

# Open Research Online

---

The Open University's repository of research publications and other research outputs

## Design principles for mobile learning

### Book Section

How to cite:

Kukulska-Hulme, Agnes and Traxler, John (2013). Design principles for mobile learning. In: Beetham, Helen and Sharpe, Rhona eds. Rethinking Pedagogy for a Digital Age: Designing for 21st Century Learning (2nd ed.). Abingdon: Routledge, pp. 244–257.

For guidance on citations see [FAQs](#).

© 2013 Taylor Francis

Version: Accepted Manuscript

Link(s) to article on publisher's website:

<http://www.routledge.com/books/details/9780415539975/>

---

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's [data policy](#) on reuse of materials please consult the policies page.

---

[oro.open.ac.uk](http://oro.open.ac.uk)

Kukulska-Hulme, A. and Traxler, J. (2013). Design principles for mobile learning. In: Beetham, Helen and Sharpe, Rhona eds. *Rethinking Pedagogy for a Digital Age: Designing for 21st Century Learning* (2nd ed.). Abingdon: Routledge, pp. 244–257.

## DESIGN PRINCIPLES FOR MOBILE LEARNING

Agnes Kukulska-Hulme, The Open University, UK  
John Traxler, University of Wolverhampton, UK

### INTRODUCTION

Mobile learning, or *learning with mobile devices*, to adopt a more inclusive term, is an expanding field of research and practice, increasingly shaped by rapid technological and socio-cultural change that is at odds with the more leisurely pace of evolving pedagogy, especially the formal pedagogy within colleges and universities. In one sense, mobility has always been part of learning, in that learning usually takes place in more than one location. However, *mobile learning* has gradually become imbued with multiple meanings, some emphasizing the physical mobility of learners; some focusing on the affordances of mobile technology; some emphasizing connections between contexts or settings; and some noting the primacy of access to digital resources. Other meanings favour more holistic, sociological or ecological interpretations of a phenomenon ill-suited to be contained within the spatial, institutional and cultural boundaries that were largely respected by previous generations of educational technology and indeed by other branches of the current generation of educational technology (Traxler, 2009). It is our aim to simplify this increasing complexity by crystallizing some principles that educators can turn to when faced with the challenge of designing for learners equipped with mobile technologies wanting more adaptable or personally engaging ways of learning.

We do believe, however, that design for mobile learning is at a crossroads. In this chapter, we explore the proposition that the foundations of design as currently understood are shifting rapidly and that the process of design must be reviewed and reconsidered. In fact, it could be argued that in practice the place of design in developing learning with technology has long been problematic. Education has always been parasitic on technology, with educational institutions appropriating commercial and corporate hardware and software technologies and these have shaped how learning activities could be designed. One reason to review the process of design is the fact that educational institutions must now appropriate personal technologies – the mobile phone, as well as social networks, immersive worlds and micro-blogging – partly due to student demand for mobile access and partly because these tools facilitate interactions that can support educational ends. In the context of design, this is not just a change in focus. Selwyn (2007) has argued that the design of education technologies is almost wholly dependent on commercial interests; if he is right, we can assume that the technologies embody a commercial or corporate ideology. Educational institutions, when they appropriate these technologies, attempt to overwrite the ideology designed into them. Now, in attempting to appropriate personal technologies for teaching and learning, they must also address the more complex ways in which different individuals and their communities adopt and adapt

these personal technologies. The space available for educational design becomes much more complex and fragmentary.

Much thinking over the last two or three years has focused on the impact and significance of social and cultural change on the nature of learning with mobile devices (e.g. Pachler et al., 2010; Rasul, 2011; Potter, 2011). It has focused, more specifically, on the impact and significance of social and cultural changes associated with widespread ownership of powerful connected personal devices, on the ethics issues, the evaluation methodologies and the institutional policies relating to mobile learning. This has in part been a reaction, or an antidote, to the hegemony of the psychology, education and computer science that are the foundational disciplines of much mobile learning research and to the dominance of the e-learning legacy in framing the agenda for the mobile learning research community.

We believe that it is now time to review and reconsider design for mobile learning. There are several reasons for this, but fundamentally, we are at a tipping point in the relations between education and society, as the ownership and use of digital technologies become universal, social, ubiquitous and pervasive - conspicuous occasionally by their absence where not so long ago they might have been conspicuous by their presence. Mobile technologies are at the heart of these changing relations. Policy-makers and practitioners, and their managers, as well as learners and the wider public, are now familiar with mobile technologies, and perhaps think they are familiar with the possibilities for learning with these technologies. Furthermore, the technology is more robust, cheaper, more scalable, commonplace and no longer the prerogative of institutions. So the idea that expensive researchers are necessary to develop imaginative and innovative propositions for mobile learning becomes increasingly difficult to sustain.

In recent years, Apple's iTunes™ and other similar services have proved incredibly successful in building *the apps economy*, a business model based on selling high volumes of inexpensive educational applications direct to learners. This was the birth of a mobile learning that could sustainably deliver learning to the *long tail*, resulting in the ultimate *mass customisation* of mobile learning, but one where the impetus behind design is commercial rather than educational. It now seems reasonable to argue that the direction of mobile learning will no longer be guided exclusively by research. In reality, it seems that a combination of commercial sense, research, and pedagogical design expertise will be necessary.

These reflections have led us to examine the nature of design for mobile learning and how it might be reconceived. At the heart of this chapter is the relationship between design for learning that plays to the strengths of mobile technologies, and the design of aspects of learning such as content, activities and communication in the context of technology that has become universal. We also consider how design should take account of both physical space layout and the networking capabilities of mobile technologies. Taken together, these considerations lead to a set of design principles that we summarise.

## **DESIGN 'FOR' LEARNING**

This section focuses on the ways in which design *for* learning can exploit the affordances or characteristics of mobile technologies. These technologies offer unique

possibilities to design for learning that are unlike any afforded by other e-learning technologies. They also offer unique possibilities to support designs for learning where access, inclusion, opportunity and participation are priorities, although like many technologies they also have the potential to exclude some people, which must be weighed up in the process of planning and design.

Mobile technologies support learning that is personalized, situated and authentic. This is currently the domain of informal and practice-based settings, often characterized by unpredictability and *ad hoc* problem-solving. Mobile technologies support digital learning and interaction across a range of settings, but this challenges the notion that design must be intentional and systematic, planned in advance and represented explicitly (see also Kukulska-Hulme, 2008). It is more difficult to design intentionally for learning that will be spontaneous and informal, indeed perhaps paradoxical; however mobile technologies do have affordances that support these types of learning. For example, mobile devices are by their nature private and personal, and so suited to spontaneous reflection and self-evaluation; these could be elements in an e-portfolio shared only with a tutor. In this example, a formal structure is used (an e-portfolio) but it is anticipated that this could be accessed on a mobile device at any time, which may change the nature of what is captured and how the learner wants it stored and shared.

By *personalized learning*, we mean learning that recognises diversity, difference and individuality in the ways that learning is developed, delivered and supported. Personalized learning defined in this way includes learning that recognizes different learning preferences and approaches, and recognises social, cognitive and physical difference and diversity (e.g. autistic people, see Rodríguez-Fórtiz, Fernández-López & Rodríguez, 2011).

Learning designed for mobile technologies offers a perspective that differs dramatically from personalised e-learning designed for networked desktop computers. It supports learning that can potentially recognise the context and history of each individual learner (and perhaps their relationships to other learners) and delivers learning to each learner when and where they want it. Prototypes exist for learning designed on the basis of knowing where the learner is, how long they have been there, where they were before, who else was learning nearby, their likely schedule and itinerary, their social networks and communities, their progress and preferences as learners (see Yau, 2011). Furthermore, the design of the learning delivered by the system can evolve with the learner and their learning.

By *situated learning*, we mean learning that takes place in the course of activity, in appropriate and meaningful contexts (Lave and Wenger 1991; see also Mayes and deFreitas in Chapter 1 of this book). The idea grew up by looking at people learning in communities as apprentices by a process of increased participation. It can however be extended to learning in the field, in the hospital ward, or in the workshop. Mobile learning can be designed to support this context-specific and immediate *situated* learning (e.g. Kneebone and Brenton, 2005; Wishart *et al.*, 2005; Seppala and Alamaki, 2003, Kenny *et al.* 2009). Key design considerations are access to situation-relevant content, situated support, and planning how learners will capture and share their experience either in situ or afterwards.

By *authentic learning*, we mean learning that involves real-world problems and projects that are relevant and interesting to the learner. It means that learning should be based around authentic tasks, that students should be engaged in exploration and inquiry, that students should have opportunities for social discourse, and that ample resources should be available to them as they pursue meaningful problems. Mobile learning enables these conditions for authentic learning to be met, allowing learning tasks designed around content creation, data capture, location-awareness and collaborative working in real-world settings (e.g. Hine *et al.* 2004).

*Informal learning* occurs spontaneously and independently of formal education - but in mobile learning the term is frequently used to describe forms of learning where the technology supports a specific activity that has been designed in advance with a particular user group in mind. For example, Corlett and Sharples (2004) describe the use of Tablet PCs with software designed to support informal collaboration among engineering students. Various informal learning experiences have been trialled in art galleries and museums (Tselios *et al.*, 2008; Vavoula *et al.*, 2009); these are often experimental projects that are imaginative in terms of their epistemological and pedagogical approaches as much as in the technology that is used.

Much of the potential became apparent as technological and pedagogical expertise built up. Case studies in Kukulska-Hulme and Traxler (2005) made it clear that progress in design for learning with mobile technologies was often hampered by the state of the technologies and by the diversity of educational objectives. Both aspects remain a challenge to the development of mobile learning. The technologies are both easier to use in terms of intuitive interface designs and more complex in terms of multi-functionality and ever smarter features; reliable and cheap connectivity is still a challenge in many environments. Educational objectives become clearer through classroom experimentation and pilot projects, yet at the same time they become more diverse as technological and social innovations add new layers of complexity.

Mobile technologies can also deliver learning specifically designed for learners' wider social and economic contexts. In particular, the widespread acceptance and ownership of sophisticated mobile phones allows educators to design learning that encourages participation in e-learning amongst groups often under-represented in formal learning, because mobile devices are perceived by these groups (for example, disengaged learners, or learners who have limited access to desktop computers) as a more motivating or convenient way to take part in learning (Attewell and Savill-Smith 2003; Unterfrauner *et al.* 2010).

Students in formal learning in the UK are under a range of growing pressures, those of time, money, resources and conflicting/competing roles. Learning designed around mobile technologies can allow these students to exploit small amounts of time and space for learning, to work with other students on projects and discussions and to maximise contact and support from tutors (Sharples *et al.* 2005; Traxler and Riordan 2004, Yau & Joy 2009).

Finally, mobile technologies also allow unique opportunities to design learning for students who might have difficulty fulfilling their potential with other e-learning technologies; one example is learners with dyslexia who may benefit from self-organisation features, handy access to reference tools, being able to hear a speech

rendition of a printed document (by using the phone's camera), and voice-based command interaction (Rainger 2005; Taylor *et al.* 2010).

## **DESIGN 'OF' LEARNING**

Now that we have some sense of how the design of learning with mobiles is constrained in various ways, we can consider design itself. In our view, there are three key designs to consider, namely, design of content, of activities and of communication. This is however an arbitrary distinction, since, for example learners may design content (for each other) as an educational activity. Also these categories are not comparable or equivalent - within the kinds of constraints we discuss, designers are in control of the outcome of designing content but not in control of activities or communications. Learning with mobiles is very different from learning with computers in these respects.

### **Content**

In terms of the ability to absorb and interact with educational content, including academic texts and interactive media, the use of small devices may initially seem unpromising when compared to desktop computers. This is increasingly less true. Not only does the technology continue to improve but more importantly so does the acceptance and appropriation of it. By looking at how the technologies are changing our approach to content, however, we can come to a better understanding of what will be appropriate on mobile devices. Our focus here is not on the content itself, but rather on ways of thinking about content. The following aspects are important to consider:

- *learner-created content*: if students are expected to construct some of the content as part of their learning, this can be done in various locations and mobile devices can facilitate it. It is personal and specific to context, usually time and place.
- *Personalised content*: learners can receive, assemble, share and carry around personally useful and appropriate resources
- *Updated content*: updates may be more easily delivered to mobile devices when learners are highly mobile and would not regularly access a desktop computer
- *Timed or scheduled content*: learners can engage with content frequently, repetitively or periodically using a mobile device without overhead or inconvenience
- *Prioritised content*: some content can be made available on mobile devices in such a way as to prioritise or reinforce it over other content; this may be a useful deliberate teaching strategy
- *Aural content*: if listening is important, delivering it via a personal mobile device can be engaging and convenient
- *Flexible content*: learners may appreciate having the option of mobile access to learning materials and resources, as an alternative to desktop content

### **Activities**

The second area to consider is the design of learning activities. According to Naismith *et al.* (2004), mobile technologies can be used in the design of six different types of learning, or *categories of activity*:

- *behaviourist* learning, where quick feedback or reinforcement can be facilitated by mobile devices because they are always to hand

- *constructivist* learning, where learners build new concepts perhaps through engaging with their physical and social environment
- *situated* learning, where learners take a mobile device into an educationally relevant real-world location and learn from that setting
- *collaborative* learning, where mobile devices are an essential means of communication and electronic information sharing for learners in groups outside their educational institution
- *informal and lifelong* learning, possibly unstructured or opportunistic, driven by personal curiosity, chance encounters and the stimulus of the environment. Mobile devices accompany users and become a convenient source of information or means of communication that assists with learning, or records learning experiences for future consultation and review
- *continuous learning*, uninterrupted by changes in location or situation
- *supported learning*, where mobile devices monitor progress, check schedules and dates, review and manage progress, receive errata

At a more detailed level, there are particular tasks that are well suited to mobile learning, for example activities that involve data collection, testing, consolidation of learning, personal reflection and skills acquisition. There is always scope to develop learning activities that combine the use of mobile devices with other learning resources; for example this can be done by providing a commentary accessed on a personal device as a means of orientation within a set of learning materials on another medium. Mobile devices can also be used as a way to facilitate remote, *on the move* participation in online activities that might be continued or completed at a desktop computer.

Mobile technologies are highly suited to learning that has variously been described as *informal, opportunistic, spontaneous* (Bull *et al.* 2004; Colley and Stead 2003) – but also as *disruptive* (Sharples 2003). This is however a major challenge for the design of formal learning since opportunistic learning and formal learning might seem difficult to reconcile, being very different in nature and intent. Furthermore these characterisations of mobile learning are implicitly making a comparison backwards towards *conventional* e-learning, seeing mobile learning as e-learning *but* mobile. This characterisation previously defined the mobile learning design agenda. Now, in a society permeated by mobile technologies, mobile learning becomes instead the education that characterises a mobile society and the design agenda may change focus accordingly. This is merely a different formulation of our opening remarks. Learning with mobile devices is not a new variant of e-learning, enlivening and extending an otherwise stable curriculum and pedagogy. Mobile devices are involved in the wider, social transformation of how people, not just learners, acquire and distribute information, images, ideas and opinions, and of how learning is redefined (Traxler 2008).

### **Communication**

This is an exciting but problematic aspect of design, partly due to worries about the extent and reliability of coverage and the costs of connectivity that might be incurred by learners and partly due to the contested nature of agency and control - communication is at the intersection of the educational uses of mobiles devices as determined by lecturers and teachers and the recreational, personal and social uses as

determined by learners themselves. Within these constraints, mobile devices can support:

- Spontaneous communication and collaboration, e.g. one-to-one or one-to-many by SMS; by sending a message to a forum or blog while travelling; by micro-blogging (e.g. Twitter)
- Beaming of stored information and images from device to device (eg. Bluetooth)
- Portable sound-recording, voice-recording, photos and video clips that are used in communication

Many phones support voice, SMS, e-mail, micro-blogging, instant messaging, social networks and web-based conferencing. Experience of *m-moderating* (moderating of mobile conferences) is still very limited (JISC 2008; Traxler & Leach 2006) but could in principle follow the same trajectory as e-moderating, moving from administrative support and reacting to individual queries, to pastoral support and proactive support for new forms of learning (Salmon 2011). Mobile learning communities are rapidly growing and diversifying. There is considerable anecdotal evidence of micro-blogging with Twitter forming the basis for un-moderated *personal learning networks*, self-help groups for academics, and increasing use of social networks, usually Facebook, (Minocha 2009) within formal learning, in turn accessed via the mobile web or mobile apps. These are by their nature transient and difficult to document but a search of Twitter reveals hash-tags from archaeology through mathematics to zoology, with a similar range of dedicated groups on Facebook, predominantly accessed via mobile devices (Sengupta 2012).

## **SPACE DESIGN**

Physical learning spaces, in other words buildings and their surroundings, must also be designed for learning and fit for purpose (Brown & Long 2006, Oblinger 2005). In UK colleges and universities, this is enormously problematic since much of their estate is ageing and over-crowded. There is a need for greater exploration and recognition of the relationships between the location and layout of learning and the nature and success of learning, and a need to integrate virtual learning spaces, that is the design and practice of e-learning, more closely, with the physical learning spaces (JISC 2006, Jamieson 2000). Much work on this topic is however still rooted in learning with desktop computers, as opposed to learning with mobile devices, and is also driven by other forces from outside education (Temple 2007). Mobile learning technologies are increasingly important in these relationships but this is an intrinsically more challenging problem – *BYOD, bring-your-own-device* strategies introduce dramatically increased technical diversity into the situation, and research into the relationships between space, movement and interaction is still emerging and not yet specifically applied to learners (for example, Mizobuchi *et al* 2005; Pasco *et al* 2000, Perry & Hourcade 2008). There are a number of points at which these intersect and there is a tension between the (re)design of spaces for learning and the design of learning for these spaces.

Firstly, there are some specialist classrooms designed to support collaborative learning based on wireless connectivity, handheld computers and interactive whiteboards (for example, Chang *et al* 2004). These are developed experimentally or sold commercially as integrated off-the-shelf packages and can require high investment in dedicated and purpose-built rooms in new buildings or dramatically

refurbished old ones. They also require a substantial commitment in staff development and curriculum design. Highly specialised learning is designed for these spaces but the emergence of more financially sustainable *BYOD* strategies is likely to forestall future activity.

Secondly, we can also see increasing opportunities for location-specific, immersive world and augmented reality learning being designed into the physical learning spaces of formal learning rather than designed into them subsequently – but only into new buildings but these opportunities are not being systematically identified and exploited (Frohberg 2006). This runs parallel to the design of informal learning in heritage, cultural and landscape spaces using similar technologies, but both these trends are only sustainable if based on *BYOD*.

Thirdly, laptops for general academic work are widely available for loan to students and for issue to staff, and many purchase their own. These laptops have the potential to free up substantial amounts of estate currently dedicated to ranks of networked desktop computers, to change the working lives of academic staff and thus change the demands these staff make on their accommodation (Vila *et al* 2010). A related strategy, known as *learner devices* (Traxler 2010) or *BYOD* (CoSN 2012), as mentioned earlier, assumes the institutional default shifts to learners choosing and providing the technology for learning and is a financially attractive solution to resource problems. There are however, practical and technical challenges, such as network security, equality of access and quality assurance, and more profound issues about the shift in the locus of agency, authority and control when learners not teachers control and understand the technologies (Traxler 2010). In the current context however there is a paradigm shift from designing education activities and artefacts for stable institutional platforms to designing for the diverse and unpredictable devices that learners choose.

Fourthly, in a wider sense, universities and colleges are public agencies, indirectly and sometimes directly funded to deliver the current government's education agenda and policy objectives (Shattock, 2006). These have recently included community education, lifelong learning and widened participation, and have now moved on to internationalisation and the student experience. The interaction of mobile learning design and physical learning space design has the potential to carry these issues forward since both challenge the arbitrary division between academic institutions, their markets and their catchment areas. Mobile learning development has the potential to carry education into communities including their most marginal and disaffected members whilst physical learning space design has the potential to entice and welcome communities into academic institutions. This too introduces another dimension into the design of mobile learning, and again undermines expectations about a stable and consistent learner community.

## **DESIGN PRINCIPLES**

In this chapter, we have outlined key considerations in order to clarify how mobile learning designs differ from current practice in design for e-learning. To design for mobile learning, first of all we need to be clear about the unique characteristics and nature of mobile learning. Next, a rationale must be constructed around how the learning will be more personal, situated, authentic or informal than would be possible by other available means. Content, activities and communication should then be aligned with the proposed rationale. Thirdly, we need to recognise the extent of

popular, that is non-institutional, familiarity with using mobile devices to not only consume the elements of learning, that is, information, images, ideas and opinions, but also to produce and share them. This takes us beyond the increasing adoption of user-centred design practices in educational design and into the co-creation of education itself. It also challenges the primacy, authority and boundaries of formal education as the locus of educational design.

We believe that design principles for mobile learning should be based on two key observations:

- that mobile technologies are ubiquitous, diverse, personal, social and changeable, not uniform, consistent, or institutional;
- that learners' expectations about educational uses of mobile technologies may be coming from outside formal or institutional education, as part of experiences driven by curiosity, personal enquiry and individual recreation.

On this basis we propose the following principles:

1. Start with learners - recognise their diversity, agency and habits, including patterns of mobility and ubiquitous social interaction.
2. Design to meet learners on their terms, with their devices, in their spaces.
3. Work with learners – seek opportunities for prototyping, participation and feedback.
4. Look for added value, e.g. opportunities for contingent learning, situated learning, authentic learning, context-aware learning.
5. Design for inclusion, enabling accessibility and greater access than may be possible using desktop computers.
6. Recognize that learning activities designed by you are liable to be played out differently as learners engage with them outside the classroom.
7. Be prepared to trial and discard activities more frequently as technologies evolve.
8. Wait for the novelty to wear off before evaluating, and take account of lifestyle and environmental factors that may impact on mobile learning.

## **CONCLUSION**

The increasing power and diversity of mobile devices supports ever more powerful and diverse learning designs. As we argued earlier, mobile learning research has historically had a narrow base, drawing mainly on psychology, computer science and education, and it has developed its agenda as a continuation of, or reaction to, the perceived triumphs and limitations of e-learning. This made sense in the 1990s when the expense and expertise required for e-learning and then m-learning needed the resource base of educational institutions. It led to an acceptance of institutions, their authority, their agency and their practices as the preferred focus for the design, deployment and delivery of mobile learning. As mobile devices become widespread and popular, and as access to free web services, social networks and shared resources begins to shape learning practices, this makes less and less sense. The design principles we have put forward recognize the centrality of learners with their personal technologies and preferences, alongside the unique nature and added value of mobile learning, and the idea that mobile learning is synonymous with unpredictability and constant change.

## **REFERENCES**

- Attewell, J. and Savill-Smith, C. (2003) Mobile learning and social inclusion: focusing on learners and learning, paper presented at *mLearn 2003: 2nd World Conference on mLearning*, London, May 2003.
- Attewell, J. and Savill-Smith, C. (eds) (2004) *Learning with mobile devices: research and development*, London: Learning and Skills Development Agency.
- Brown, M. & Long, P. (2006) Trends in Learning Space Design, in D. Oblinger (ed) *Learning Spaces*, Educause available online [www.educause.edu/learningspaces](http://www.educause.edu/learningspaces)
- Bull, S., Bridgefoot, L., Corlett, D., Kiddie, P., Marianczak, T., Mistry, C., Sandle, N., Sharples, M. and Williams, D. (2004) Interactive Logbook: the development of an application to enhance and facilitate collaborative working within groups in higher education, paper presented at *mLearn 2004 - Mobile learning anytime everywhere*, Bracciano, Italy, July 2004.
- Chang, S-B., Wang, H-Y., Liang, J-K., Liu, T-C. & Chan, T-W. (2004) A Contest Event in the Connected Classroom Using Wireless Handheld Devices, In Proceedings of *The 2nd IEEE International Workshop on Wireless and Mobile Technologies in Education (WMTE '04)*.
- Colley, J. and Stead, G. (2003) Take a bite: producing accessible learning materials for mobile devices, paper presented at *mLearn 2003: 2nd World Conference on mLearning*, London, May 2003.
- Corlett, D. and Sharples, M. (2004) Tablet technology for informal collaboration in Higher Education, paper presented at *mLearn 2004 - Mobile learning anytime everywhere*, Bracciano, Italy, July 2004.
- CoSN (2012) *Making Progress: Rethinking State and School District Policies Concerning Mobile Technologies and Social Media*, Washington: Consortium for School Networking.
- Facer, K., Stanton, D., Joiner, R., Reid, J., Hull, R. and Kirk, D. (2005) Savannah: Mobile gaming and learning?, *Journal of Computer Assisted Learning*, 20: 399-409.
- Finn, M. and Vandenham, N. (2004) 'The Handheld Classroom: educational implications of mobile computing', *Australian Journal of Emerging Technologies and Society*, 2/1: 21-35.
- Frohberg, D. (2006) Mobile Learning is Coming of Age - What we have and what we still miss, *Proceedings of DeLFI*, September 11-14, Darmstadt, Germany
- Hine, N., Rentoul, R. and Specht, M. (2004) Collaboration and roles in remote field trips, paper presented at *mLearn 2003: 2nd World Conference on mLearning*, London, May 2003.
- Jamieson, P., Taylor, P. G., Fisher, K. A. C. F., Trevitt, A. C. F. & Gilding, T. (2000) Place and Space in the Design of New Learning Environments, *Higher Education Research & Development*, Vol. 19, No. 2, 2000.
- JISC (2005) *Innovative Practice with e-Learning: a good practice guide to embedding mobile and wireless technologies into everyday practice*, Bristol: Joint Information Services Committee.
- JISC (2006) *Designing spaces for effective learning: a guide to 21st century learning space design*. Bristol: Joint Information Services Committee.
- JISC (2008) *MELaS – Mobiles Enabling Learning and Support: Final Report*, Bristol: Joint Information Services Committee, available <http://www.jisc.ac.uk/media/documents/programmes/elearninginnovation/melasfinalreport.pdf>
- Kenny, R.F., Park, C. L., Van Neste-Kenny, J. M. C., Burton, P. A. & Meiers, P. A. (2009) Using mobile learning to enhance the quality of nursing practice

- education In M. Ally (ed.) *Mobile Learning: Transforming the Delivery of Education and Training*. Athabasca, AB: Athabasca University Press
- Kneebone, R. and Brenton, H. (2005) Training perioperative specialist practitioners, in A. Kukulska-Hulme and J. Traxler (eds) *Mobile Learning: A Handbook for Educators and Trainers*, London: Routledge.
- Kukulska-Hulme, A. (2008) What should we do with Jack-in-the-box? Anticipating surprises in mobile learning. In: Allegra, M., Fulantelli, G., Gentile, M., and Taibi, D. (eds) *Emerging Educational Technologies and Practices*. Palermo: Consiglio Nazionale delle Ricerche, Istituto per le Tecnologie Didattiche. pp. 7-18.
- Kukulska-Hulme, A. and Traxler, J. (eds) (2005) *Mobile Learning: A Handbook for Educators and Trainers*, London: Routledge
- Lave, J. and Wenger, E. (1991) *Situated Learning: Legitimate Peripheral Participation*, Cambridge, UK: Cambridge University Press.
- Manolo (2006) Project description. Online. Available HTTP: <  
<http://webdocs.alterra.wur.nl/internet/corporate/GlobalResearch/gipsy-manolo.pdf>> (accessed 25 March 2012).
- Minocha, S. (2009). Role of social software tools in education: A literature review. *Education and Training*, 51(5/6), pp. 353–369.
- Mizobuchi, S., Chignell, M., and Newton, D. (2005). Mobile text entry: relationship between walking speed and text input task difficulty. *Proc. MobileHCI 2005*, pp122-128.
- Mulholland, P., Collins, T. and Zdrahal, Z. (2005) ‘Bletchley Park Text: Using mobile and semantic web technologies to support the post-visit use of online museum resources’, *Journal of Interactive Media in Education*. Online. Available HTTP: <  
<http://jime.open.ac.uk/2005/24/>> (accessed 18 March 2012).
- Naismith, L., Lonsdale, P., Vavoula, G. and Sharples, M. (2004) *Literature Review in Mobile Technologies and Learning, Report 11 for Futurelab*. Online. Available HTTP: <  
[www2.futurelab.org.uk/resources/.../lit\\_reviews/Mobile\\_Review.pdf](http://www2.futurelab.org.uk/resources/.../lit_reviews/Mobile_Review.pdf)> (accessed 18 March 2012).
- Naismith, L., Sharples, M. and Ting, J. (2005) Evaluation of CAERUS: a Context Aware Mobile Guide, paper presented at *mLearn 2005 – The future of learning in your hands*, Cape Town, October 2005.
- Oblinger, D. (2005) Leading the Transitions from Classrooms to Learning Spaces, *Educause Quarterly*, 14–18.
- Pachler, N., Bachmair, B., Cook, J. Kress, G. (Eds.) (2010) *Mobile Learning: Structures, Agency, Practices*. Springer.
- Pascoe, J., Ryan, N., and Morse, D. 2000. Using while moving: HCI issues in fieldwork environments. *ACM Trans. Computer-Human Interaction* 7, 3 (Sep. 2000), pp 417-437.
- Perry, K. B. & Hourcade, J. P. (2008) Evaluating One Handed Thumb Tapping on Mobile Touchscreen Devices, *Proceedings of Graphics Interface*, Ontario, Canada
- Rainger, P. (2005) Accessibility and mobile learning, in A. Kukulska-Hulme and J. Traxler. (eds) *Mobile Learning: A Handbook for Educators and Trainers*. London: Routledge.
- Rasul, A.A. (2011) *Cultural Factors in a Mobile Phone Adoption and Usage Model: A Case of UUM Postgraduate Students*. Masters thesis, Universiti Utara Malaysia.

- Rodríguez-Fórtiz, M.J., Fernández-López, A. & Rodríguez, M.L. (2011) Mobile Communication and Learning Applications for Autistic People. In: Tim Williams (Ed) *Autism Spectrum Disorders – From Genes to Environment*. InTech (Open Access Publishing). 349-362.
- Potter, J. (2011) Creation and curatorship in new media. In: Rummier, K., Seipold, J., Lübcke, E., Pachler, N. & Attwell, G. (eds) (2011) *Mobile learning: Crossing boundaries in convergent environments. Book of Abstracts*. London Mobile Learning Group. 53-56.
- Salmon, G. (2011) *E-Moderating: The Key to Online Teaching and Learning*, London: Routledge.
- Selwyn, N. (2007) The use of computer technology in university teaching and learning: a critical perspective. *Journal of Computer Assisted Learning*, 23, 83–94.
- Sengupta, S. (2012). Facebook's Prospects May Rest on Trove of Data. *The New York Times*. , May 14, 2012.
- Seppala, P. and H. Alamaki (2003) 'Mobile Learning in Teacher Training', *Journal of Computer Assisted Learning* 19 (3): 330-335.
- Sharples, M. (2003) 'Disruptive devices: mobile technology for conversational learning', *International Journal of Continuing Engineering Education and Lifelong Learning*, 12 (5/6): 504-520.
- Sharples, M., Corlett, D., Bull, S., Chan, T. and Rudman, P. (2005) 'The Student Learning Organiser', in A. Kukulska-Hulme and J. Traxler. (eds) *Mobile Learning: A Handbook for Educators and Trainers*. London: Routledge.
- Shattock, M. (2006), Policy Drivers in UK Higher Education in Historical Perspective: 'Inside Out', 'Outside In' and the Contribution of Research. *Higher Education Quarterly*, 60: pp130–140.
- Sheehy, K., Kukulska-Hulme, A., Twining, P., Evans, D., Cook, D. and Jelfs, A. (2005) *Tablet PCs in schools: A review of literature and selected projects*, Coventry: Becta. Online. Available: <<http://webarchive.nationalarchives.gov.uk/20101102103654/publications.becta.org.uk//display.cfm?resID=25889> > (accessed 18 March 2012).
- Sutch, D. (2005) 'Bossing adults and finding spotty bras: Learners as producers within mobile learning contexts', *Proceedings of mLearn 2005 – The future of learning in your hands*, Cape Town, October 2005.
- Taylor, J.D., Dearnley, C.A., Laxton, J.C., Coates, C.A. , Treasure-Jones, T. , Campbell, R., and Hall, I. (2010) Developing a mobile learning solution for health and social care practice. *Distance Education*, 31(2), 175 -192.
- Temple, P. (2007) *Learning spaces for the 21st century - a review of the literature*, York: Higher Education Academy
- Traxler, J. (2009) Learning in a Mobile Age, *International Journal of Mobile and Blended Learning*, 1(1): 1-12.
- Traxler, J. (2010) Students and Mobile Devices, ALT-J, *Association for Learning Technology Research Journal*, 18(2): 149–160.
- Traxler, J. and Riordan, B. (2004) *Using Personal Digital Assistants (PDAs) to support students*, Higher Education Academy Resources, Belfast. Online. <http://www.ics.heacademy.ac.uk/Events/conf2003/John%20Traxler.pdf> (accessed 25 March 2012).
- Traxler, J. (2008), Learning in a Mobile Age, *International Journal of Mobile and Blended Learning*, Vol. 1. No. 1, pp 1-12

- Traxler, J. and Kukulska-Hulme, A. (2005) Evaluating mobile learning: reflections on current practice, paper presented at *mLearn 2005 – The future of learning in your hands*, Cape Town, October 2005.
- Traxler, J. & Leach, J., (2006), Innovative and Sustainable Mobile Learning in Africa in Proceedings of WMUTE (IEEE), Athens, Greece, November, 2006
- Tselios, N., Papadimitriou, I., Raptis, D., Yiannoutsou, N., Komis, V., Avouris, N. (2008) Mobile Learning in Museums: Design and evaluation challenges. In Lumsden, J. (ed.) *Handbook of Research on User Interface Design and Evaluation for Mobile Technology*, pp. 253-259, Hershey, PA, USA:IDEA Publishing.
- Twining, P., Evans, D., Cook, D., Ralston, J., Selwood, I., Jones, A., Underwood, J., Dillon, G. and Scanlon, E., with Heppell, S., Kukulska-Hulme, A., McAndrew, P., and Sheehy, K. (2005) *Tablet PCs in schools: case study report*. Coventry: Becta.  
<<http://webarchive.nationalarchives.gov.uk/20101102103654/publications.becta.org.uk//display.cfm?resID=25914>> (accessed 18 March 2012).
- Unterfrauner, E., Marschalek, I. & Fabian, C. (2010). Mobile Learning with Marginalized Young People. In I. Arnedillo Sánchez & P. Isaias (Eds.), *Proceedings of the IADIS International Conference Mobile Learning 2010* (pp. 28-35).
- Vavoula, G., Sharples, M., Rudman, P., Meek, J., and Lonsdale, P. (2009) Myartspace: Design and evaluation of support for learning with multimedia phones between classrooms and museums. *Computers & Education*, 53(2), .286-299.
- Vila, M. C., Gálvez, A. P. & Campos, J. C. (2010) Mobile Services in the Rector Gabriel Ferraté Library - Technical University of Catalonia, *Reference Services Review*, 38(2), 321-334.
- Wishart, J., McFarlane, A. and Ramsden, A. (2005) Using Personal Digital Assistants (PDAs) with internet access to support Initial Teacher Training in the UK, *Proceedings of mLearn 2005 – The future of learning in your hands*, Cape Town, 25-28 October 2005.
- Yau, J. Y-K. (2011) *A mobile context-aware learning schedule framework with Java learning objects*. PhD thesis, University of Warwick.
- Yau, J. Y-K and Joy, M. (2009) A mobile context-aware framework for managing learning schedules : data analysis from an interview study. *International Journal of Mobile and Blended Learning*, 1 (4), 29-55.