The Future of Mobile Learning and Implications for Education and Training

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Abstract

The future of mobile learning (mLearning) in education and training holds much promise, but it also poses many challenges and dangers. In imagining what mLearning may mean to us in the years to come, we should be wary of making predictions. Nevertheless, we can reflect on current and emerging technology and practice and usefully suggest how we might guide their future application and development. In doing so we should be careful not to ignore the lessons of the past, continuing to engage with the deeper questions about teaching and learning that will continue to underlie the application of learning technologies. This chapter is structured primarily as a series of "top fives" under different headings, intended to highlight some of the concerns of mLearning, both now and in the future. These cover mLearning myths and misunderstandings, mLearning innovations, and both the potentials and risks for mLearning in the future. Together these various perspectives on mLearning seek to provide an inclusive view of what mLearning means today, recognition of the best achievements of mLearning so far, and an agenda for the future that will, we hope, assist us in gaining the maximum benefits from mLearning while minimising the potential negative effects of technological, social and pedagogical change.

The Future Is Now

A few months ago, a student research assistant brought one of his home projects to show to a class, a robotic vehicle controlled by the orientation of a mobile phone. His current project is using off-the-shelf hardware to control the robot with brain waves. In a world where amateur student projects involve the mind control of robots, it is hard to look ahead without finding that one's predictions are already part of everyday life.

With this caveat in mind, this chapter begins with a brief mobile learning (mLearning) scenario from a possible future.

> Mobile learning as we approach the middle of the 21st century is just part of life. The old model of educational institutions has withered away, with learning now a lifelong, pervasive experience, delivered via the practically invisible devices that I have with me day and night, the personal network that delivers information to my eyes, ears and other senses, the e-glasses, the flexible smart-touch screen that folds into a small case but expands to poster size and will stick to or project onto any surface. These devices seamlessly connect and collaborate with ambient technologies in the environment. For example, in my informal learning activities related to photography, my camera will scan for nearby 3D printers to create models from my 3D photos. For my interest in literature, scenes from books play out in front of me if I happen to enter a location used by one of my favoured authors. For somewhat more formal learning, I attend immersive virtual reality classes whenever I want, mixing my avatar with those of other virtual students and both real and robot instructors. I learn when I need to, where I want to. When I am at work, I have professional learning support with me at all times, guiding me in new situations, online Artificial Intelligence systems reacting to my ever-changing contexts and giving me expert task and problem-solving support. I have all the knowledge ever gathered available in an instant, tailored to my own learning profiles and preferences, quality controlled by the world's best minds. Not that I am just bombarded with data. The mobile learning systems that I use are able to help me filter the huge amount of data in the computer cloud, assisting me in making meaning out of a mass of information, working with my own goals, learning styles and changing moods and activities to ensure that the material I am exposed to will help me learn rather than overwhelm me. As a mid-21st-century learner, I am never lost, never alone, never unsupported, never not learning.

If there is one thing that can be said for trying to predict the future, it is that we are bound to be wrong, at least if we try to go beyond very broad assumptions such as "the use of mLearning in education and training will increase." We might therefore consider what the merits might be of attempting to look ahead to the future of mLearning, and the possible implications for education and training. Perhaps in doing so we might reflect on the idea that writing that purports to look to the future is often instead recasting the present through another lens. A classic example of this would be George Orwell's *1984*, the title of which a number of commentators, including Burgess (1978), have suggested is a partial inversion of the year the book was written (1948). Much science fiction follows similar themes, projecting current concerns either near or far into the future. Those who look at "near future" fiction and dismiss its inaccurate predictions (think *The Shape of Things to Come, 2001, A Space Odyssey, Blade Runner* or even *Back to the Future*) miss the point that accurate prediction is not the purpose of such creative works. Rather, they hold a mirror up to the present that reflects the potential implications of our present actions.

Thus, this chapter does not propose to attempt accurate predictions of the future. Instead, it intends to reflect on the current technologies and affordances of mLearning, and consider which of these might continue to be useful to us in the future, as the worlds of work, learning, technology and society continue to evolve. In fact, the somewhat futuristic scenario above is based on the work of Golding (2008), who begins his book with a similar type of proposition based, as he makes clear, not on fantasy technology but by extrapolating from what we already have, here and now.

Top 5 Mobile Learning Myths and Misunderstandings

In an attempt to look ahead to the future of mLearning, one thing that may unnecessarily hold us back is making assumptions about what mLearning is, or what it could be, and so we could fail to appreciate its full set of potentials. This section lays out a "top five" of mLearning myths and misunderstandings. In doing so, it should be noted that these are not necessarily wrong; rather, they provide excessively limiting definitions of mLearning that do not serve us well in truly knowing what it means to be a mobile learner. In fact, in the examples that follow, we might easily insert the word "only" to make the point that these are all valid views of mLearning, but all are too restrictive to truly reflect what mLearning can be. In this section, we will take apart each of these myths and misunderstandings and explore how these definitions can limit our ideas about what can be achieved in mLearning.

Mobile Learning Is "Anytime, Anyplace" Learning

This is perhaps the most prevalent view of mLearning. The image is frequently used of commuters "learning" from a mobile device on the bus, on the train, etc. The limitation of this definition is that it focuses on the pervasiveness of the learning, but perhaps neglects the concept of mLearning at *this* time, in *this* place — in other words contextualised or situated learning (Seely Brown, Collins, & Duguid, 1989). One of the major affordances of a mobile device is that it can be brought to use in a specific context, a concept not acknowledged by "anywhere, anyplace." To only follow this thread is to risk disconnected learning fragments, isolated from the reality around us.

Mobile Learning Is "Just In Time" Learning

There is nothing wrong with the concept of just-in-time learning. In fact, it is often used as the main justification for using mLearning in the workplace; the ability to get the information when and where you need it, at the point of delivery. The problem with just-in-time learning is that it potentially bypasses any concept of a curriculum, or a developmental frame within which learning takes place. It raises rather deeper questions about what we mean by learning. Is looking something up on the fly learning? Does it matter if you remember it or not (given that you can always look it up again)? This type of learning is sometimes called "performance support," and perhaps this is how we should define it: not as learning, but as a tool to be used in the performance of various duties and responsibilities. Learning, we must assume, should go deeper than this.

Mobile Learning Is Learning While Mobile

This is an interesting misunderstanding, as it challenges us to consider what we mean by "mobile." Is there an inherent expectation that the key to what we are doing is mobility? And what does mobility mean: Actually being in motion? Or being able to transition from place to place? We rarely learn while physically moving (leaving aside being in a moving vehicle) since the distractions are usually too problematic (Doolittle, 2009). What we tend to do is take our learning tools with us to the appropriate places. This raises the question: Do these learning tools need to be mobile devices? Or can we do mLearning with books, pens, paper, etc.? Indeed, in some experiments comparing mLearning solutions to paper-based solutions, it has been difficult to see the benefits of using the mobile device over the paper-based version (Fisher et al., 2012). Of course this will depend very much on the affordances that we require to deliver a particular type of learning. In some cases, traditional learning tools, in a learning context, will be able to deliver as much learning as any technology-based solution. In other cases, new technologies are essential to the activities.

Perhaps if there is confusion of perceptions here, it may be that some approaches to mLearning are seen as device centric whereas others are seen as learner centric. Both approaches, of course, have merit, but a learner-centric approach might tend to consider types of learning where the mobile device plays a minor role, whereas device-centric approaches are often those that push the boundaries of current tools exploring the new potentials of emerging and disruptive technologies (e.g., Ogata & Yano, 2010). It is interesting to consider Amit Garg's "Top 7 Myths of Mobile Learning" (2012), and note how many of these myths are about technology rather than learning, including perceived issues with screen size, costs of creating and distributing content, security, fragmented platforms and SCORM compliance. Garg's point is, perhaps, that we can easily get hung up on technological aspects of mLearning when these are not important barriers at all.

Mobile Learning Is an Extension of eLearning

There is a common approach to mLearning that is based on the mobilisation of existing eLearning systems, particularly learning management systems (LMS). An example of this would be mobile clients for the Moodle LMS. Many commercial eLearning providers have embraced the rush to HTML 5, keen to stress how the same content can be developed for desktop computers, tablets and smartphones. The problem with this approach is that the best that can be hoped for is content designed for eLearning adapted for a different form factor. It does not take into account any of the additional affordances of the mobile device, such as location awareness and both synchronous and asynchronous collaborative communication. "In reality, mlearning is different from elearning in terms of size of courses that can (or should) be delivered on mobiles; the context in which mlearning is accessed. Designers must consider the always on nature of phones which help capture the moment of creative learning and other such factors" (Garg, 2012).

Mobile Learning Is an Extension of Distance Learning

It is true that distance learners can benefit from mLearning. However, once again to regard the mobile device as only for use at a distance is to miss its opportunities for use in the classroom, where mobile applications can support learning processes. Indeed one of the major current movements in education worldwide is the integration of mobile devices, particularly tablets, into the daily life of the classroom. Some applications of mobile devices in the classroom have in fact seen them become embedded in the environment itself, thus becoming entirely static (e.g., Moher, 2006). Nevertheless, they still provide one form of mLearning, with mobile students using mobile devices that just happen to remain in one place.

To draw some ideas from these myths and misunderstandings about the future of mLearning in education and training, perhaps the main concern is that future mLearning tools may continue to use narrow definitions of what mLearning is (for example, just the mobilisation of an existing eLearning system) driven by the target markets of a particular vendor, or an emphasis on worker support tools by employers. To ensure that future mLearning systems meet their full potential, it is necessary that our understanding of mLearning encompasses all of its unique characteristics, and that we recognise that any form of learning that takes place using a mobile device is mLearning, whether on the move or static, whether in formal or informal settings, whether working collaboratively or alone.

Top 5 Mobile Learning Innovations

If the previous section took a somewhat negative viewpoint about myths and misunderstandings that might hold back the development of future mLearning, this section provides a more positive perspective of how mLearning is unique and powerful. In looking at the "top five" innovations describing the ground-breaking features of mLearning, we can see why definitions saying that mLearning is just an extension of eLearning or distance learning do not do it justice. It is important to note that these are not just technical innovations, but examples of how technology and pedagogy have been used together. Most (though not all) of the ways of learning listed below have an intimate relationship with the concept of mobility, emphasising the unique role that a mobile device can play in learning. In all cases, there are significant differences between these activities and traditional eLearning. Even where these are also standard learning activities (e.g., contributing to shared-learning resources), doing these things with mobile devices provides a much broader range of opportunities for gathering and exchanging knowledge with other learners and teachers.

Placing Learning in a Specific Context

One of the main affordances of a mobile device is that you can take it with you wherever you go. Much has been written about the importance of context in learning, to support situated cognition (Seely Brown et al., 1989). This idea has been much explored in mLearning projects, where the museum, the woodland or the city become meaningful locations for learning to take place. The great thing about having a modern mobile device is that it is a compendium of tools — an electronic Swiss Army knife. As such, once you are in a given context, it can help you to measure and analyse, to capture and publish, to organise and

communicate. This means, for example, that learners can apply mathematical or scientific inquiry in real-world problem-solving situations, using mLearning tools such as MobiMaths (Tangney et al., 2010).

Augmenting Reality with Virtual Information

With a mobile device, you can overlay something virtual onto something real. This has proved a very popular theme in recent mobile applications. Augmented reality tools such as Google Goggles, Wikitude and Layar show the potential for using a mobile device to give you information about artifacts, locations, etc. in areas as diverse as architecture, history and geography. Beyond these common tools, which overlay factual information onto what is physically present, there have been a number of mLearning applications where a virtual reality has been superimposed onto a physical location in order to provide a new learning experience. These include Savannah (Facer et al., 2004) and Invisible Buildings (Winter & Pemberton, 2011).

Contributing to Shared Learning Resources

One of the key themes of Web 2.0 is the concept that Web-based resources no longer work in one direction only (from a server to a client), but that users become their own content creators. A valuable aspect of learning is the ability to create new material and share it with others, for peer review and collaborative learning. Being able to do this with the assistance of a mobile device, which you can have with you in many contexts, broadens the range of sharing opportunities. It also further enhances the concept of bricolage and diverse learning ecologies (Seely Brown, 2000), in this way making meaning out of the digital artifacts we create from the physical and conceptual learning moments that we constantly encounter. The ability to learn while communicating and contributing at a distance with other learners supports the concept of distributed cognition (Hutchins, 1995). While the initial work in this area found this distribution to be among groups physically co-located, the concept also includes communication with others at a distance. An early example of this type of mLearning can be seen in the distributed collaborative field work described in the Wireless Coyote project (Grant, 1993).

Having an Adaptive Learning Toolkit in the Palm of Your Hand

A mobile device is increasingly a toolkit. As well as the tool-like functions that are built in to the device hardware (camera, sound recorder, video recorder, multimedia messaging, etc.), there are also many applications that can take advantage of various combinations of functions and sensors to make the phone into all kinds of tool. Your mobile can be a distance-measuring device, a guitar tuner, a musical instrument, a compass, a speedometer, a spirit level, and a whole range of other things. This allows the device to be adapted for use as a supporting tool in an almost infinite range of learning activities. In particular, the role of device as tool is well suited to supporting inquiry-based learning (Powell et al., 2011). Whether being used as a support tool to scaffold learning in the classroom or as a means to capture learning experiences in the field, there will be some kind of hardware and/or software feature that can be utilised in the learning process.

Taking Ownership of Learning

One of mLearning's most significant innovations has to do with the ownership of personal learning devices. The personal digital device gives learners the ability to appropriate and personalise their own learning experience, to autonomously acquire the learning material that they want, whenever and wherever they wish to do so. Equally, they have to ability to capture their own learning moments (take photos, videos, notes) and share their insights or questions with others using social media and LMS. Emphasising the personalisation of learning, Sergio (2012) notes that "'m' usually stands for 'mobile' but also just as easily for 'me.'" He further acknowledges the importance of accessibility, noting that mLearning opens access to all kinds of people who previously had limited access to learning, in particular in areas of the globe where some members of society have had no previous access to any technologies that could support learning.

To reflect on the innovations covered in this section, we can see that mLearning encompasses learning that is situated, collaborative and adaptive. In addition, it provides for augmented and virtual realities that provide learning opportunities that go beyond physical environments. Increasing accessibility also means that mLearning can be for the many, not just the few. In the future, we can look forward to these themes developing more broadly and becoming more pervasive. Future mobile learners will have devices that can act as all kinds of learning tools, simulating and supporting all kinds of learning environments, and providing access to mLearning for all, regardless of their location, culture or socio-economic status.

Top 5 Future Potentials for Mobile Learning

Perhaps the most important aspect of a chapter looking at the future of mLearning is to look forward to its main potentials. These are based primarily around the increasing power and pervasiveness of mobile devices, and their mass integration into the world of teaching and learning.

All Students in a Class Can Use Their Own Device for Learning

Perhaps the defining characteristic of mLearning in the second decade of the 21st century is that the Bring Your Own Device (BYOD) approach has suddenly become the norm rather than the exception. This opens up major new opportunities for digital learning in the classroom, since the old constraints of having to provide all learning technologies from central resources gradually fade away. Not that central resources are no longer required, since networks and cloud-based services become even more essential, but enabling a learner's own devices to be used for learning leads to greater efficiencies and digital inclusion.

We Capture Existing Technology and Best Practice for Learning

We should always be wary of reinventing the wheel. Educational research, including research into educational technology, has a long history and we would be foolish to embark on new technology-driven interventions in the classroom without taking full account of what we have learned in the past, and already understood about the processes of teaching and learning. The balance that needs

to be struck is between embracing new ways of teaching and learning that are afforded by mobile devices, while holding to the underlying principles of good education. One very positive aspect of mobile technology is that it allows us to share the very best of existing practice using mobile technology. A good example of this would be the O2 Learn website (O2, 2012), which provides not only a video-sharing website for categorised educational content, but a tailored mobile app for easily capturing and uploading this content directly from the learning context.

Everything We Want to Teach Can Have a Mobile App

To some extent this is probably true already. Indeed, in some cases there are more apps (and other learning resources) for a given topic than you could possibly absorb. How many applications and websites teach basic mathematics, for example? We have seen the rise of online initiatives such as iTunesU and the MOOC (massive open online course) phenomenon, all of which threaten to overwhelm us with quantity without necessarily giving us the means to select the right applications for our own teaching or learning purposes. However, we can assume that over time the wisdom of crowds will assist us in finding the most suitable apps for a particular learning content; that, over time, the best apps will go viral while the weaker offerings fall by the wayside.

We Re-engage Students by Integrating Mobile Technologies into the Classroom

Lecture attendance in non-compulsory education has never been 100%, but gradually we have been eroding the reasons why students should come to class, particularly to large lectures (as opposed to smaller workshops, seminars, labs, etc.) by adopting LMS that often do no more that host a mass of uncontextualised material. The alternative to this is that we rethink our pedagogy by integrating mobile technologies so that face-to-face classes, even in large lecture halls, can become engaging and productive. We have already seen initiatives such as clickers and the "flipped classroom." However there is huge potential to do much more in transforming our teaching philosophy to embrace mobile technologies in the classroom. The recent surge in BYOD initiatives suggests that many educators see the potential of mLearning as part of regular classroom delivery.

We Teach Things in a Practical Way That Could Previously Only Be Taught Theoretically

One of the major potentials of learning technologies is that they enable us to provide access to learning experiences that were previously too expensive, complex, dangerous or specialised to provide. We can now overcome these limitations by connecting learners to remote learning activities. It is already the case that distance students can perform engineering experiments remotely using remote data connections (Toole, 2011). Indeed, such virtual interactions need not take place only with physical contexts but also virtual contexts, performing experiments in virtual worlds (Vallance, Martin, Wiz, & van Schaik, 2010). As mobile technologies become more pervasive and seamless, new opportunities will arise for us to create practical learning experiences, accessed remotely through mobile devices.

In general, the future potential for mLearning is to enhance learning both inside and outside the classroom and workplace. By bringing devices into the classroom, we have the opportunity to transform formal education into a more engaging, relevant, collaborative and outward-facing activity. By taking learning outside the classroom using mobile devices, we have the opportunity to transform informal education, by turning the whole world into a learning space.

Top 5 Future Risks for Mobile Learning

While we are looking ahead, it would be unwise to focus only on the potential positives. We also need to guard against possible negative impacts. Some of the most important of these are outlined in this section.

Entrenched Digital Divides

Any approach to learning that involves technology may have an impact on digital divides. These divides can be quite subtle. They relate not only to access to equipment and connectivity, but also to the skills to make use of that equipment, and other aspects of the learners' situation that may impact on their ability to make meaning, to appropriate and to contribute. Wei, Teo, Chan, and Tan (2011) defined three levels of digital divide: the digital access divide, the digital capability divide and the digital outcome divide. Each influences the next and has an impact on learning. The message here is that we cannot address digital inequality just by providing access to technology. In addition, we need to address many aspects of digital literacy and digital citizenship.

Digital Distractions and Threats

Many schools have sought to ban mobile devices from the classroom on the grounds that they are purely distractions. For example, Greenwich Free school in London states in its public documents that "Mobile phones are a huge distraction in lessons, with pupils thinking about text-messaging, Twitter or Facebook in class instead of their work" (Greenwich Free School, 2012). This school is by no means unusual in this policy. In addition, fears about theft of devices and cyber-bullying exist too. A further dimension to distraction is the potential for information overload, distracting us from our learning objectives. We want to make meaning, not just accumulate data (Shum & Crick, 2012).

The Opposite of a Green Manifesto

Already there are more computers in landfill sites than on the desktop, and we continue to turn the planet to trash at a frightening rate. Every year, hundreds of millions of electronic items go to landfill in the United States and, globally, tens of millions of tons of e-waste go to landfill. To compound the problem, mobile phones have a particularly short lifespan. "Cellular contracts are 2 years for a reason; it takes approximately 1 year to recoup the costs of marketing, manufacturing, activating, and maintaining a cell phone, and the average cellphone lasts only 2 years. Battery life spans average 18 to 30 months" (Walker, 2010).

Even where electronic material is recycled, the impacts on developing countries can be disastrous, with dangerous recycling practices poisoning individuals

and the environment (Bosavage & Maselli, 2006). Although many aspects of this negative environmental impact may be out of our direct control, we should nevertheless attempt to make wise choices in the purchase and use of mobile devices for learning, preferring devices that have low power consumption and a long service lifetime (e.g., have maintainable components), and that can be safely recycled — even if these may be more expensive to purchase in the first instance.

Uncontrolled, Misleading Effects on Outcomes

One of the issues facing us in evaluating the value or otherwise of mLearning is that we may find it hard to measure the real, as opposed to the perceived, impacts of new technologies. There are two well-known types of effect that can lead to false positives in assessing changes in practice or new forms of presentation. Various proposed effects, such as the "Hawthorne effect," suggest that it is hard to directly measure the real benefit of a change to a learning process because the context of the experiment itself may have effects that are separate from the actual intervention. The other effect that might be relevant is the "Dr. Fox effect," which is where people tend to give more value to something that is well presented regardless of the real value of the content being presented (Naftulin, Ware, & Donnelly, 1973).

Whilst the original Dr. Fox experiment, where an actor posing as an academic gave a highly engaging but meaningless lecture to a great reception, would now be hard to repeat without a considerable amount of fake material being posted on the Web, the same effect might be seen in the tendency for many student researchers to regard Wikipedia as the default first port of call for information and, further, to cite it with an uncritical eye. Thus, we should be careful not to allow the allure of new technologies and novel activities to suggest real teaching and learning benefits that may not really be present. We still have much to learn about instructional design, as new technologies present new challenges. In assessing new strategies, we must be mindful of drawing the right conclusions (Merrill, 2007).

Poor Return on Investment

Much literature (e.g., Brynjolfsson & Yang, 1996) has concerned itself with the "IT productivity paradox," referring to the elusiveness of productivity returns from information technology (IT) investments. Remarkably, it seems to be very hard to see where the return on investment comes from with IT. Whilst that debate is complex and ongoing, we should at least acknowledge that return on investment in learning technologies (indeed, any form of educational investment) is very important. Investment in education should see a return in terms of learning taking place, whether in a public school system, a university, or a corporate training environment. Large investments in educational technologies take funding away from alternative investments in education. It is therefore essential that the return on investment in any form of mLearning be at least as valuable as alternative forms of educational investment.

Researchers are failing in their duty if they do not consider what negative outcomes might flow from their work. Those of us who wish to promote mLearning need to be aware of its impacts on individuals, organisations and the

environment that may be negative, and attempt to mitigate these. In addition, we need to ensure that our research methods are rigorous enough to avoid false positives, and ensure that any benefits we claim are in fact real.

Conclusion

Attempting to predict the future is an uncertain business, but an essential characteristic of the researcher is an interest in looking ahead to what we might be able to achieve. By addressing some major issues in mLearning as a series of "top fives," this chapter has attempted to contextualise both current and future concerns from both positive and negative perspectives.

- In addressing myths and misunderstandings, the chapter has outlined the areas where mLearning has been characterised in limited and unimaginative terms. By being aware of these assumptions, we may be able to more fully exploit mLearning in the future.

- In addressing mLearning innovations, the chapter has explored the broad range of affordances that are now offered by the types of mobile devices that are widespread in the learner community.

- In addressing future potentials, the chapter has shown how such technological progress, coupled with imaginative approaches to teaching, can bring true innovation to the classroom and to learning experiences in the wider world.

- Finally, in addressing possible future risks for mLearning, the chapter has attempted to raise awareness of potential negative effects, to assist researchers and educators in avoiding possible pitfalls of mLearning innovation.

In this chapter, we have seen the past contributions of mLearning, its most innovative characteristics, and some of its potentials and risks for the future. Whatever developments may come in technology and pedagogy, it is certain that the concept of mobility will have an increasingly important role to play in lifelong learning, as our experiences as learners and with the supporting technologies become more fluid, adaptive, collaborative and exploratory.

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