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Link(s) to article on publisher's website:
http://dx.doi.org/doi:10.4324/9781351252805

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CHAPTER 11

DESIGN PRINCIPLES FOR LEARNING WITH MOBILE DEVICES

Agnes Kukulska-Hulme and John Traxler

EDITORS' INTRODUCTION

In this chapter the context for design is unashamedly shaped by technology. Designing for learning with mobiles has had to adapt to a context of ubiquitous technologies that is personal, informal and thoroughly learner centred. Mobile technologies have already been appropriated for social and informal activities and for accessing and creating a rich supply of online digital resources. Education is no longer designed for a group of learners situated in a defined context; rather teachers face the challenge of designing for individuals who engage in their own learning, through their own devices, from their own settings, and on their own terms. Institutions must consider not only what technologies to provide but how to incorporate learners' own devices, experiences and practices. The design principles presented in this chapter take account of the characteristics of mobile technologies and consider the social context into which they are appropriated. These principles are prescient and likely to have much wider applicability beyond mobile learning as personalized, situated, authentic and informal learning becomes the norm.

INTRODUCTION

Since the earlier versions of this chapter, there has been considerable change in the dynamics between technology, pedagogy and society. This is epitomised in the shift from mobile

technologies being relatively scarce, fragile, difficult to use, expensive and institutionally

provided at the turn of the century to now being easy to use, cheap, powerful, robust,

universal and personal. This change is responsible for opening up a new reality whereby

individuals and communities can produce, share, valorise, transform, discuss and discard

ideas, images, information and opinions on an unprecedented global scale. These activities

were previously largely the prerogative of professionals and the institutions of formal

learning but are now facilitated by freely available Web 2.0 platforms and resources accessed

by everyone's mobile technologies. Learners can often act as each other's teachers, without

professional or institutional endorsement or involvement. The authority, agency, credibility

and substance of teaching and learning are thus transformed, even if the implications are not

yet well understood.

Furthermore, the two decades we are describing have seen the end of the political will and

financial capacity that resourced the first generation of institutional 'mobile learning'

innovations and initiatives. Over the same period, increased awareness of mobile learning

achievements and activity in growing markets for mobile technologies has led to the

emergence of sustainable business models around their educational use.

These factors have meant that the nature of design for learning with mobiles, previously

based around institutional and professional procurement, development, control and

deployment of resources and focussed on the artefacts of education, has widened to embrace

the exploitation of the abundance of online digital resources (content, communities and

tools). The concept of design for learning with mobiles has been reconfigured to mean the

design of educational experiences that require the orchestration of these resources. The earlier

design activities were informed by rigorous research practices and findings but these were

anchored in a very specific set of contexts; subsequent design activity is taking place in a much more fluid and unbounded context with fewer stable points of reference.

Our focus in this chapter is on the nature of design for learning with mobiles within formal education. Design cannot however take place without recognising the potentially enormous impact of everyday uses of mobile phones and other personal technologies on the experiences and expectations of learners before and whilst they go through formal education. It must also recognize the impact of everyday informal mobile learning as an ever-present alternative to formal education, at least from the learners' point of view.

Since around the start of the century, personal ownership of mobile technologies has accelerated to the point where many societies are seriously considering how education will be affected by these developments. At a micro level, teachers are faced with the challenge of designing learning that takes account of the ubiquity of these devices and associated social practices. Learning with mobile devices is increasingly shaped by rapid technological, economic and socio-cultural change that is, however, at odds with the more stately pace of evolving institutional pedagogy.

Learning with mobiles 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 (Kukulska-Hulme *et al.* 2011). Pegrum (2014) explains that the 'learning experience' becomes mobile 'as learners shift between contexts that feed directly into their unfolding learning' (p.19). Other meanings of learning with mobiles 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 (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 and wanting more adaptable or personally engaging ways of learning aligned to their experiences and expectations of using mobiles for anything and everything in their daily lives. 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 the next section, we further elaborate how design is impacted by technology choices that may be made at institutional level or by learners (and to a lesser extent teachers) making use of personal mobile devices for learning.

DESIGN IN RELATION TO LEARNING TECHNOLOGY

The role of design in developing learning with technology has long been problematic. Education has always been parasitic on the technologies of other sectors, with educational institutions appropriating commercial and corporate hardware and software technologies, and these have shaped how learning activities could be designed. We have to recognise that this appropriation has in fact served two purposes; firstly to provide learners with a stable, consistent and standardised platform for learning (and therefore a more equitable one, at least while they were learning within the confines of the institution), but secondly to protect the institutional business model by constructing a pay-wall around institutional assets to protect intellectual property.

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. This challenges the institutional business model but also the locus of control, in terms of technology and in terms of pedagogy. Learners have increasing experience of using the plethora of free and familiar web 2.0 technologies that enable publication and sharing with diverse (global) audiences, without the need for any institutional endorsement. These phenomena pose a challenge to those teachers who cannot imagine how such learner activities and competencies can be incorporated into their teaching. They also challenge those whose favoured pedagogical approach precludes giving learners more choice over their environments for learning and more control over knowledge production. To incorporate learners' own uses of mobile devices and social networks into teaching practices is to concede to the locus of control being increasingly located with the learners.

In the context of design, this is not just a change in focus. Selwyn (2007) has argued that the design of education technologies has previously been almost wholly dependent on one set of commercial interests, those of the makers and vendors of large-scale digital installations and infrastructure; if he is right, we can assume that the technologies embody a specific commercial or corporate ideology. Educational institutions, when they appropriate these technologies, may be in broad consensus with the ideology designed into them or may attempt to overwrite it. Now, in attempting to appropriate personal technologies for teaching and learning, they must also consider the ideologies built into these personal and social technologies – which may be adopted and adapted differently by their users, but in any case come from a different set of commercial interests, those of the digital recreation,

entertainment, publishing and media corporates. The space available for educational design becomes much more complex and fragmentary, the constraints become more complex and fluid, and the commitments (or resistances) of individual students to the ideologies inherent in their digital devices become more significant.

Much thinking over the last decade 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; McCauley *et al.* 2017). 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 disciplines of psychology, education, computer science and information systems design that were the foundational disciplines of early 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 vital to review and reconsider design for learning with mobiles. There are several reasons for this, but fundamentally, we are at a tipping point in the relations between education and society, as the use of digital technologies has become universal, social, intrusive, 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 with the idea that they are available for learning. Researchers and developers employed by institutions can continue to make imaginative and innovative propositions for mobile

learning, but learners' everyday mobile practices are a strong influence shaping the reception of these designs.

In recent years, Apple's iTunes™ and similar services have proved incredibly successful in building *the apps economy* (Genachowski 2010), a business model based on selling high volumes of inexpensive educational applications direct to learners. This has accelerated the growth of learning with mobiles that can sustainably deliver to the so-called 'long tail': the idea that digital technology could service smaller and smaller niche interests and still turn a profit, resulting in the ultimate 'mass customisation' of digital learning. In this new landscape, the direction of learning with mobiles is no longer guided exclusively by research or evidence-based practice. It is increasingly guided by learners' everyday choices, particularly their personal consumption and informal social media practices, which shape their expectations and impact their investment in formal learning. The technologies and practices shape not only how learning takes place but also what learners are able to know.

These reflections have led us to examine the nature of design for learning with mobiles 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 a technology that has become universal. We must recognise that issues of infrastructure, networking and connectivity are of diminishing significance as a barrier or determinant. Furthermore, design principles must recognise the challenges of formal institutional learning situated in societies permeated by people supporting each other's learning through mobile devices. Taken together, these considerations lead to a set of design principles that we propose and briefly elaborate in this chapter.

DESIGN 'FOR' LEARNING

This section focuses on the ways in which design *for* learning (as defined by Beetham and Sharpe in the Introduction to this volume) can exploit the affordances or characteristics of mobile technologies, whilst recognising how these are shaped by popular and social appropriation. These technologies 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 devices support learning that is personalized, situated, authentic and informal. This kind of learning typically takes place in practice-based settings, often characterized by unpredictability and ad hoc problem-solving. It 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 it is paradoxical. Mobile technologies do however have affordances that support these types of learning, and can be used to integrate it with more formal learning opportunities. For example, mobile devices are suited to spontaneous reflection and self-evaluation; these could be elements in an e-portfolio shared with a tutor.

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 social, cognitive and physical difference and diversity (e.g. autistic

people, see Rodríguez-Fórtiz, Fernández-López and Rodríguez 2011). It also recognizes that cultural and social exclusion from access to formal education may be compensated by a personalized approach whereby learning can be done by individuals in their home or in a private place.

Personalized learning systems can potentially recognise the context and history of each individual learner (and perhaps their relationships to other learners) and deliver learning to each learner when and where they want it. Prototypes exist for learning designed on the basis of knowing aspects such as 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 (see e.g. Yau 2011; Rubino *et al.* 2015). Furthermore, the design of the learning delivered by the system can evolve with the learner and their learning. Learners can also be involved in designing their own location-based mobile learning (Edmonds and Smith 2017).

By *situated learning*, we mean learning that takes place in the course of activity, in appropriate and meaningful contexts (Lave and Wenger 1991). The idea was formed 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 (see Ellaway, Chapter 12, this volume). Mobile learning can be designed to support this context-specific and immediate *situated* learning (e.g. 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. Whilst personalization emphasizes learner freedom and choice, situated learning may appear to be

tied to a location or situation that the learner did not choose. In actual fact the learning design may allow plenty of choice as to the situations in which they learn.

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. 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.

In previous editions, this terminology (situated, personalized, authentic, informal), was useful to distance mobile learning from institutional e-learning or formal learning. We used to say that mobile learning took learners out of the classroom and off the campus. Now, however, we find some of these distinctions breaking down. Learners are using their phones and tablets to support their learning in everyday life, on and off campus. Their activities can be

personalized, authentic and informal, even in the formal situations of lecture theatres and seminar rooms – though they are often constrained to be otherwise. Their social connections and interactions with their environment are constantly evolving. The use of augmented and virtual reality is adding new depths and layers to the experience of authentic, situated learning.

Much of the potential became apparent as technological and pedagogical expertise built up. Early 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 and confusion 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 some 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 devices can deliver learning specifically designed for learners' wider social and economic contexts. In particular, the widespread ownership of mobile phones allows educators to design for 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 accessible, motivating or convenient way to take part in learning (Unterfrauner *et al*. 2010). However, the public funds to make this happen are no longer readily available. The reduction in political will and financial resources in many countries since 2008 has led to a dramatic curtailment of state intervention

to support educational innovation, inclusion and social mobility, so there is correspondingly less mobile learning of this kind taking place.

In the same timeframe, students in formal education have come under a range of growing pressures – 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 asynchronously with other students on projects and discussions, and to maximise contact and support from tutors (Yau and Joy 2009).

Finally, mobile technologies present 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 (using various text-to-speech apps and built-in mobile device functionality), and voice-based command interaction (for example Siri on the iPhone). There has been a transition away from the design of technology and learning to address specific cognitive or physiological characteristics towards the aspirations of inclusive design *for all*; in the mobile device economy, there are commercial reasons for device designers and app designers to design *for all,* if only to increase their customer base.

All of these remarks equally apply to the design for learning that exploits resources generated locally and to the design for learning that orchestrates or curates resources discovered externally. The latter is however still exploratory and experimental in learning with mobiles but represents a movement across educational technology as a whole (Higgins 2011).

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 the design process itself. In our view, there are four key designs to consider, namely, design of content, of activities, of communities, and of communication. This is however an arbitrary distinction, since, for example learners may design content as an educational activity. Also these categories are not strictly equivalent. Within the kinds of constraints we discuss, designers are in control of the outcome of designing content (when they themselves design it) but not of activities or communications, especially when learning takes place outside of classrooms or closed learning environments.

Design of 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, including time and place.

- *Learner-curated content:* learners, and indeed their teachers, should seek, share and critique existing external content (and apps, podcasts, etc.) as a way of accessing and exploiting the richness and diversity of material available, not only matching their various personal preferences but also building insights into their own learning.

- *Personalized content*: learners can receive, assemble, share and carry around personally useful and appropriate resources.

- *Up-to-date 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.

- *Prioritized content*: content can made available on mobile devices in such a way as to prioritise it or draw attention to it through notifications; this may be a useful deliberate teaching strategy.

- *Content in multiple media*: e.g. if listening is preferred over reading, delivering audio via a personal mobile device can be engaging and convenient, and allows learners to exploit different situations such as routine walking and commuting, seamlessly.

- *Flexible content*: providing mobile access to learning materials and resources, as a more flexible alternative to desktop content.

Design of communities

Learners may prefer to learn in groups or may be constrained to learn in groups. These groups may be constituted from their fellow formal learners, inside the institutional mobile-friendly VLE, or they may be constituted from informal learners with a shared interest,

inside, for example a Facebook or WhatsApp group. Either way, these learners may be creating content or just consuming it, and teachers or designers will have a role and responsibility for designing the community, its interactions and its behaviour. Experience of *m-moderating* (moderating of mobile seminars) is still very limited (JISC 2008; Traxler and Leach 2006) but could in principle follow the same trajectory as e-moderating, moving from administrative support and reacting to individual queries, to purely pastoral support and then creating expectations and processes that learners can find and share solutions amongst themselves (Salmon 2011). There is considerable anecdotal evidence of micro-blogging with Twitter forming the basis for un-moderated *personal learning networks*, and increasing use of social networks within formal learning (Minocha 2009), 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). We should add that they are also difficult to research for both methodological and ethical reasons.

Design of activities

The third area to consider is the design of learning activities. According to Naismith *et al.* (2004), mobile technologies can be used in the design of seven 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, where mobile devices can provide ready-to-hand access to information and communication, or record learning experiences for future 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 etc.

We should also now add:

- Connectivist learning, as exemplified by the early MOOCs, exploiting rich broadband connectivity and massive enrolments but with variable participation to exploit and manage the *wisdom-of-the-crowd.*

- Private learning, exemplified by girls and women accessing content and communities in spite of cultural and social exclusion, pressures and barriers.

- Embodied learning, emphasizing the role of movement through space and using gesture in learning, where the mobile device can be part of the gesture (Lee 2015).

These different types of learning extend the typology offered in Mayes (Chapter 1). 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 and spontaneous (Bull *et al*. 2004; Colley and Stead 2003) and as disruptive (Sharples 2003) or intrusive. This is a major challenge for the design of formal learning, since opportunistic learning and learning to a pre-designed format are so different in nature and intent. Moreover, in a society permeated by mobile technologies and practices, mobile learning can no longer be seen as the exception. If all learning is (potentially) mobile, and a mobile society is always learning, then the agenda for learning design must change its focus. This is 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 2009).

Design of communication

This is an exciting but problematic aspect of design, due to residual worries about the extent and reliability of coverage and the costs of connectivity that might be incurred by learners, but mostly due to the contested nature of agency and control. Mobile communication takes

place at the intersection of the educational tasks as determined by lecturers and teachers and the recreational, personal and social uses as determined by learners themselves, with the balance relentlessly moving towards the latter. 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 (e.g. via Bluetooth)
- Portable sound-recording, voice-recording, photos and video clips that are used in communication

Most phones support voice, SMS, e-mail, micro-blogging, instant messaging, social networks and web-based conferencing. Mobile learning communities are rapidly growing and diversifying. From the perspective of designing educational experiences mediated by mobiles, we must remember that *phonespace* (Townsend 2000: 95), the space inhabited by the users of mobiles and traversed by their communications, unlike cyberspace is characterised by a blizzard of different modes, those mentioned above being used for a multitude of purposes, and mixed in with real-time, real-world communications and people.

DESIGN PRINCIPLES

In this chapter, we have outlined key considerations in order to clarify how the designs for learning with mobiles 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. Earlier ideas and principles for designing mobile learning had drawn on those of e-learning (so for example methods such as ADDIE had been co-opted by some organisations seeking a documented and structured approach (Barking *et al.* 2012), but we have argued for an ever increasing divergence of e-learning and learning with mobiles. Next, a rationale must be constructed around how the formal learning will be more personal, situated, authentic or informal than would be possible by other available means. Content, communities, activities, tools and communication should then be aligned with the proposed rationale. Thirdly, we need to recognise popular familiarity with mobile devices, not only to consume information, images, ideas and opinions, but also to produce, share, transform and unsettle them. This takes us beyond the 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 and blurs the skills of designers, teachers and possibly librarians.

We believe that design principles for mobile learning should be based on two key observations. First, that mobile technologies are ubiquitous, diverse, personal, social and changeable, not uniform, consistent, or institutional. Second, 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, individual recreation and perceptions about utility (see also Charitonos and Kukulska-Hulme 2017).

This chapter specifically addresses designing for learning with mobiles but the following recommendations barely mention 'mobiles'. This is in keeping with our argument that mobile technologies are no longer a simple and discrete technology but a pervasive social

phenomenon, and perhaps also starting from learners and their world rather that fitting them to a predefined and specific technology solution or educational technology formulation.

On this basis, we propose the following principles:

1. Start with learners; explore their aspirations, diversity, limitations; their experiences and expectations of learning, working, interacting, inclusion, access, and technology.

2. Be prepared to trial and discard activities frequently as technologies evolve and are adapted and appropriated by the societies and cultures in which our learners are embedded.

3. Accept 'good enough for now' and obtain feedback from learners; the sooner learners can you tell about your design in their world, the sooner you improve it. Think about the fact that education is probably only a small part of their digital experiences, even though it is a big part of yours, and how this shapes expectations.

4. Look at what you want in terms of content, communities and tools and ask how much you can curate, collate and adapt before you ask how much you, or your institution, need to create and construct.

5. Recognize that learning activities designed by you will be played out differently as learners engage with them outside the classroom and the campus; take account of environmental factors that may impact on mobile learning and unexpected learning outcomes.

6. Design to help learners contribute as well as consume mobile content, to develop their transferable critical and creative skills. Seek opportunities for creating, prototyping, participation, and evaluation with learners in their world.

7. Focus on designing the education experience; consider the function of the educational artefact as part of that experience.

8. Consider assessments and assignments within the wider context of the educational experience and the learners' worlds, and how assessments and assignments exploiting context and location, focussing on authentic and situated experiences, can make connections between the two.

9. Look for added-value from mobile, e.g. opportunities for contingent learning, situated learning, authentic learning, personalised learning; for capturing data and image, for using location and context.

10. Recognise that phonespace is not an impoverished version of cyberspace but just as rich, far more fluid and much more permeable to 'real' space, and that each has its own norms in terms of vocabulary, formality, courtesy, interaction, responses.

CONCLUSIONS

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, including its approaches to design, 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 became widespread, familiar and popular, and as access to fast and free web services, social networks and shared resources begins to shape learning practices, this made less and less sense. The design principles we have put forward recognize the centrality of learners with their personal technologies and their preferences, experiences and expectations drawn from outside, before and after their educational institutional identity,

alongside the unique nature and added value of mobile learning, and the idea that mobile learning is synonymous with unpredictability and constant change.

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