobile learning, funding numerous research projects and producing reports and guides synthesising good and emerging practice. Notable high-level guides relevant to mobile and wireless technologies include:

- Effective Assessment in a Digital Age (2010) - www.jisc.ac.uk/assessment.html
- Effective Practice in a Digital Age (2009) - www.jisc.ac.uk/publications/programmerelated/2009/effectivepracticedigitalage
- Effective Practice with e-Portfolios (2008) - www.jisc.ac.uk/effectivepracticeeportfolios
- Student Experiences of Technologies (2006) - www.jisc.ac.uk/publications/reports/2006/lxpfinalreport

In addition, reports, podcasts and briefing papers have been published by JISC and its delivery partner, JISC Advance, which comprises a range of advisory and complementary services. Specifically mobile learning-related publications by JISC can be found at www.jisc.ac.uk/publications/filter.aspx?Tags=30. More information about JISC Advance is at www.jiscadvance.ac.uk.

JISC seeks to “inspire UK colleges and universities in the innovative use of digital technologies, helping to maintain the UK’s position as a global leader in education”. This report will inform an ‘innovative practice’ guide due mid-2011. JISC infoNet (www.jiscinfonet.ac.uk), a JISC Advance service, “aims to be the UK’s leading advisory service for managers in the post-compulsory education sector promoting the effective strategic planning, implementation and management of information and learning technology”. The latter shall be developing a Mobile Learning infoKit which shall also be available from mid-2011.

JISC Digital Media (www.jiscdigitalmedia.ac.uk) is another JISC Advance service featuring resources and advice relating to mobile technologies. Focusing on the creation, delivery and managing of digital media resources their helpdesk, blog and training resources provide a useful service to the UK Further and Higher Education community. As well as relevant legal information and guidance from JISC Legal (www.jisclegal.ac.uk) other JISC
Advance services provide more tailored services for the support of mobile learning initiatives. JISC Mail, for example (www.jiscmail.ac.uk) would like to gather opinions on the types of apps and mobile developments those in the sector would like to see.

A final JISC body to mention is JISC CETIS, the Centre for Educational Technology and Interoperability Standards (http://jisc.cetis.ac.uk). JISC CETIS “provides advice to the UK Higher and Post-16 Education sectors on educational technology and standards” and has a number of briefing papers and reports that may be of use to those developing mobile learning initiatives.

In addition to the final reports from a whole host of JISC-funded mobile learning-related projects, the following relate either directly or tangentially (but importantly) to the theme of mobile learning:

- Mobile Enhancing Learning and Support (2008) - www.jisc.ac.uk/publications/reports/2008/melasfinalreport
- Google Generation (2007) - www.jisc.ac.uk/whatwedo/programmes/resourcediscovery/googlegen

Reviewing JISC publications and other outputs since 2005 a clear evolutionary path is evident, both in terms of mobile devices and attitudes towards them for learning. The technological context for mobile learning was vastly different in 2005: the first Apple iPhone was two years away; the social networking site Facebook was small, largely US-centric and closed to those without an educational institution-provided email address; YouTube was founded in the February. These three have proved not only to be phenomenally popular in mainstream culture but have served as catalysts to the mobile technology sector and, in turn, to mobile learning.
Whilst there are timeless elements to mobile learning, some are context-specific. Take, as an example of the former, the discussion of accessibility considerations (not just for those with some kind of learning or physical disability) and the ‘cool’ factor in JISC’s 2005 Innovative Practice with e-Learning Guide (p.16). The ability of mobile technologies to make learning experiences more inviting, engaging and accessible was as true then as it is with tablet devices such as the Apple iPad. On the flip side, some things change. The discussion of institutionally-owned devices and potential of USB flash drives reflects very much its time and context.

Perhaps most useful from this 2005 JISC publication is the ‘model of implementation for mobile and wireless learning’ on page 47:

![Model of implementation for mobile and wireless learning](image)

This remains a good basis on which an institution can begin a discussion about mobile learning. And again, the ‘Final Word’ (p.49) remains as relevant as ever:

“The introduction of mobile and wireless technologies in a phased process, starting with the development of resources on a learning platform and moving on to policies to ensure secure network access from handheld devices, is more effective than uncoordinated...
experimentation. Implementation of mobile and wireless learning will involve long term planning and will be ideally linked to teaching and learning strategies, audits of current infrastructure and e-learning provision, knowledge derived from pilot studies and student perception surveys, and an understanding of the pedagogical gains that can be achieved.”

Whilst now the social element of learning is much more at the forefront of colleges and universities’ approaches to engaging students than in 2005, the importance of basing mobile learning initiatives on sound pedagogy continues.

An increasing realisation of the affordances of mobile learning was evident in the 2006 publication of both JISC infoNet’s ‘Designing spaces for effective learning’ (www.jisc.ac.uk/publications/programmerelated/2006/pub_spaces) and JISC’s ‘Student Experiences of Technologies’. The latter talked of the ‘fragmentation’ of time and “the expectation of information and results on demand” (p.6). Whilst students cited email and search engines above mobile devices as technologies most used for learning (p.56) this was still above those who cited Virtual Learning Environments and electronic libraries. The shift towards the use of student-owned mobile devices for learning had begun.

The explosion of social software and so-called ‘Web 2.0’ technologies at this time, along with a growing realisation of the changing ‘blended’ world in which students increasingly inhabit, led to several JISC reports and publications in 2007. ‘In Their Own Words’ (www.jisc.ac.uk/publications/programmerelated/2007/intheirownwords) discussed how “ubiquitous mobile connectivity challenge[s] our preconceptions about what e-learning means and how learners should be supported” (p.3). A JISC-commissioned MORI ‘Student Expectations Survey’ (reporting before the launch of the Apple iPhone) found that whilst a third of young people intent on university did not use the ‘advanced’ features of their mobile phone, nevertheless:

“Technology was used by the majority of those that we spoke to as an aid to their life – finding information, communicating with friends and family and organising events – although they were wary of using technology for the sake of it.”

At this time, and again reflected in the JISC/MORI report, was an uncertainty relating to the boundaries of student-owned mobile devices. Debates around the appropriateness of, for example, sending SMS (‘text’) messages to students continued. This was followed-up in a JISC-funded ‘Mobiles Enhancing Learning and Support’ (MELAS) project in 2008 which found that “universities and their students will benefit from institutional wide use of communication via SMS” (www.jisc.ac.uk/publications/reports/2008/melasfinalreport).
‘Tangible Benefits of e-Learning: Does investment yield interest?’ was a timely 2008 JISC report (www.jisc.ac.uk/publications/briefingpapers/2008/bptangiblebenefitsv1) that visualised the problem educational institutions face when dealing with innovation:

Transforming learning using complex, disruptive technologies such as mobile devices is both expensive and uncertain in terms of Return On Investment (ROI). One of JISC’s roles is to provide the evidence base for such investments and to share good practice with the rest of the sector. This mitigates some ‘first mover’ risk.

In addition to funding reports into the state of integration of technologies with institutional strategies and outsourcing email to third-party providers, JISC funded a study in 2007 entitled ‘Web 2.0 for Content for Learning and Teaching in Higher Education’ (www.jisc.ac.uk/publications/reports/2007/web2andpolicyreport) which foresaw the rise of mobile devices for learning once third-generation (3G) high-speed connections became the norm. This prediction was built upon by a 2008 publication, ‘Effective Practice with e-Portfolios’ which cited the possibility for mobile devices to capture evidence for learners’ e-portfolios.

The evidence base for the success of mobile learning initiatives grew, especially after a follow-up MORI report, ‘Great expectations of ICT: How Higher Education institutions are measuring up’ (www.jisc.ac.uk/publications/research/2008/greatexpectations) found that:

“Students… seem to be well equipped with their own ICT kit. [They] all appear to have their own computers / laptop, access to the internet and a mobile phone. They are
expectant of the university to provide them with support for use of these technologies and most seem to provide this adequately.” (p.40)

Despite media outlets such as the BBC promoting podcasts, most students remained both unfamiliar and uncomfortable for learning. Text messages, so long as of an administrative nature, were deemed relevant; social networking services such as Facebook, whilst familiar, were not comfortable places for ‘learning’ with students:

![Diagram showing familiar and comfortable with using vs. not comfortable with using technologies for learning.]

This report raised a latent ‘digital divide’ issue with the use of student-owned technologies for learning. Over and above issues surrounding e-safety and appropriateness, educational institutions became acutely aware of potential problems regarding the cost of devices being relied upon for learning. Smartphones in particular, despite their affordances (e.g. GPS and 3G connections), continue to be viewed as luxury items rather than necessities by institutions.

The mobility of the learner and researchers of tomorrow was addressed in a JISC and British Library-funded ‘Google Generation’ project ([www.jisc.ac.uk/whatwedo/programmes/resourcediscovery/googlegen](http://www.jisc.ac.uk/whatwedo/programmes/resourcediscovery/googlegen)) that showed younger people do indeed interact with each other and systems differently - although not necessarily in ways institutions expect. Specifically, the assumption behind discussions of ‘digital natives’ and ‘digital immigrants’ was shown to be wide of the mark.

In 2009’s ‘Effective Practice in a Digital Age’ ([www.jisc.ac.uk/practice](http://www.jisc.ac.uk/practice)) JISC could, for the first time, assume that institutions were both aware of the importance of the social context for learning and interested in the results of their student satisfaction ratings in the National
Student Survey. “Ownership of personal technologies” stated the introduction, “is now pervasive and use of the internet, including Web 2.0 technologies, is commonplace” (p.3).

The case study featured in ‘Effective Practice in a Digital Age’ reflecting upon Southampton Solent’s use of iPod Touches with students spoke of mobile devices enabling learning to be “timely, spontaneous and flexible” (p.28) whilst the Director of ILT at Kingston College was quoted as stating that,

“Students’ mobile phones are sacred to their sense of personal and social identity: in many cases, they have made a considerable financial investment in their choice of phone and selected tariff… Mobile phone ownership is a clearly lifestyle issue for students; it is not a simple matter to invade that aspect of their lives. You have to accept there are boundaries between personal and institutional technologies that it is not always profitable to cross.”

The use of specific, student-owned technologies is of particular importance when students have a disability that may impede their learning (p.9). JISC TechDIS blog about accessibility considerations relating to specific devices such as the Apple iPad (www.techdis.ac.uk/blog) but fund, through a scheme called HEAT (www.techdis.ac.uk/getheatscheme), institutions to develop and share good practices relating to the inclusive use of technologies. Inevitably, many HEAT projects involve mobile devices and multimedia.

For those institutions wanting to develop inclusive practices, but for whom the HEAT scheme may not be appropriate, JISC TechDis have two resources that may be of interest. ‘Upwardly Mobile: Getting Started in Inclusive m-Learning’ (www.techdis.ac.uk/upwardlymobile) is a DVD-ROM that provides guidance on creating and distributing inclusive mobile learning practices. ‘GoMobile! Maximising the potential of mobile technologies for learners with disabilities’ is a publication that, in conjunction with MoLeNet, draws on the “experiences of those working in the vanguard of mobile learning and inclusivity in independent specialist colleges and further and higher education institutions” (www.molenet.org.uk/search/resource-30492.aspx).

In 2010 JISC published ‘Effective Assessment in a Digital Age’, a much-anticipated resource that, amongst other things, talked of ‘moments of contingency’:

“The concept of ‘moments of contingency’ [is] a pivotal factor in making assessment formative. These are critical points in the teaching and learning process where the flow of instruction cannot be predetermined. Technology does not create these moments but can enable spontaneous change to occur through affordances which can be exploited in the assessment design – for example, harnessing the portability of mobile phones to capture
images of a learning experience that can be used later to prompt reflection on what has been learnt.” (p.20)

The use of mobile devices for assessment purposes is the final piece in the jigsaw puzzle for mainstream adoption of mobile learning in Further and Higher Education.
Discussion and Recommendations

This section outlines the current state of play of developments in the mobile learning arena, some ‘good’ practice from the past three years, international comparisons, a look to the future and trends. The status of mobile learning in relation to access and support, staff development and cost/benefit considerations is also discussed.

Past 3 Years
As mentioned in an earlier section, with the overwhelming ubiquity of smartphones and the emphasis on mobile ‘apps’ it is easy to forget that the first Apple iPhone was launched in the UK as recently as November 2007. At that time Twitter was not widely known or used, Facebook was not ubiquitous, and YouTube had only just launched a UK version of its video-sharing site.

The confluence of affordances that hardware, software and social acceptance can lead to a ‘perfect storm’ of acceptance, to be investigated in more depth in the ‘Cost/benefits’ section. 2007 effectively saw the end of the widespread use of Personal Digital Assistants (PDAs) in large-scale educational projects. Their affordances - wireless connectivity, image and video capture/storage, larger screens - could be found increasingly on mobile phones that students and staff already owned.

Over the past three years, then, a tension has been felt by institutions as to what constitutes ‘good’ practice when it comes to the ownership of mobile devices. Those proposing using student-owned technology for learning have often been rebutted by talk of a ‘digital divide’ and possible security issues. Part of the problem is the assumption of a universal context for learning.

As almost institutions-within-institutions and free from some of both the political and academic wrangling of the wider institution, libraries have led the way when it comes to pragmatic, learner-focused use of mobile technologies. Many libraries have begun experimenting with Quick Response (QR) codes and Radio Frequency Identification (RFID) devices to reduce friction for learners accessing learning resources. Kevin Campbell-Wright have provided some guidance with the assistance of JISC Regional Support Centre Yorkshire & Humber on QR codes. This is accessible at: www.slideshare.net/shibberson/a-quick-response-to-promoting-library-services-how-you-can-use-qr-codes.
A previous wave of innovation within most libraries equipped learning spaces with wireless internet and network access, allowing users to blend digital and physical learning experiences. Some libraries, usually in conjunction with IT Services, have allowed for ‘virtual tours’ that have evolved as technology has allowed for richer and more immersive experiences. This shall be explored in more depth in forthcoming sections of this review.

Whilst hardware functionality and software versions - the advantages of a device - are matters of objective fact, the associated usability is subjective and highly contextual. Cochrane (2010:19) quotes a second-year student given the use of an institutionally-owned device as grumbling,

“The Nokia’s UI was so bad and non-intuitive that I didn’t use the phone as much as I wanted to - I really like the whole idea - just not this phone.”

The move from PDAs to smartphones not only increases the affordances available, but adds some lustre from the marketing machines that push such devices. More importantly, however, if learners carry around smartphones more capable than PDAs used in pre-2007 projects, then institutionally-owned devices would seem unnecessary.

Just as definitions of mobile learning have shifted in the last decade, so too have the relevant challenges. Although technology-related issues remain, it is issues relating to technology’s adoption and use in wider society that are at the current foreground:

"The main barriers to developing these new modes of mobile learning are not technical but social. We have little understanding of context and learning outside the classroom, and even less about how this can be supported through new mobile technologies." (Sharples, 2010, p.4)

The use of student-owned (and staff-owned) technologies for learning and teaching is not simply a matter of cost and familiarity but of convenience, accessibility and choice. So long as institutions provide facilities and devices for those without access to particular technologies, staff can expect - and indeed require - students to use these technologies for their learning. When all learners within a community are using mobile devices for learning this leads to powerful pedagogical change. As David Sugden puts it,

"Mobile devices, especially mobile phones are so powerful these days that it would be a crime not to use their facilities with all sorts of Internet enabled tools and techniques. These days we can capture sights, assessment evidence, opportunities and share them with our cohort, our assessor and/or our colleagues; within seconds."
Several JISC-funded projects, including EVAF4ALL (JISC, 2009), have initiated a ‘loanership’ scheme where either some or all students are loaned a device for the duration of their course. This can help bridge ‘digital divide’ and social justice issues.

One use of wireless technology that has been quietly popular in the last decade has been voting handsets. Ways of using these as they have become more well-known and used have improved. Recently, such systems have been expanded to provide a ‘backchannel’ to the learning event - such as a lecture - taking place. Poll Everywhere (http://polleverywhere.com) is a commercial offering with a free testing option that allows learners to respond to prompts via SMS, Twitter, or directly via a web-enabled device.

Hotseat (http://purdue.edu/hotseat), “a social networking-powered mobile web application” has been developed by Purdue University in the USA. This system also connects with Facebook and “creates a collaborative classroom, allowing students to provide near real-time feedback during class and enabling professors to adjust the course content and improve the learning experience.”

Integration with Facebook is an example of the increasing willingness (and perceived acceptability) of institutions to both contact students and facilitate connections via social networking sites. This is a carry-forward from the success, in terms of student retention and support, of SMS initiatives (Stone, 2004).

As referenced in the ‘Pedagogical context’ section, Puentedura’s SAMR model suggests that institutions should expend their energies on technologies that afford more that mere ‘Substitution’. For example, simply making a ‘mobile-friendly’ version of a VLE would be to ignore the transformational additional affordances of mobile devices. Integration of location-based information services in particular is a highly cost-effective method of making good use of mobile learning. Another is breaking down large amounts of content into smaller, more digestible ‘chunks’ that can be accessed and reflected upon on-the-go. Some VLE and LMS providers, such as Blackboard (http://blackboard.com/Mobile), are beginning to offer mobile solutions that can be tailored to individual institutions.
Anecdotal evidence would suggest that FE institutions are more likely to embark upon small-scale innovation in the mobile learning sphere than HE institutions. Reasons given for this range from increased behaviour management considerations to having more of a vocational focus. Whatever the reason, encouraging innovation within the boundaries of an overall digital strategy is important for any institution. Warrington and Chesterfield colleges were cited by interviewees as examples of active and considered use of Facebook to engage students, although increasingly individual departments and projects seem to be setting up shorter-lived and specific groups to share and record ideas.

Those in charge of digital strategy need to make a pragmatic decision as to the boundaries within which innovation takes place. This is innovation upon standardisation, the strategy making sure everybody is ‘on the same page’:

"If your organization is ready for mobile adoption or has mobile deployed in pockets of the organization, the first discussion to embark upon is the notion of governance and control. You should not be concerned with defining what employees will do with the devices; you will never be able to keep pace with anticipating new uses as whole new technologies and applications emerge in the mobile world each month. Instead, focus on what you aren’t ready for employees to do with mobile devices. As you can see, this is the converse of articulating business requirements, but it is the only way to strike a balance between allowing rapid innovation and wildfire adoption, and having key controls in place." (Woodill, 2011, p.220)

Ron Mitchell agrees: infrastructure, strategy and setting the context are vital. "In my experience," he says, “the more successful mobile learning projects have typically invested as much, if not more, in infrastructure as they have in mobile devices”. Many projects, even if not realising so at the beginning have concluded “that a robust infrastructure matched to the planned/required level of usage is essential for the effectiveness and sustainability of mobile learning beyond the scope of any initial project”. In other words, the sustainability is predicated upon any innovation being built upon a commonly-understood foundation and within the scope of a wider digital strategy.

Puantedura’s SAMR model is a useful guide to discussions surrounding digital strategy and the level of ‘innovation’ in any given project. Innovation is a term that should be applied to how the affordances of a device are used in practice, not to the device itself. Case studies illustrating mobile learning initiatives at each level of the SAMR model are outlined below. These were taken from the LSIS Excellent Gateway (www.excellencegateway.org.uk) and LSN’s MoLeSHARE site (www.moleshare.org.uk):
Substitution
At this level, the technology simply gives a technological gloss to an established procedure or practice. It may speed up the process, but there is no functional improvement. There are many examples of this, including straightforward use of voting devices in the classroom (Castle College, Nottingham), completing assessment tasks (Chelmsford Training Services) and accessing training materials (Charnwood Training).

Often in these situations the technology is used as a motivating factor and/or something that breaks up lessons and provides a different focus.

- Chelmsford Training Services - [www.excellencegateway.org.uk/Programmes/page.aspx?o=241635](http://www.excellencegateway.org.uk/Programmes/page.aspx?o=241635)
- Charnwood Training - [www.excellencegateway.org.uk/Programmes/page.aspx?o=164016](http://www.excellencegateway.org.uk/Programmes/page.aspx?o=164016)

Augmentation
To ‘augment’ learning some kind of functional improvement has to be evident. Not only does the technology streamline procedures, but additional functionality is available to staff and students. Examples of augmentation including mobile technologies include solving accessibility issues (Barnet College), going ‘paperless’ (JHP Training), and QR codes (Moulton College).

These situations regularly include occasions where an individual or group has been aware of the technology available and used it in a focused way.


Modification
Those mobile learning initiatives involving ‘modification’ are those where there has been significant task redesign due to the affordances available. Examples of this include using mobile devices on field trips (Strathmore College), involving students with learning disabilities in safe sporting activities (Trafford College) and using Flip video cameras for new forms of assessment (Dearne Valley College).
Situations in which modification takes place tend to include new ‘channels’ or methods of delivery and communication. Using video recording and/or playback devices often fits into this category.


Redefinition

It is currently difficult to find examples of mobile learning initiatives that involve ‘redefinition’ - that is, promoting new, previously inconceivable, tasks. Such initiatives need to take advantage of the particular affordances of mobile devices and the situations in which they are used. Redesigning learning spaces to facilitate mobile learning (York College) and redesigning curricula around mobile devices (South Nottingham College) may be two examples that qualify as ‘redefinition’.

In future, removal of barriers regarding assessment and the separation of it from learning and teaching are likely to lead to new developments in this area.

- South Nottingham College - [www.excellencegateway.org.uk/Programmes/page.aspx?o=165762](http://www.excellencegateway.org.uk/Programmes/page.aspx?o=165762)

Use of mobile devices in learning is not in its infancy but nor is mobile learning a mature area. As the affordances of mobile devices grow, awareness of how they can be used in learning increases, and demand surges from staff and students, so mobile learning shall mature.

Current Practice

Given the highly contextualised nature of mobile technologies, it is difficult to point to examples of ‘best’ - or even ‘good’ practice. As Richard Hall explains:

"I struggle with the use of the term “good”. However, practice that I feel is appropriate, or good enough, in its own context is based around curriculum reinvention, and the role of
student as producer. Personal technologies enable students to produce/share their curriculum, their learning experiences, their own content etc."

As Jon Trinder quotes Jeff Beck as quipping, asking what is the ‘best’ solution is “a bit like asking which is the best breakfast”. There is "only the best for you given context, location, time, budget, etc.,” adds Trinder. There are, however, both approaches and specific guidelines that can inform mobile learning initiatives and wider digital strategies. The key is to start at the end and work backwards, picking a point in time to support and then iterating towards your goal.

Central to every mobile learning initiative should be people and places rather than technologies and times. As Geoff Stead notes, “a common mistake is to start your mobile learning by being excited about the gadget itself, when ultimately the success of any mobile learning episode is really about the learner.” Thinking about how and why students might want to use mobile technologies will enable discussions that lead to transformative practice.

An example that Andrew Middleton gives is the ability of mobile devices to capture the “rich conversations and ideas that students have on the periphery of our formal learning spaces.” He talks of facilitating reflective practice by encouraging students to use voice notes immediately after lectures and seminars. Whether an iPad, iPod touch or Android device is irrelevant, especially if the learner already knows how to use it effectively for learning.

Whilst opinion is split in the mobile learning sphere as to whether tablets such as the Apple iPad constitute a new category of device, the reality is that, increasingly, learners will own them. Whilst appropriate attention should be taken of ‘digital divide’ issues and potential exclusionary policies, the affordances of such devices should be explored. Incorporating and mentioning new kinds of devices as they appear on the horizon in a digital strategy allows for planning to take place. Not only does this prevent knee-jerk reactions (such as the banning of devices not fully understood) but encourages such strategies to involve conversation and ‘flow’.

Gary Woodill cites (2010, p.198-9) seven levels of mobile learning, originally identified by Robert Gadd, Chief Mobile Officer at OnPoint Digital:

- Level 1 - Messages (one-way)
- Level 2 - Interactive messaging (two-way)
- Level 3 - Voice-based content and assessments (podcasts and the like)
- Level 4 - Reference materials and static content (material accessible by mobile learner for just-in-time learning)
- Level 5 - Learning content and courseware (interactive and lesson-based materials - e-learning on a smaller screen)
- Level 6 - Rich media (high-end audio/video playable on both smartphones and laptops/netbooks)
- Level 7 - Interactive and immersive media (device-based learning games, virtual reality, augmented reality, learning games)

Whilst many institutions are at Level 4 or 5 under this model, there are very few that have a strategy incorporating elements of Levels 6 and 7. Iterating a coherent, transparent and fair appliance management policy can help different users be supported effectively. For example, Mike Short tells of O2’s use of the terms Huggers, Hoppers and Visitors. ‘Huggers’ are workers who remain in one place, ‘Hoppers’ are those constantly on-the-move, and ‘Visitors’ are those who do not belong to the organisation but require use of their infrastructure. Identifying core groups and tailoring access and security policies accordingly can pay dividends.

Several elements to consider when helping facilitate effective mobile learning experiences for students can be usefully be put under the heading ‘human factors’. These include: locations, settings, movement, posture, devices, workloads, distractions, activities, and personas. A 10-step strategy, adapted from Woodill (2011, p.190) might look like the following:

1. Evaluate the current needs around mobile learning (student voice and business case)
2. Identify user groups and needs
3. Explore the affordances and limitations of relevant mobile devices
4. Define security requirements and identify delivery constraints
5. Develop a mobile learning pedagogy and strategy (as part of wider digital strategy)
6. Design the interaction ‘flow’ and navigational elements (digital/physical)
7. Test with closed-beta group
8. Evaluate and iterate with feedback from closed-beta group
9. Open beta, repeat feedback mechanism
10. Launch mobile learning initiative

This process should be one of many loops within a digital strategy that is itself integrated into an institution’s forward developmental planning. A holistic approach such as this avoids talk of the ‘real’ and ‘digital’ worlds when we all - and students in particular - inhabit blended environments. This is more than simply ‘the physical environment’ and ‘the internet’, but a blended ‘real world’ of the two, accessible on the move. As Alan Livingstone puts it in ‘The Revolution No One Noticed’:
“The past decade has witnessed two revolutions in communication technology. The first — the Internet revolution — has changed everything in higher education. The second — the mobile phone revolution — has changed nothing. We’re vaguely aware that our students have mobile phones (and annoyed when they forget to turn them off in class), but it hasn’t occurred to us that the fact they have these devices might have anything to do with our effort to provide them with educational experiences and services.” (Livingstone, 2009)

He goes on to tell a fictional story about six students and the difference mobile technologies makes to their learning experiences. Whilst most of the examples he cites are administrative in focus, “collectively, they’re far from trivial”. The UK has perhaps a more developed mobile learning research and practice base on which to draw thanks, in part, to the work of JISC and LSN funding innovative projects. See www.jisc.ac.uk and www.molenet.org.uk for further details.

Currently, there is a (perceived) tension existing between senior management wanting, as John Cook puts it “just working on all devices” and learners desiring the kind of rich media experience and social interaction they experience elsewhere. Learning support and technical support are often caught in the middle doing the best they can given strategies and policies that no longer dealing with everyday realities. Documents relating to online safety and protection, for example, often deal solely with institutionally-provided resources rather than the 3G connections students are equally, if not more, likely to be using.

Moreover, there is a lack of joined-up thinking in the sector between what we know about effectively pedagogies and blended learning environments. We know, for example, through many years of research that timely, formative feedback, project-based learning and student choice motivates learners. Mobile learning initiatives that respond to the context of an institution can help transform educational experiences for staff and students alike.

**International**

According to a recent UN report, current figures for mobile phone adoption are over 100 per cent for developing countries. Perhaps more surprising is that penetration stands at 58 subscriptions per 100 people in the developing world, spawning micro-enterprises (Reuters, 2010)

As alluded to in previous sections it is the context and existing infrastructure around innovations and technologies that define use. In developing countries, without existing copper cabling - whether due to lack of funding or banditry - the choice is a stark one between mobile phone or continuing disconnection.
Just as developing nations do not necessarily have the follow the same trajectory through an ‘industrial revolution’ period that already-developed nations have traversed, so the changed context leads to a difference in mobile device use. Instead of ‘catching-up’ with the West, Africa (for example) wants to leapfrog it. An example of the latter would be mobile payment systems, common in Africa but still evolving in the West (ReadWriteWeb, 2010). As Niall Winters explains, context is key:

“Determining how to support African mobile learners in their own socio-cultural contexts is a significant challenge and remains under-researched. Simply put, not enough is known about how phones can be productively used in education and training in these contexts.”

Graham Brown-Martin agrees, pointing out that we need apps ‘from’ Africa rather than apps ‘for’ Africa. The primacy of mobile devices with 3G connections in that continent is demonstrated by their exponential growth compared with the linear growth of traditional, fixed DSL lines. Mobile devices, with backlit screens and access to online resources, become a necessity rather than a luxury when it comes to learning (infoDev, 2010). The importance of mobile devices to developing economies is outlined by Ford & Leinonen (2010, p.196):

"Contrary to trends in the developed world, where PC and Internet connectivity is almost ubiquitous, mobile phones are currently the most important networked knowledge-exchange technology used in the developing world. From a developing country perspective, features such as limited or no dependence on permanent electricity supply, easy maintenance, easy-to-use audio and text interfaces, affordability and accessibility are the most important considerations for using mobile phones as potential learning tools (Masters 2005; Mutula 2002; Stone et al. 2003)."

Another area in which context makes a big difference to the mobile learning landscape is Australia. In a similar way to Africa, the large distances and related infrastructure issues have led to a focus on mobile devices. The opposite is true of the context in Japan, with small houses, a population concentrated mainly in cities, and strong mobile culture resulting in world-leading smartphone ownership. Such hardware development and innovation, however, does not necessarily translate into a sustainable interest or expertise in mobile learning.

As regards the USA, ordinarily a powerhouse in all things technological, it still ‘lags behind’ according to academics in the field - despite overtaking Japan in 2009 as the overall biggest market for mobile learning (Ambient Insight, 2010). Scandanavia continues to be

It is the UK that has, over the past few years, been at the forefront of mobile learning initiatives. The Mobile Learning Network, MoLeNET, an LSN-funded programme, provided “technical and pedagogic advice and support, materials development, continuing professional development, mentoring, facilitation of peer-to-peer support, networking and resource sharing, research and evaluation” (www.molenet.org.uk). Despite funding and supporting 104 projects and reaching around 40,000 learners and over 7,000 members of staff, the future of MoLeNET is (at the time of writing) unclear. Some have criticised it as focusing too heavily upon the technology itself and an alignment with ‘home access’ initiatives rather than transformative learning but Lilian Soon, for one, believes that without MoLeNet, learning and teaching in FE would not have “moved on from the chalk and talk, hurdled past some of the didactic use of VLEs and engaged learners in mobile learning activities.”

It is clear that context is key when it comes to worldwide mobile learning initiatives. Whilst there are lessons to be learned from global programmes, each country - and indeed each institution - continues to have its own unique enablers, barriers and communities of practice.

**Future/Trends**

A problem for any institution wanting to develop a policy or strategy in relation to mobile learning is its seemingly ever-changing nature. As Gary Woodill puts it in the introduction to The Mobile Learning Edge (2010, p.xiv):

"Unfortunately, mobile learning (and mobile computing in general) is in a state of constant flux with new developments appearing on a weekly basis. If you plan to undertake a comprehensive strategic initiative to use mobile learning in your business, you need to develop a future-oriented strategy. This means anticipating trends and technology lifecycles, and have a sense of what might be coming in mobile learning in the next five years."

Given that, as Mick Mullane puts it, "we will never be able to fully equip students with all the IT they require" and that, as Ron Mitchell adds, “we’re far from the widespread m-maturity that some suggest we’ve now reached with e-maturity”, what are institutions to do? Mike Ellis suggests institutions ‘cherry-pick’ those technologies that may be relevant and chart their progress from ‘bleeding edge’ to mainstream adoption:
Timing the introduction of elements of a mobile learning initiative is important, claims Mike:

"There is both frustration and safety in not being “bleeding edge” when it comes to technology. The frustration is obvious: our institutions are slow to move, politically motivated and often difficult to change. On the other side, this creates a level of safety: we can watch new technologies, see how they develop and react accordingly, picking up the ones which have crawled out of the “Disillusionment Trough” and up the “Slope of Enlightenment” rather than the ones which remain in the trough and become deadpooled."

This idea is predicated upon the Gartner Hype Cycle, itself influenced by the ‘diffusion of innovation’ adoption curve:

Source: [www.slideshare.net/dmje/web2-and-distributed-services-mike-ellis-v2/15](http://www.slideshare.net/dmje/web2-and-distributed-services-mike-ellis-v2/15)
This curve has been used widely used as a model to discuss the mainstream adoption (or otherwise) of an innovation, but is also criticised for engendering some of the ‘reification’ discussed in an earlier section of this review. As Mike Ellis continues,

“A two year (say) gap between an innovative product entering the market and going through these growing pains is enough to prove or semi-prove the technology and marketplace, by which time cultural or educational institutions are sitting up and ready to take notice of that product or approach.”

This is evident in the evolution of mobile learning, although ‘mini adoption curves’ exist with some innovations (such as PDAs) never reaching the ‘Plateau of Productivity’ stage. However, perhaps we subconsciously retrofit developments to a model rather than vice-versa? Some, such as Mike Sharples, would question the above conceptualisation, seeing a “direct chain” from the vision Alan Kay set out in his 1968 Dynabook project:
“Arguably,” says Sharples, “we are still working to realise the original 40 year old Dynabook concept.” Those who see mobile learning as ever-changing “maybe aren’t sufficiently aware of its long history”.

Taking the long view, it can often be a compound of technologies that pave the way for innovative learning solutions within a given context. Jon Trinder claims that some technology “creeps up on us. Some of the new technologies and or services may not in themselves change the world… [T]heir potential may not be apparent until they are are combined with others”. He gives the example of GPS which “is not that exciting” but “in conjunction with maps or augmented reality has greater potential”. Institutions need to be aware and agile enough to take advantage of affordances in both their single and combined forms.

A large barrier to the uptake of mobile learning in FE and HE is the cost implications of such projects. As John Cook puts it, there are no collective purchasing arrangements for mobile technologies as there are through Eduserv’s CHEST agreements for software and data:

“The problem is that the Mobile Operators (mobos) tie you down to the services that they provide. So you need mobile phone, apps and mobo operator interoperability. If we can solve this problem and strike a CHEST like deal for mobile learning with all these players
then we will really see a revolution like those in retail brought about by the likes of Amazon and eBay."

Mobile providers are flexible in their provision to large organisations but, to a great extent such problems are created and subsequently mitigated by circumstances beyond the control of institutions. Free BlackBerry-to-BlackBerry (B2B) messaging, for example, explains the explosion of such devices in the student market; and when both text messages and data are effectively ‘free’ as part of a student’s contract, barriers to mobile learning initiatives are removed. Further work is needed to augment the work of Edinburgh Napier University (2010) who found that half of its students owned a smartphone with over two thirds having a ‘pay monthly’ contract. Such contextual information is vital to inform mobile learning strategies at any institution.

The development of the mobile sphere is not the same as the development of the World Wide Web (WWW); in fact, one is the mirror image of the other. Whilst the WWW is decentralised and built upon standards, mobile is under the central control of telecoms operators (‘telcos’) with standards varying across device, operating system and telco. The affordances of mobile devices and the WWW are predicated upon the Internet, the worldwide system of interconnected computer networks. They are both at the third layer level in a ‘stack’ as Joi Ito explains visually:

Source: [www.slideshare.net/joi/joi-etech-2009-creative-commons](http://www.slideshare.net/joi/joi-etech-2009-creative-commons)
Given this way of thinking with, quite rightly, ‘knowledge and ideas’ being at the top of the stack, arguments about whether the future is ‘open’ or ‘closed’ take second place to pedagogy and collaboration. An Open Source approach, such as that seen in the ‘Mobile Oxford’ project (http://m.ox.ac.uk/desktop), may be appropriate in one context whereas an off-the-shelf solution such as CampusM (www.ombiel.com/campusm.html) may be more appropriate in others. The freedom of developing something from the ground-up needs to be offset with the resources and in-house expertise required. As Dr Christine Sexton, who oversaw the first Higher Education adoption of CampusM at the University of Sheffield, explains:

“It's a pragmatic approach - I'm into rapid development and deployment at the moment, and if someone can do it quicker than we can we should let them do it.” (http://cicsdir.blogspot.com/2009/10/campusm-launch.html)

Under the auspices of the JISC-funded Business and Community Engagement programme, MyMobileBristol is taking a wider view by integrating the Mobile Campus Assistant software at the University of Bristol with data provided by Bristol City Council. The aim is to “facilitate communities of developers, data providers, policy makers and user groups to promote the development and deployment of innovative technologies” (http://mymobilebristol.ilrt.bris.ac.uk). Working with external partners may make mobile initiatives more useful, economically viable, and sustainable.

As with any change management initiative, institutions should look at their in-house capabilities, current context (previous related initiatives), and potentially-instructive case studies and examples from similar organizations. There are many bandwagons upon which institutions could jump, but it is important to know where those bandwagons are going. As mentioned above, there are similarities and differences between the WWW and mobile devices: both operate at the same ‘layer’ but the lack of standards, especially surrounding using mobile devices for learning, makes institutional support a potentially difficult area.

An instructive case study from a related area is the BBC iPlayer (http://bbc.co.uk/iplayer). The BBC is a publicly-funded body and, as such, must provide a level playing field for its offerings whether available via online streaming or otherwise. Launched in 2005 to a small number of ‘beta’ users, iPlayer was limited to a particular operating system and had limited functionality. In 2007 iPlayer was released as an ‘open beta’ - that is, it was feature-complete but still undergoing usability testing. The popularity of iPlayer led to a public petition forcing it to be made compatible with other operating systems, including those of mobile devices. Further upgrades have included the ability to download programmes to watch offline for a specified amount of time, social networking integration and, most
recently, plans to make iPlayer available globally. The latter will be a significant revenue stream for the BBC, recouping some, if not all, of the cost of development.

The lessons from the BBC iPlayer are that initiatives evolve, that generating user demand can lead to rapid innovation, and that unintended consequences can create new revenue streams and possibilities. Scenario planning and ROI figures sometimes do not tell the whole story. As with other areas, institutions need individuals or departments with the responsibility for ‘horizon-scanning’. Given their remit for the safety, security and integrity of networks and devices, IT Services are not usually best-placed to do this.

Mobile devices are fundamentally disruptive. They put into the hands of individuals what was previously only possible via institutional delivery or through specialists. As has been discovered by institutions across the world, banning devices is not a sustainable strategy and may, in fact, cost more to police than embracing them. In The Mobile Learning Edge (2011:40-44), Gary Woodill lists the following technologies that are on the horizon:

- Bar codes
- Biofeedback
- Digital ink and paper
- Digital pens
- Footpads
- Gesture recognition
- Haptic devices
- Implanted devices
- Instruments and sensors
- Internet radio
- Location sensing devices
- Miniature or Pico projectors
- Motion recognition devices
- Multitouch screens
- Point of view devices
- RFID tags for learning
- Ruggedized mobile computers
- Speech recognition
- Wearable devices

Some of these have important implications for assessment, some for accessibility, some for what is pedagogically possible. With all of these technologies a ‘tipping point’ will either emerge or fail to materialise. Institutions should be aware of the affordances, barriers and
implications of each. This will lead to institutions being ready to ‘ramp up’ planning and start initiatives at a time relevant to their particular context.

A technology very much on the near horizon is mobile projection. Already available as ‘pico’ projectors that mobile devices can be plugged into, these shall soon be built-into smartphones. This is an example of a technology, like high-speed internet access, that was previously only available at a fixed location becoming widely available and becoming another affordance of mobile learning.

Some high-level trends that institutions should currently be investing time and energy researching and discussing are location-based services, augmented reality and tablet devices. As Jon Trinder alluded to earlier, it is often the case that a ‘compound’ of technologies can result in affordances that make an institutional or societal difference.

On the technical side, the cross-platform abilities of HTML5 (http://en.wikipedia.org/wiki/HTML5) and W3C widgets (http://en.wikipedia.org/wiki/Widget_engine) should be investigated as a potential way of delivering content and services to staff and students - both current and prospective. In addition, the concept of ‘ambient buildings’ (http://en.wikipedia.org/wiki/Ambient_intelligence) should be considered in any building redesign.

As Patrick McAndrew argues, ‘augmented reality’ is, on a practical day-to-day level, anything that improves or significantly changes your perceptions and interactions with the local environment. Examples, as given by Andy Black, include Near-Field Communication (NFC) - as seen with devices like London Underground’s Oyster card - and Marked GPS. The latter allows for pin-point location-based services within buildings whilst the former, if included in smartcards or student-owned mobile devices, could allow for single sign-on (SSO) to various institutionally-provided services.

The overwhelming picture and recommendation from research and discussion in putting together this section is that institutions need to be agile. Provision and initiatives evolve and where, how and when a service will be used often cannot be foretold in great detail.

**Access and Support**

Accessibility is not merely a ‘bolt-on’, something to be considered afterwards as a way that ‘non-mainstream’ learners can access the same content as ‘mainstream’ learners. In the context of this report, accessibility refers to personalising the digital element of the blended world that students (increasingly) inhabit.
Indeed, for some learners, their mobile device is almost a physical appendage. The term ‘nomophobia’ is a relatively new term that indicates the seminal importance students attach to their mobile devices:

"Students respond to requests to shut off their phones with a sense of panic, a feeling that they will be cut off from their world of personal relationships. This feeling, taken to its extreme, has been dubbed "nomophobia," the fear of being forced to shut off a phone, or the obsessive worry of losing a phone. There is even a support Web site for nomophobics." (Woodill, 2011, p.150)

With the social networking service Facebook currently accounting for around half of the time spent by people using the mobile web (GSM World, 2010) mobile devices are as much about carrying around a semi-synchronous support and learning network as voice calls and text messages.

This sense of ‘connectedness’ that mobile devices can afford users is analysed in Peterson, et al. (2010, p.92):

“Three different categories of connectedness in the domain of teacher education have been identified (Hug & Möller 2005) and they include both formal and informal aspects of learning. They are: i) intellectual which relates to sharing and developing ideas about the connectedness subject studied, ii) emotional to the feeling of “not being alone” and supporting one connectedness which relates to another and iii) pedagogical connectedness which allows examining beliefs about the subject. In other words, these categories suggest that a social context for learning can be facilitated by the possibility to share information and learning resources, as well as emotions and experiences (Smith & Peterson 2007)."

The same article goes on to suggest that services such as Twitter can be appropriated for “quick and mobile support” as “SMSs are not flexible and rich enough to tackle the diversity of situations and challenges” that students can face (p.97). The frequency and increased informality afforded by mobile device-centred communications is something picked up by Glahn, Börner & Specht (2010) who cite the “availability” of mobile devices as being key. They “enable people to connect their fragmented learning experiences to their long-term learning goals”, state the authors (p.27).

Connectedness is more that just a feeling that it would be nice for students to have. There is at least anecdotal evidence that focusing support via mobile devices upon those students who travel furthest to get to their place of learning, and/or who may be experiencing personal difficulty, can significantly improve retention rates. Mick Mullane
talks of figures of between eight and ten per cent, with Professor Agnes Kukulska-Hulme (2010) adding,

“The journey between classes and home or work can be a good time to reinforce, or reflect on, what has been learnt. In the periods between formal sessions, set work may be done but learner motivation to do it can be lacking. Mobile devices even have a proven role in supporting learners in these periods, to make sure they persist with their studies (Jones, Edwards, & Reid, 2009).”

Although social networking can be used by institutions to engage and support students, text messaging can often be a more targeted method. Three types of SMS campaign have been highlighted by Tretiakov and Kinshuk (2005, in Woodill, 2011, p.143)

1. Text blasting (recipients opt-in and SMS sent out to entire list in one operation, can opt-out at any time)
2. Keyword response (generates automatic reply when someone sends specific word to designated phone number)
3. Smart texting (incoming SMS messages contain a query with a variable - program looks up information in a database and sends response based on query)

A range of studies show that retention rates depend on many factors. However, positive communication and a feeling of ‘keeping up-to-date’ is of paramount important to all learners. Mobile devices can help facilitate this.

Whilst there has been some hesitation about encouraging students to use their personal mobile devices for learning and wider institution-related purposes, the benefits are enormous. It is often the case that students are unaware of the ways in which mobile devices can be used for learning. If this is the case, urge Kukulska-Hulme & Pettit (2010, p.51), they need to be shown how to use their devices for purposes other than socialising:

“It seems that for an individual, it is largely a matter of coming up with the ideas and perhaps making the mental leap that takes one from seeing a device in one light to being able to use it in a different way altogether.”

A small-scale study carried out by Bradley & Holley (2010) identify some innovative ways in which students use their mobile devices. Whilst many cite “recording lectures,” “looking up information on Google” and “setting reminders in the calendar” others use more specific functionality. Shriya, for example, in Case Study 2 talks of her use of the ‘MemoPad’ feature on her BlackBerry smartphone (2010, p.236). Not only does she make notes to
herself but uses the added functionality of MemoPad to attach alarms to set herself reminders. Innovative appropriation of mobile technology is not limited to the intended use foreseen by device manufacturers. The authors also cite the novel case of Heidi (Case Study 3):

"She uses her mobile for learning because “I know I have it on me always, and I can check it always, it’s better than writing in a small calendar book for me”... However, she doesn't like to set alarms and reminders on her phone as some students do, as she doesn’t like her phone “beeping” all the time... She commented that other students were “amazed” at her use of making notes as text messages (it’s not a common practice)." (p.237)

Students' thinking can be prompted by encouragement from staff. The former may be 'experts' at using mobile devices for socialising, but the latter should know how to help them appropriate mobile devices for learning. David Sugden in particular commented upon the lack of leadership shown by some teachers and lecturers:

“I’ve heard post 16 teachers call their students “the cut and paste generation”, the implication being that they find something on the ‘net and simply copy it into their assignments. This is a problem that teachers need to address. They can do this by changing the way in which they require assignments to be presented, maybe employing podcast, video, discussion, collaboration – anything that helps the young learner to ‘think’ about the consequences of their learning."

This is another example of mobile learning being a ‘trojan horse’ for reflective practice and wider change management initiatives.

One focus and ‘way in’ to help staff and students begin to use mobile devices for learning-related activities is to focus upon the already-established idea of e-Portfolios. A simple starting point that could be used in addition to the more detailed advice in the e-Portfolio infoKit (www.jiscinfonet.ac.uk/e-portfolios) is that of ‘levels’. Chan and Ford (2007, cited in Woodill, 2011) identify five levels:

- Level 1 - scrapbook concept
- Level 2 - more structure (CV-standard)
- Level 3 - working portfolio showcasing student work
- Level 4 - opens up web folio to other parties (family, employers, tutors, etc.)
- Level 5 - becomes “authentic and authoritative evidence that links the contents of the folio to standards” and “higher order taxonomies"
If Levels 1 to 3 can be completed offline, and Level 4 is facilitated through the use of Learning Management Systems and Virtual Learning Environments, then Level 5 seems ideally-suited to the capturing of evidence and experience via a mobile device.

With the affordances that mobile devices provide, and the ‘game-changing’ ways in which they can be used by staff and students, mobile learning has the potential to be more than simply a delivery method.

**Staff Competencies and Training**

Mobile learning initiatives are inherently cross-institution (or ‘across-the-grain’) in their scope and impact (Woodill, 2011, p.130). Even those that begin as small-scale projects or initiatives inevitably grow, if successful, and spawn imitations. As it is not subject-specific, mobile learning is best thought of as a multi-sensorial improver of communications (Nyíri, quoted in Bradley, 2010, p.158).

As a result, designing authentic, engaging and useful mobile learning situations and contexts can be challenging, requiring the assimilation and integration of deep knowledge from educators, researchers, practitioners, designers and software developers (Winters & Mor, 2008). Whilst each individual might have expert knowledge in one domain, it is extremely unlikely that any one person will have expertise in all of them.

There are, then, three main barriers to the adoption of mobile learning:

1. Lack of expertise in mobile instructional design.
2. Lack of awareness of the full scope of costs, benefits, and risks.
3. Conflicting accountabilities, interests, and procedures among content stakeholders (learning creators and business budget holders) and IT implementers. (Woodill, 2011, p. 215)

Whilst the first two of these can be solved by bringing in consultants, creating new posts, or commissioning internal research, the third is very much a strategy issue. Conflicting interests and accountabilities can lead, for example, to IT Services resisting mobile learning initiatives as their first priority is the integrity of the institutional network. Clear procedures and expectations must be communicated from senior leaders in order for a standardised, agreed basis to be constructed upon which innovation can thrive.

Mobile learning initiatives are all about change management, and change management is about dealing with people: "Without praise, support and appreciation IT technical staff will become resistant to change. They will steer towards the safest outcome for themselves - not necessarily the best outcome for teachers or students," says Mick Mullane. This
message of staff empowerment is echoed by David Sugden who talks of putting “the teacher back in the driving seat” when it comes to staff training:

"I think that you have to subtly remind colleagues that they are teachers and that they are the experts. Over the last few years they have been bombarded with all sorts of new technologies and online facilities. It takes a while for many to assimilate these and to plan for their use. If we attach the training we provide on these new tools and techniques to sound educational theory it can be much more beneficial."

All too often policies, procedures and top-down change management initiatives can erode educators’ skills by stereotyping. Whilst, as Aquino states, “teaching has a long established culture of individualism and secretiveness” (quoted in Peters, 2007:119) and members of staff may claim to not have the skills to deliver mobile learning solutions, appeals to their professional status and pedagogical knowledge should be made. Mobile learning is about learning, not about the mobile device.

Banning devices, as already mentioned, is not a sustainable policy. A rules-based approach when dealing with the plethora of new and existing devices available seems futile when revisited only occasionally. Instead, Ford and Leinonen call for a ‘values-based’ approach:

“Because mobile phone use is difficult to monitor in a classroom setting, the appropriate use of these instruments can be encouraged through values-based principles, instead of managing it on a rules-based system. Values must be clearly defined, understood, communicated, and practiced. Individual responsibility and accountability can be stipulated and its acceptance is to be encouraged amongst all stakeholders. Well established communication channels can also help ensure proper participant behaviour.” (2010, p.212)

Engaging and motivating staff with mobile learning initiatives can pay dividends not only in terms of the main thrust of the project, but through associated critical awareness and collegiality. As the conclusion to JISC’s ‘Effective Practice in a Digital Age’ stated,

“It is often stated that the introduction of technology into learning and teaching has by-products that are as important as the benefits of the technology itself: practitioners exploring new possibilities become more critically aware of their practice in general, and more conscious of the importance of planning.” (2009, p.49)
One of the most valuable commodities in the life of any institution is time. This is especially true of mobile learning when staff may have to not only come to grips with new devices and their affordances, but how this may affect their current style of teaching and/or supporting learners. Wishart (2010, p.17) writing about the ethical implications of mobile learning in secondary schools comments,

"We have ever more fantastic learning opportunities to look forward to as handheld devices gain acceptance, reliable and affordable connectivity and even the ability to project images on nearby walls or screens. Yet we are in danger of losing such opportunities through collective fear of cyber-bullying and irresponsible use by pupils of a technology whose potential their teachers haven’t been given time to fully explore."

Related fears, fuelled by ignorance, rumour and speculation, exist throughout the education sector. Sunshine being the best disinfectant, a full and frank debate based on a framework similar to the one below may be the quickest method to getting members of staff onboard:

### Table 1: Framework for prioritising ethical issues for consideration before engaging in research into mobile learning.

<table>
<thead>
<tr>
<th>Key Ethical Issues in Mobile Learning</th>
<th>Do good</th>
<th>Avoid harm</th>
<th>Respect user choice</th>
<th>Share resources fairly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal information, privacy and images</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Informed consent</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Ownership</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data storage and protection</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User-generated content</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Source:** Wishart (2010:18)

Underpinning the above, however, is the importance of recognising and sharing the limitations and barriers inherent in any mobile learning initiative. Gaved (2010, p.346) cites Oulasvirta (2008) as noting, “if participants know there is a limitation, they can evolve strategies to adapt to local circumstances and do not problematise it.”

Mobile learning initiatives, despite the technical, ethical and disruptive elements, should be viewed - at least in the beginning - as a change management process. As with all such
processes, the appropriate research, policies and staff development time should be undertaken.

**Cost/benefits**

“There are a variety of problem associated with evaluating mobile learning. Perhaps the most fundamental is the problem of defining the characteristics of a "good" or acceptable evaluation.” (Traxler, 2007, p.19)

Not only, as John Traxler points out, are mobile learning initiatives difficult to even begin to evaluate, but as work by Becta (http://becta.org.uk) demonstrated, ROI can be difficult to prove. However, ROI is never the whole picture as, even if they are calculated in a conscientious manner, “a comprehensive picture of true enterprise costs are seldom included or accurately estimated” (Woodill, 2011, p.215). This is due to project teams only thinking of project costs rather than wider impact and associated costs. Mobile learning initiatives have to stem from more than a desire to make money - or even to claw back all costs.

Mobile learning initiatives are likely to stem from pressure coming from cultural elements, government, or stakeholders. The major decision, as Jocelyn Wishart points out, is whether or not to provide devices to learners:

“The current and extremely important consideration for an institution's senior managers and ICT support team was whether to go down an institutionally-owned path purchasing devices for student use or even requiring their purchase as has started happening in some colleges in the US. Or to go down a student-owned path supporting students in using their own mobile devices to access college systems.”

Whilst there has been a significant trend away from institutions providing devices and towards using student-owned mobile devices for learning, there are significant costs associated with both. Sam Adkins at Ambient Insight has identified what he terms the ‘perfect storm’ driving the adoption of mobile learning:
Mobile learning initiatives cannot be considered in isolation to wider societal, cultural, sector and institutional changes. The move towards ‘cloud computing’ and flexible service delivery, for example, is a development that will transform the parameters of any debate about mobile learning within an institution. JISC infoNet is currently developing a resource in this area: [www.jiscinfonet.ac.uk/flexible-service-delivery](http://www.jiscinfonet.ac.uk/flexible-service-delivery). As David Sugden puts it:

"Mobile devices, especially mobile phones, are so powerful these days that it would be a crime not to use their facilities with all sorts of Internet enabled tools and techniques."

As an example, outsourcing email to Google Apps for Education or Microsoft Live@Edu has the knock-on effect of making not only email, but the associated tools such solutions offer more accessible to mobile devices. One of the main benefits of mobile learning is a combination of this accessibility and availability. As cited earlier, Glahn, et al. (2010, p.27) talk of the ability for people to connect their fragmented learning experiences to long-term goals. If a digital strategy links together developments around assessment, curriculum, IT provision and learner needs then the question becomes less one of ROI and more one of the status of educational institutions in the 21st century.
Conclusion

The main barriers to the adoption of mobile learning in UK Further and Higher Education institutions are not technical but social (Sharples, 2010, p.4). There exists a fundamental tension between economic ‘best practice’ and pedagogic ‘best practice’ making strategy in this area difficult. However, as John Traxler (2007, p.21) explains, the road to widespread adoption it is ‘messier’ than simply solving this tension:

“Mobile education, however innovative, technically feasible, and pedagogically sound, may have no chance of sustained, wide-scale institutional deployment in higher education in the foreseeable future, at a distance or on site. This is because of the strategic factors at work within educational institutions and providers. These strategic factors are different from those of technology and pedagogy. They are the context and the environment for the technical and the pedagogic aspects. They include resource (that is, finance and money, but also human resources, physical estates, institutional reputation, intellectual property, and expertise) and culture (that is, institutions as social organizations, their practices, values and procedures, but also the expectations and standards of their staff, students, and their wider communities, including employers and professional bodies).”

There are glimmers of hope, however. Woodill (2011, p.214) sees mobile learning (m-learning) as easier to implement than e-learning and, indeed, outlines four key lessons (2011, p.233) for mobile learning initiatives:

1. Learning content is medium-dependent (cannot just re-purpose)
2. Centralized content governance is necessary for an optimal experience (security, management of IP, testing, consistency, efficiency)
3. One LMS is more effective than multiple content hosting platforms (costs, scalability)
4. Highly structured approach to learning vendor management is critical (cost efficiencies, protecting IP, achieving scalable, flexible function)

Pragmatic, context-sensitive initiatives work best allied with an ‘emergent strategy’ (2011, p.186). This may be small-scale within a wider digital strategy, or institution-wide, in the case of iTunesU or OpenCourseWare.
To a great extent, the problem with mobile learning initiatives is that we, to quote Marshall McLuhan, “look at the present through a rear view mirror. We march backwards into the future” (McLuhan and Fiore, 1967). Mobile learning may mean different things to different people, but it is the dialogue that an institution begins with itself 0 its staff, its learners, its community - that matters. It is certainly not time for ‘business as usual’. It is time to define and start driving innovation.
References


For a visualisation of the key trends, the following is a link to an unofficial timeline: http://tinyurl.com/2voqt5e


JISC (2009a) 'Effective Practice in a Digital Age' (available online at www.jisc.ac.uk/practice, accessed 18 November 2010)


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