



Big Issues in Mobile Learning

Report of a workshop by the
Kaleidoscope Network of Excellence
Mobile Learning Initiative

Edited by Mike Sharples,
University of Nottingham



Kaleidoscope is the European research network shaping the scientific evolution of technology enhanced learning. It integrates the leading research teams in the field, who work collaboratively across educational, computer and social sciences to transform the quality and reach of the learning experience. Kaleidoscope fosters innovation and creativity through the development of new technologies, methodologies and concepts, defining the challenges and solutions for interdisciplinary research. Kaleidoscope's goal is to inform knowledge transfer between education, industry, and the wider society. Through its scientific programme, Kaleidoscope is helping to build a dynamic knowledge-based economy for Europe, engaging with social, economic and political stakeholders at all levels.



The LSRI, University of Nottingham, is a world-leading centre for research into the science and technology of learning. Its objective is to explore the cognitive, social and cultural aspects of learning and to design innovative technologies and environments for learners. The Institute brings together staff from the founding Schools of Computer Science and IT (CSIT), Education, and Psychology, as well as expertise from other disciplines. The Big Issues workshop was held at the National College for School Leadership on the Jubilee Campus, also the site of the LSRI research facilities.

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foreword>

Over the past ten years mobile learning has grown from a minor research interest to a set of significant projects in schools, workplaces, museums, cities and rural areas around the world. These projects range from providing revision questions to children by mobile phone (BBC Bitesize Mobile), through small group learning in classrooms using handheld computers (MCSCCL from Pontificia Universidad Católica de Chile), to context-sensitive learning in museums (MOBlearn European Project).

Each of these projects has shown how mobile technology can offer new opportunities for learning that extends beyond the traditional teacher-led classroom. As the projects developed, the researchers became aware of significant issues that were not obvious at the outset. Some are technical problems, such as how to manage technology with short battery life, or how to interact with a mobile device when walking. Some are educational, such as how to coordinate small group learning in the classroom, or to deliver teaching content through a small device. And some are broader issues of society, for example whether it is ethical for software on mobile devices to monitor and control children's learning activities outside the classroom.

Mobile Age

We are now entering the mobile age, where phones are carried everywhere, banks are accessed from holes in the wall, cars are becoming travelling offices, airplane seats are entertainment centres, computer games are handheld, and advertising is ubiquitous. We now have the opportunity to design learning differently: to create extended learning communities, to link people in real and virtual worlds, to provide expertise on demand, and to support a lifetime of learning.

The entertainments industry is comparable in size and complexity to the education sector. One hundred years ago people travelled to music halls or concerts to be entertained. Then broadcasting and the gramophone brought mass entertainment into every home. Now a second revolution is underway as the internet enables people to create and share entertainment media across the world.

Challenges and Opportunities

One hundred years ago children travelled to schools to sit in rows and be instructed by a teacher. Today they still do the same. Why is education so resistant to change? Over the next decade will it undergo as radical a transformation as the music industry? If so, it will have to face some of the same issues, such as preserving copyright and maintaining quality, and also some unique ones such as assessing learning in the field and bridging the gap between formal and non-formal education. We urgently need to address these issues if learning is to meet the challenges and opportunities of the mobile age.

Mike Sharples

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“ We now have the opportunity to design learning differently: to create extended learning communities, to link people in real and virtual worlds, to provide expertise on demand, and to support a lifetime of learning ”



introduction> mapping the landscape of mobile learning >

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Mobile learning projects are blooming all over Europe. They range from the use of Personal Digital Assistants (PDAs) and tablet computers in classrooms, through mobile phones to support learning between schools and museums, to context-aware technology for field trips and tourist visits. International conferences such as mLearn, WMUTE and Handheld Learning are presenting the details of these projects, but it is time to reflect on the issues behind the growth in mobile learning. This was the aim of the "Big Issues in Mobile Learning" workshop organised as part of the mobile learning theme of the Kaleidoscope European Network of Excellence in Technology Enhanced Learning. It brought together forty researchers in mobile learning from across Europe for a two-day workshop where seven themes were discussed in depth for a day each, by groups of between 8 and 13 people.

The participants also held plenary sessions to survey the mobile learning landscape, presenting and debating important implications from the discussions. "We've got a reasonable idea about what works," said Mike Sharples (University of Nottingham, UK) in his opening remarks. Among these are classroom response systems, laptops and tablets with standard software, text message alerts sent to mobile phones, small-group learning with wireless devices, multimedia museum guides, but these are just the tip of the iceberg.

Learning Across Contexts

One issue that became clear is that mobile learning is not just about learning using portable devices, but learning across contexts. As Jorge de Sousa Pires (Uppsala University, Sweden) said, it is about "a society on the move". Mobile learning is not something that people do; learning is what people do. With technology getting smaller, more personal, ubiquitous, and powerful, it better supports a mobile society.

Design

And so designing for mobile learning becomes a critical challenge. 'How to enhance the experience without interfering with it' was the title of Russell Beale's (University of Birmingham, UK) workshop session.

“Mobile learning is not just about learning using portable devices, but learning across contexts.”

"For lots of people, children particularly, education is not optional," he said. "It's something that they have to do, and they don't necessarily want to do it. Whereas one of the good things about technology is that it offers an opportunity for choice."

Thus, said Peter Lonsdale (University of Birmingham, UK) we shouldn't cram existing activities onto mobile devices, but instead make use of different ways of organising learning communities. "Children want to learn," claimed Ann Jones (Open University, UK), "but what they want is choice over what to learn. You can stop a child from learning by just presenting a load of information."

Evaluation

How can we effectively measure learning in mobile environments? Josie Taylor (Open University, UK) ran a session exploring this, and the group discovered that evaluation overlaps with design. Mobile learning is often blended with other types of learning. >

A mobile device could act as a tool for thinking: for example, when learners know that everything is being recorded or is easy to record, this changes their behaviour.

Thus, argued Barbara Wasson (University of Bergen, Norway), we should focus on activities, and the dialectic relation between the learner and the technology, not on people or technology in isolation.

New Conditions for Learning

Technology creates new conditions for learning, said Ulrich Hoppe (University of Duisburg-Essen, Germany), and can induce new ways of learning as well. Innovative learning scenarios were explored in a group led by Marcelo Milrad (Växjö University, Sweden).

"We need to look at innovation in a social context," he said. Think of card games such as poker, or the trading card games popular with kids. Now imagine 'augmented reality' cards linked to live data, virtual or sensor-embedded cards that can be shared, hidden, or traded.

Or imagine being on holiday in Thailand and wanting to know how to say good morning to a local person; you punch a number on your phone and simply ask someone in a local language-learning community (for a small fee) to teach you the phrase over the phone.

A similar service by SMS text, called Any Questions Answered (<http://www.aqa.issuebits.com/>), already operates in the UK and Ireland with a staff of over 500 people working from home to provide answers to any question that can be sent by text.

Classroom Impact

What about the impact of mobile devices on the classroom? Mobile devices can support learning in schools, but some argued that they have the potential to render schools obsolete, and several groups explored this tension. Jones led a session on mobile devices and affect, as the 'coolness' of mobiles is sometimes used to motivate students.

Sharples' group staged a debate on formal education and mobile learning, with Tony Hall (University of Nottingham, UK) arguing for the increasing irrelevance of classroom-based learning. Jan Derry (Institute of Education, UK) pointed to history, however, showing the relative lack of substantial change over many years. There are more interesting things going on outside, he said. "We need," suggested Derry, "to get the balance right" between formal and informal education.

Mobile Society

Mobile technology doesn't just mean delivering content to small screens. The Big Issues workshop took place at a time when Nike was teaming with Apple to link shoes with iPods, and Nokia had designed a phone with a built-in projector. Not only is Europe awash in mobile technology, but there is also a rapid growth in mobile phone use throughout the developing world.

Projects in Africa are beginning to explore how basic phone technology can be used to coordinate and support teacher training and distance learning. Today's big issues are only going to get bigger.

'Mobile learning' may be the buzzword of the day, but the emphasis should be on what people learn as much as how they learn. The Big Issues participants are mapping out the territory of the mobile society, and Kaleidoscope provides a context for exploring this new place.

“ We shouldn't cram existing activities onto mobile devices, but instead make use of different ways of organising learning communities. ”

what is mobile learning? >



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Participants: Do Coyle, Katie Fraser, Tony Hall, Elizabeth Hartnell-Young, Simon Patton, Yinjuan Shao, Esra Wali, Kevin Walker, Barbara Wasson, Helen Whitehead.

As a result of the dedicated work of the mobile learning community, in recent years we have witnessed an explosion in the growth of mobile learning across all sectors of education. While this is to be welcomed, a re-conceptualisation of the precise nature of mobile learning needs to occur. Why? Primarily because mobile learning has been a victim of its own success. Many communities have defined it based on their own particular experiences, uses and backgrounds. This has led to a fertile proliferation of views and perspectives. However, the downside is that the unique nature of mobile learning is becoming very difficult to characterise. Worst still, mobile learning, as a concept, is currently ill-defined; it seems to be all things to all people.

Formal definitions from European and Government agencies espouse its relationship to e-learning. Technologists place a high emphasis on novelty and the functionality of the devices (phones, PDAs, iPods, PSPs) themselves. Some researchers focus on the mobility of the learner. Yet others focus on learning in informal settings, leading to a juxtaposition between mobile learning and formal education. Furthermore, mobile learning applications are underpinned by many different theories of learning. While this breath of perspectives is to be welcomed because it leads to many possibilities for development, it poses problems when trying to develop a theory of mobile learning. Therefore, this workshop proposed that, as a community, we pragmatically delineate the unique dimensions of mobile learning.

Current perspectives

Current perspectives on mobile learning generally fall into the following four broad categories:

Technocentric. This perspective dominates the literature. Here mobile learning is viewed as learning using a mobile device, such as a PDA, mobile phone, iPod, PlayStation Portable etc.

Relationship to e-learning. This perspective characterises mobile learning as an extension of e-learning. These definitions are often all-inclusive and do not help in

characterising the unique nature of mobile learning. What is needed is clarity: in agreement with Traxler (2005), the technocentric/e-learning based definitions only seek to place "mobile learning somewhere on e-learning's spectrum of portability".

Augmenting formal education. In the mobile learning literature, formal education is often characterised as face-to-face teaching, or more specifically, as a stereotypical lecture. However, it is not at all clear that this perspective is wholly correct. Forms of distance education (for example, distance correspondence) have existed for over 100 years (Peters, 1998), leading to the questions regarding the place of mobile learning in relation to all forms of "traditional" learning, not only the classroom.

Learner-centred. A strong lineage of research into conceptualising mobile learning is traceable by reviewing the combined works of Sharples, Taylor, O'Malley and their colleagues. In their early research, the concept of mobile learning was strongly linked to the device (Sharples et al., 2002) and the potential for enabling lifelong learning (Sharples, 2000). However, it soon became clear that rather than the device, the focus should be on the mobility of the learner. This led to considering mobile learning from the learner's perspective, and to the definition that: >

“The workshop preferred to characterise mobile learning as an intervention in terms of guiding what the learner is constructing.”

“Any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of learning opportunities offered by mobile technologies” (O’Malley et al., 2003). Current work (Sharples, 2005; Taylor et al., 2006) is exploring the notion of learning in the mobile age, to develop a theory of mobile learning that builds on Engeström’s conceptualization of Activity Theory and Laurillard’s (2002) Conversational Framework. The focus of their work is on mobile learning as communication in context (Sharples, 2005).

Exploring the issue

The workshop began by exploring the issue of what is unique about mobile learning. The aim was to focus on the various dimensions of mobile learning in order to help clarify what is meant by the term.

The day began with a short 20-minute presentation of current perspectives, as outlined above. This formed the basis for 50 minutes of brainstorming around the issue. There was general agreement that a precise definition of mobile learning is unattainable. Instead, key characteristics of mobile learning that emerged were as follows:

- Enables knowledge building by learners in different contexts.
- Enables learners to construct understandings.
- Mobile technology often changes the pattern of learning/work activity.
- The context of mobile learning is about more than time and space.

There was a strong view that for mobile learning applications to be innovative they should not focus on

information transmission and must move away from a model of ‘anytime, anywhere’ access. This led onto a discussion regarding how the technologies and, critically, how the applications developed might be transformative in nature, i.e. allow learners to achieve things that they couldn’t have achieved before. However, evidence of ‘transformation’ (from a discussion of current applications) was found to be lacking. Thus, the workshop preferred to characterise mobile learning as an intervention in terms of guiding what the learner is constructing. Based on this premise, the next stage of the workshop was concerned with developing short mobile learning scenarios. For this, we broke up into two groups and each group was asked to focus on what mobile learning means for them in terms of their everyday practices. Key points that emerged from the scenario-building process were as follows:

The relationship between the learner, teacher and parent/caregiver is important. This is because it helps to structure the interplay between student appropriation of technology and practices in formal education.

Mobile applications often afford cross-curricular activities. This aspect was seen as a key advantage when engaging with teachers to link mobile use with classroom activity.

The ethical dimension is critically important. this point came up at multiple points throughout the day and was viewed as becoming even more relevant as we move towards a world in which ubiquitous technology is ever present.

Representation on mobile devices is an issue. Not only do characteristics of the technology, such as the small-screen size, need to be taken into account but there must



also be an emphasis on the types of representations that can be used for constructing knowledge. For example, the ‘poverty’ of texting was brought up as a constraint for visual learners.

Participants felt that the role of mobile devices in the socialisation process, and the implications this has for learning needs were currently under explored.

Implications

The workshop proposed many implications for mobile learning. However, they are preliminary and flag a need for further collaborative work. The first implication is that mobile learning applications are best viewed as mediating tools in the learning process. They are not ends in themselves and should be related to other learning tools that students and teachers are already using, and/or tools that having arisen as a result of technical developments (e.g. social software). The second implication is that designing a mobile learning activity can be supported by addressing the following factors:

1. The learner and their personal relationships (peer groups, teachers, etc.)
2. What is the learner learning (topic, relationship to prior experience, etc.)?
3. Where and when are learners learning? This is deeply related to the notion of context as emergent phenomena (Dourish, 2004).

The third implication is that by answering these questions, the application will be designed from the ground up to form the basis for a distributed learning network. This construct sees mobile learning as part of a greater whole in which learning tools, activities, contexts and people are distributed over time and space. However, by designing in this way and for this network complex issues at both a technical and social level arise. This led on to a discussion around issues that participants felt were important in the context of mobile learning within distributed learning

networks including: socialisation, representation and personalisation. Each of these is a topic in itself and points to potential fruitful avenues for future research.

Resolution

To being resolving some of the issues raised during the workshop, we spend the latter part of the day focusing on how we might re-conceptualise mobile learning in light of what we had learnt. This was done through a single group dialogue, capturing by iterating a concept map of key characteristics, the final version of which is shown in Figure 1.

Perhaps, the most revealing aspect of this map is that it is centred upon mediated rather than mobile learning. This reflects the participants’ view that learning is mediated by a number of factors, which when viewed from a particular perspective, help in characterising the unique dimensions of mobile learning. By beginning to delineate these factors, participants felt there was a strong rationale for using the concept map as a collaborative tool for all stakeholders to identify design sensitivities that need to be accounted for when developing mobile learning applications. A partial list of these factors include:

- Contexts
- Curricula
- Cultures
- Ethics
- Tools
- Learning activity
- Access to information and people
- Communication
- Community building
- Appropriation

“ Mobile learning applications are best viewed as mediating tools in the learning process ”

These factors are further delineated in Figure 1. Another interesting characteristic of this map is that the technology itself takes a secondary role. What is important is to get the nature of the tool (application) right, based on social factors (such as communication and appropriation)

and learning activities. When viewed in this way, the characteristics of the technology can be leveraged in new and interesting ways.

A related point is that new learning applications emerge through interaction and communication between key participants in the development cycle (researchers, teachers, learners, software developers), rather than educationalists only having the opportunity to appropriate existing technologies for their purposes. It was noted that this topic is being addressed by the ‘Learning patterns for the design and deployment of mathematical games’ research theme within the Kaleidoscope Network.

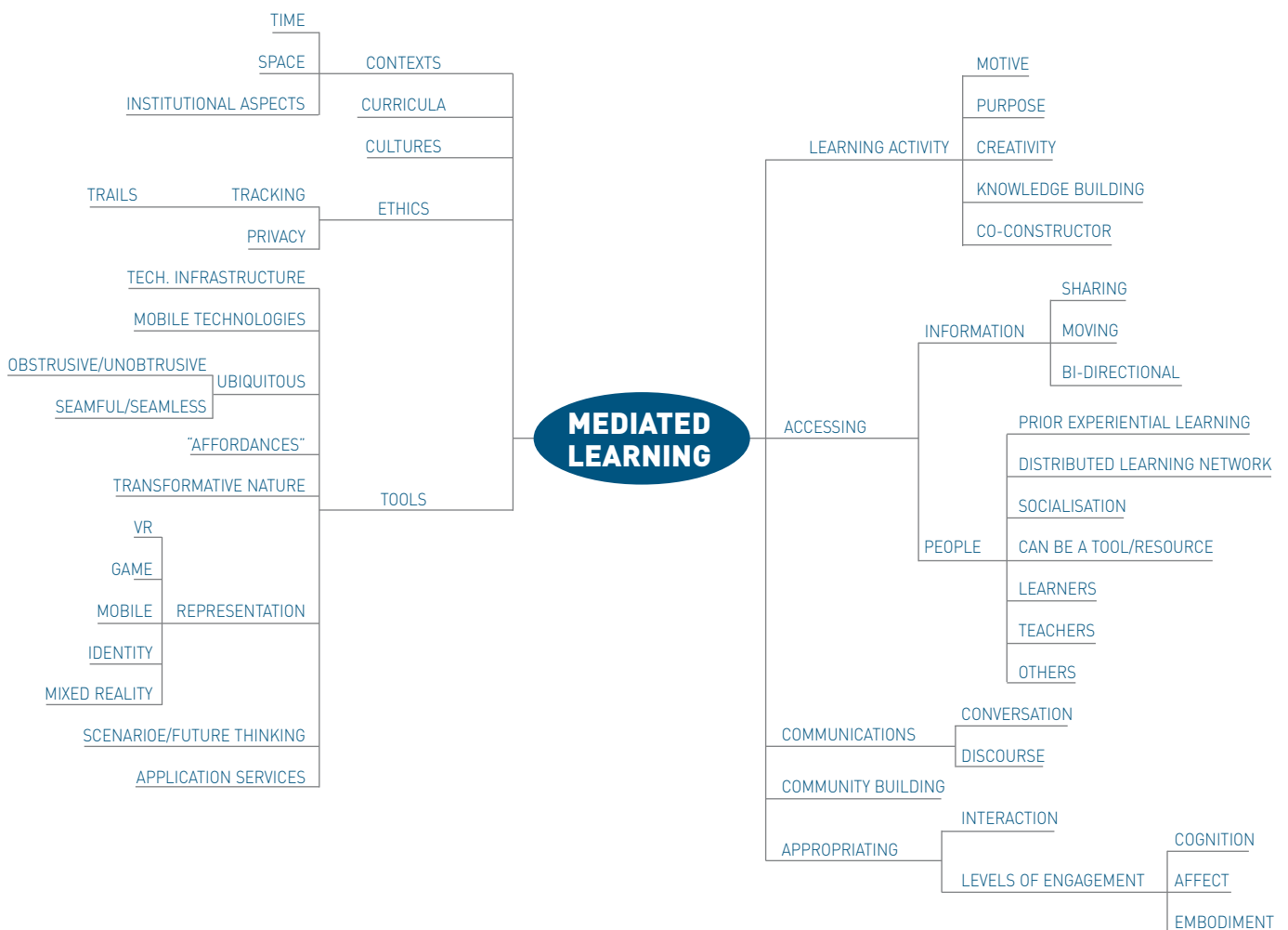


Figure 1: Mediated learning through mobile technologies (M² learning)



Conclusion

This workshop aimed to address the issues of 'what is mobile learning?' This proved a topic of fruitful discussion, with the rejection of any particular definition of mobile learning. Instead, we focused on characterizing the dimensions of mobile learning. The main outcome was a

repositioning of the 'mobile' in learning. As one participant put it "learning is learning", reflecting the general consensus that learning is mediated through mobile technologies, which are in themselves interwoven with other learning tools.

“ New learning applications emerge through interaction and communication between key participants in the development cycle ”

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how to enhance the experience without interfering with it?>

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This workshop focussed on how to enhance the experience on learning and interacting without interfering with it. Is this possible? What do we understand by interference, and is it always bad? How can we design for optimal enhancement? These and other questions were explored by the participants.

The report is in three main sections. The first details the structure of the workshop, so that others running similar events can adapt and develop the structure used here. The second summarises the main discussions, whilst the final part summarises the key findings from the day.

Workshop structure

The format and organisation of a workshop shapes the interactions and hence the effectiveness and direction of any discussions, and so it is relevant to summarise the approaches taken in this workshop, so that others can understand more about the dynamics and thus contextualise the results and discussions more effectively.

Round Table Introduction

The workshop was specifically designed to be an extended working session, with short presentations and question and answer sessions. Therefore, it was important to establish the group dynamic early on. Introductions are a key element to getting people to know each other and to feel confident in interacting in the group environment: we undertook a round table introduction which was about 2-4 minutes per person: participants gave their name, affiliation, interests and expertise, a brief picture of why there were there, what they wanted to get out of the session, plus something unusual about themselves. And

within that précis, they had to include something untrue as well. Once the person had finished introducing themselves, the remainder had to identify the lie. This device ensures that others pay more attention to the speaker, offers the chance for humour, and allows some clarification in the exchange that follows.

Scenario Discussions

We then moved to scenario discussions, in which participants discussed brief scenarios in which interference occurs, presenting the social and technological environment, detailing the problem, and also trying to find some examples in which enhancement is not interference as well. From these, we tried to develop the main issues that are more generic. Within our structure, we split into two groups for this, having a session where we collected and explored ideas and scenarios and then came back together to present the most significant of these to the whole group.

“New technologies allow us to develop full digital records of our lives and experiences.”



“Technology in general tends to be much like Marmite, in that people either love it or loathe it – very few are neutral about it.”

Creative Session

A creative session followed, envisaging the future, using creative approaches such as “imagine if....”, feature matrix development (in which characteristics of existing systems are listed and new systems with a new combination of features are identified), and ‘bad ideas’ in which deliberately poor concepts are proposed, dissected, and the characteristics that make them bad were identified – which, if solved or rethought, can lead to novel solutions. The scenarios had to cover technological, cognitive and social issues, and be as complete as possible. We worked in two smaller groups to develop these ideas as far as possible. From this view of the future, we then tried to work backwards to see if any of the futures we saw could be used to solve existing problems, or if they offered insights into creating new scenarios of use in which interference was much less of an issue.

Reflection

The workshop concluded with a session to pull the ideas together, to reflect on what we’d learned, to see if we’d met our individual goals, and to discuss any future steps.

We were flexible with timings, though the suggested ones worked well: 30 minutes for introductions, 30 minutes for scenarios and 45 for issues, then lunch. The afternoon spent 30 minutes on future envisaging, an hour on the solutions, and 30 minutes pulling the workshop to a conclusion.

Key Issues

The workshop identified a number of key issues related to the theme.

Recording of experiences in tension with privacy/security issues. The new technologies allow us to develop full digital records of our lives and experiences, and those of others, and yet doing that may well impinge on both the actual enjoyment of those experiences in the first place, and on the rights of others to have their experiences without being recorded or observed by others. In addition, the security and privacy of our own experiences needs to be understood and respected, since determining rights over this material is complex, especially if it involves others.

How physical device characteristics affect the interference. A mobile phone may be small and light but, for example, it is usually poor at recording video and requires detailed cooperation from participants to get something acceptable. This clearly causes interference in a negative way. However, sharing a mobile photo on the screen is often adequate, and can enhance an experience for many. The drift towards ubiquitous computing (computers available everywhere, embedded in everyday devices) doesn’t remove this issue, but does alter its impact.

Social issues. There is almost always an interference with ‘normal’ interaction, which necessarily affects it. In particular, there can be enhanced feelings of inclusion or exclusion within a group: maybe only some can see a photo on a mobile phone, for example.

Technical capabilities and familiarity come into this, but more obvious are the social, somewhat tribal groupings that occur. Technology in general tends to be much like Marmite, in that people either love it or loathe it – very few are neutral about it. >

Trust and affordances are imposed on technologies. We have a reasonable idea of how much to trust other people, and how to interact with them. However, technological intervention can alter our perceptions, in that people are opened up to more external influences than the immediate environmental experience, and our experiences of technology vary wildly so that people have different expectations of it. For example, youth culture has integrated text messaging and mobile phone use in a very different way to adult culture and their experiences of any particular situation are influenced by the reactions of their remote friends as they share it with them via text message as well as the immediate sensations and local reactions.

Perceptions of learning conflict with personal choices and freedoms. Learning is, for many, what you do in school, and so is not a personal choice or a freedom. And yet mobile learning can be about supporting people in the activities in which they willingly participate, and can enhance their enjoyment of these. We need to ensure that we understand more about the roles of technology in supporting the interactions between formal and informal learning, and in the understandable personal needs of people to turn things off, to be out of contact, and so on.

Attentional aspects: design and working in real spaces all impact the roles and use of technology. If we are out and about, we may well be in new, often uncontrolled environments, in which we need more basic situational awareness and alertness in order to navigate it, survive it, or appreciate it (depending on the situation). Having to change a focus of attention from the 'real world' to a specific device can be problematic.

Technology can deskill users, with old and new skills interfering. Technology can provide us with so much assistance that we forget how to do things for ourselves: why remember anything if you can look it up on Google, for example? This is not often a wholly good thing, and sometimes a very bad one. We have to be careful to design learning experiences with technology that enhance learning (in whatever shape or form we are considering) rather than simply making it easier for people to do something. In addition, old skills and new ones can interfere with each other. For example, the desktop metaphor was a useful construct in moving people from their paper-based offices towards understanding and using computers. But for many people, especially younger ones more actively involved in their own educational development, they are more used to computers than to filing cabinets, and the metaphor may be holding back development in certain areas. Why, for example, do modern mobile devices have the same desktop metaphor in their interface – is there not something more appropriate?

The yooof of 2day: modern children have a different perception of technology to older people. They re-appropriate it for their own uses, they have different expectations of it, it is an integral part of their everyday world. These social, psychological, experiential and technical differences are often not fully understood, and even more rarely utilised, by existing or proposed systems, and yet they need to be if the systems are to have a more significant impact.

“ The history sheet is a massive, computationally capable display, which can provide a real-time, interactive, exploratory overlay of information, images, re-enactments and so on over the real world. ”



“We can therefore see a new learning system in which we provide a safe environment for learning, but one that is much more individual and project-based.”

Two Future Scenarios

Two scenarios developed in the workshop are worth reporting. They show how learning, the environment and technology can be combined in alternative ways to provide new and potentially better experiences for the participants.

The History Sheet

The history sheet is a foldaway device, able to be easily carried in a rucksack or a shoulder bag. Light and semi-translucent, it can be opened out to form a large ‘window’ through which a large group can view the world. Its aim is to make the intangible tangible, and is deliberately large to support shared group awareness, and to be inclusive. Consider that you’re standing on the shore, overlooking the Solent. The sun shines on the relatively calm sea, light reflecting off the small waves in a shimmering pattern. It was on a day just like this in 1545 that the Mary Rose, a purpose-built warship, rolled over and sank whilst trying to engage the French navy. But on a day like today, it’s just a seascape, and hard to bring to life. Roll out the history sheet, spread it out, and watch the Mary Rose sail into view – see and hear the battle, investigate the theories of how it came to sink – understand how the geography of the Solent contributed to the tactics, understand how small waves could sink such a large warship, and so on. The history sheet is a massive, computationally capable display, which can provide a real-time, interactive, exploratory overlay of information, images, re-enactments and so on over the real world.

Some interesting things emerge from the scenario. One

theme relates to attentional aspects. A desktop machine tends to require full attention. A mobile device requires partial attention, and there can be an awkward context switch between the foci of attention. Keyboards are difficult to use in this more mobile context, and in general our visual channels are fairly heavily loaded already. With the history sheet, the interaction with the sheet involves users in the experience. It can create new context, and can act as the prime focus of attention, drawing on both the real and the technological. There are potentially interesting tensions between group needs and individual ones, not least in terms of how the scenarios develop and what is explored next. A key issue in the history sheet and the forms of social learning it supports is that its use is optional – it is possible to undertake the same learning objectives without it – and it is ideal if students desire it, rather than it being forced on them.

This scenario suggests that we need to work on developing new interaction paradigms and devices to optimise the potentials of learning in these ways. However, the existing lack of both standards, and standards compliance when such standards exist, is a commercial inertia that slows down necessary investment into the research, development and marketing of new approaches. It is clear, however, that the general trend towards ubiquitous computing open up some interesting possibilities for exciting, desirable and effective experiences that can enhance learning.

Longleat for Learning

A future vision contemplates a different view of society, and questions why schools exist at all. >

For many parents, their main role is one of childminding, since in modern society it is often both parents that work, sometimes out of financial necessity, but often because they enjoy their work and feel more fulfilled with it as part of their lives as well as their children.

We can therefore see a new learning system in which we provide a safe environment for learning, but one that is much more individual and project-based. It could be a fenced in area, 5-6 miles across, over which the children can range and learn whilst doing so.

This domain was termed a Longleat for Learning, after the safari park that allows lions to roam freely around a fenced-in perimeter. It would have similarities to summer camps, such as those managed by PGL, that offer a mix of curriculum-based activity, adventure and personal study. Into this space the family and community feed in their expertise and social elements, providing a motivation to the children to learn. Teachers are now much more like rangers – they support projects and provide generic or specialised expertise as and when necessary. Some structures can be provided (like an organised safari) or children can roam more freely. Work is project-based not discipline-based, and is in a more work-orientated environment.

A personal curriculum records what you have learned, and your level of competence in it and the related skills and knowledge that you have obtained. Essentially, the approach is to teach people to learn how to learn, and to motivate them to do exactly that. The technology does more than simply record the activities; it informs learners' choice, and connects communities with each other. This is no utopia: there are concerns about tribalism, about power relationships, and about whether people would bother to learn at all. But then, that latter point is one that we are currently battling with in conventional education at all levels anyway.

Conclusions

The workshop was happy to conclude that we couldn't yet reach any firm conclusions: there is need for a massive effort in understanding how we can usefully adapt and enhance technology for the benefit of society – and how we need to adapt society to maximise the benefits of new technologies.

The key issues we identified offer a new perspective on issues to consider in developing this research agenda, whilst the future scenarios illustrate some of the potentials and challenges awaiting us.

“The technology does more than simply record the activities; it informs learners' choice, and connects communities with each other.”

Affective factors in learning with mobile devices >

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Affective factors play a strong role (both positive and negative) in harnessing technology for learning. For example, as long ago as 1983, Open University research on students' use of learning technologies showed that students were strongly affected not only by their own perceptions and experiences, but also other students' experiences, particularly bad experiences (Jones and O'Shea, 1983).

Such perceptions and bad experiences with technology have persisted, although in some areas (e.g. collaborative on-line learning) many students have positive experiences and really value working together and this has a significant impact on their engagement and satisfaction. The advent of widely used mobile devices has changed the landscape however. Whilst a low but significant proportion of learners decide not to use (or don't have access to) computers, the usage figures for mobile technologies are much higher. So it seems that the anxieties or lack of confidence that users experience with static technologies don't apply so much to (at least some) mobile devices. It is argued, therefore, that many learners find mobile devices to be particularly attractive and are motivated to use them. As yet, however, there is little analysis or understanding of what it is that makes mobile devices so engaging. This was the starting point for the workshop on affective factors in learning with mobile devices. To paraphrase the early Malone paper (Malone, 1981): what makes mobile devices fun? As yet, however, this line of thinking has relatively little empirical evidence, nor do we know whether the theories of motivation that have been applied to non-mobile learning apply equally well and are adequate for this new context. It was therefore proposed that this is a key area for investigation.

Defining Affect

As with many 'large' concepts, defining affect is not

straightforward. Oatley and Nundy's (1996) definition was used as a working definition and defines affect as covering mood, emotion, attitude and value. Clearly this is an enormous area and although there is now a growing literature on affect and learning with technologies, until recently it has been a neglected area of research. To make the workshop discussions and activities manageable the participants agreed to focus on motivation but note that the workshop did not include any detailed discussion of psychological theories of motivation – see the recent special issue of *Learning and Instruction on Feelings and Emotion in the Learning Process* (Efklides and Volet, 2005).

Motivating Factors

The introduction to the workshop included a presentation by the convenor which proposed a number of 'mobile' motivational factors with a particular emphasis on informal learning about Science, drawing on the literature and shared experience of a Kaleidoscope funded project on Mobile Learning in Informal Science Settings (Melissa project (2006)). For example, the results from the Savannah project (Facer et al. 2004) where children learn about the Savannah through role play, using mobile devices on their school playing fields provide some direct evidence of the children's identification with the game scenario and their immersion in the game (Facer et al. op. cit.). >



Six Motivations

Six reasons why mobile learning might be motivating were suggested in the opening presentation (see Jones et. al. 2006):

- control (over goals)
- ownership
- fun
- communication
- learning-in-context
- continuity between contexts

In the first activity participants were invited to propose and discuss features of mobile learning that were either motivational (i.e. positive motivational factors) or were barriers to learning. The workshop participants focused on some of the proposed factors and added others including: identity or 'coolness' (fashion is an important consideration for young people in particular), privacy, instant access, sharing and portability.

Freedom and Control

It had been argued in the initial presentation that the association between the use of mobile devices and informal learning was salient because learners often find their informal learning activities more motivating than learning in formal settings such as schools because they have the freedom to define tasks and relate activities to their own goals and control over their goals. By the very nature of informal learning, there is a strong relationship

to learners' goals and interests which means that intrinsic motivation is likely to be high.

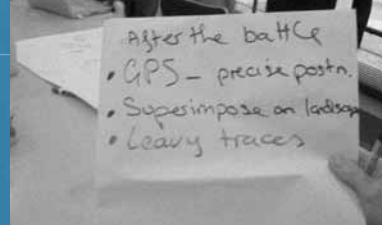
However, the locus of such control varies with age and with setting. In formal settings (e.g. schools), not only is there usually less control over learning activities and goals but it also varies with age, with younger children usually having much less control, and older children more freedom. The traditional separation between extrinsic and intrinsic motivation (e.g. learning in order to get grades as opposed to having a deep interest in what is being learnt) is not always sustainable. Activities that start off being externally motivated may change as the learner discovers they have a passion for the particular topic they have been set. Feeling in control matters.

Ownership and Appropriation

The issue of ownership was also perceived to be a powerful motivational force. Ownership of learning has been highlighted in research on motivation as a key motivational feature and also in mobile learning research. However, it was suggested that it was not straightforwardly owning the device that mattered so appropriation might be a better concept. Waycott (2004) has applied an activity theory approach to analysing the way in which learners use and adapt mobile devices, in this case PDAs, for activities in different settings including the workplace, formal learning and museum visits. She defines appropriation as the integration of a new technology into the user's activities.

Her analysis revealed a two way process in which the user

“By the very nature of informal learning, there is a strong relationship to learners' goals and interests which means that intrinsic motivation is likely to be high.”



adapts the tools they use according to their every day practice, prior expectations and preferences in order to carry out their activities and how, in turn the tools also change the user's activities. For example, some of the participants in one of her studies who were touch-typists coped with the usability constraints of the PDA by using it in conjunction with a foldout keyboard or as an adjunct to the desktop computer so that entering text was not so difficult and enabled users to 'fit' the use of the PDA into their every-day preferred practice.

It was argued that appropriation can also be subversive: users and learners can appropriate technology in ways that were not foreseen by its designers, or that undermines its original purpose. For example, 'pay as you go' mobile phones, by their portability and anonymity, are particularly useful tools for drug dealing and international terrorism.

support social networking: however, it was suggested that this is often a one-way process. People like to offer their own resources or experiences but are less interested in what others offer to share with them.

Unlike personal computers, mobile devices can provide instant access: they can be always on and ready to run, and their portability is also motivating. Their size means that they can be concealed for privacy, if not stylish enough, or alternatively displayed to show off coolness.

Implications

In the second activity of the morning, three different small groups discussed the implications of these issues for theory, design, or practice. The theory group identified and discussed a range of theories including the work of Dewey, Pask, Levy, Vygotsky, Durkheim and others that related to motivation in mobile learning.

“ People like to offer their own resources or experiences but are less interested in what others offer to share with them. ”

Identity

Having the appropriate mobile device and using it for appropriate activities was viewed as being a very important part of constructing an appropriate "cool" identity in particular for young mobile users. There are usability and cultural issues related to coolness, for example understanding trends in youth culture. Who are the trend setters and the trend followers? Who are the geeks? The context of use is also important.

Other issues identified and discussed included sharing, instant access, portability, and privacy. Mobiles enable people to share a number of things ranging from blogs to photographs. Sharing just about anything is highly motivating as can be seen from the number of sites that

For example, in relation to sharing, an important idea is the joint construction of knowledge and the culture of sharing or possession of knowledge. Taking a cultural historical activity theory perspective (which had also been crucial for Waycott's work cited earlier in considering appropriation) there are tensions between different activity systems and between individualism and altruism e.g. some people may be looking for individual payoff, asking "what is in it for me"? But one of the motivations here may be of performance.

It was suggested that Vygotsky's concept of the zone of proximal development (ZPD) could also be applied here in considering collective ZPD: for example a community can help and support an individual to develop. >

The current plethora of open content and freely available sites and software would suggest that there is indeed a motivation to share.

User Centred Design

The design group decided to focus on designing for appropriation, discussed earlier, and considered how the User Centred Design (UCD) process would take motivation and engagement into account. In UCD, scenarios of use would typically be developed through observations and user data, before developing prototypes of a system. Different views can be taken to focus on, for example, either the applications or the activities that people engage in.

Understanding what technologies and devices people currently have and how they relate to them and appropriate them is needed in order to consider how new technologies or devices might fit with current technologies. It was argued therefore that it is necessary to take much more account of the entire social context than is usual in UCD and thus adopting an activity system approach would be productive. Issues such as the tensions in activity systems and the stability of activities over time were discussed. Such an approach will enable a focus on the tensions that were identified by the theory group.

Focusing on motivational aspects may also mean highlighting some aspects of design whilst downplaying others: for "coolness" functionality is less important, whilst understanding more about the role of technologies in constructing personal identities becomes much more important.

Formal Settings

The group discussing practice concentrated on a formal setting, the classroom and its teacher and pupil practices, and considered the role of personal motives when engaging with technologies. Within school settings motivation can often be engendered by peers and teachers and by inspirational leaders. A participant cited an example from a research study they had been involved in where energetic, determined and inspirational teachers were able to effectively mobilise technology for learning and motivate their pupils. Interestingly, what is important here is the supportive environment within which the teachers are working: it is not about one particularly innovative 'leader' teacher. In turn, the school would need to be supported by national initiatives and government policy. However, once learners have become disaffected and are outside the school system, then increasing children's self-esteem is particularly important. Initiatives could involve mobile technologies to engage disaffected learners in order to motivate them to learn. Although policy was not within the group's remit it was not possible to consider practice without considering policy and the role of agencies and or individuals in this regard.

The afternoon focused on developing research scenarios and considering the methodological challenges and three scenarios were developed: one by each group:

Research scenario 1: Ownership or appropriation?

This group wanted to investigate what influenced appropriation by young people and decided on a scenario

“What is important here is the supportive environment within which the teachers are working: it is not about one particularly innovative 'leader' teacher.”



that adopted a quasi-experimental approach where a class of 20 pupils would be given new devices for a period of 12 weeks. They would be surveyed at various point during that period and also interviewed. A challenge for this scenario was developing a precise enough definition of appropriation. Findings that emerged from this hypothetical study were that many factors influenced appropriation including providing mechanisms for social networking, motivation, control and disruption.

Research scenario 2: Fun

Group 2 decided to develop an activity that was fun. In order to be engaging it should include the following elements: challenge, competition, collaboration, serendipitous surprise, and speed. These elements could be physical, social and/or cognitive. The agreed scenario was a castle treasure hunt and team game in which the castle is under attack and the competing teams need to collect clues to find out more about the attack, and in particular the aim is to find the point of attack. The clues that the team collect relate to the history of the castle and teams have to deal with obstacles such as ghosts capturing team members.

The issues that this raised included what is fun. How is this maintained over time? Different roles could be adopted by different team members which could allow for some sustainability over time rather than it being a one-off. How many features are needed to make it fun? Can these be unpacked? What is the appropriate age? It was decided that it would be appropriate for younger children or adults but not for teenagers.

Research scenario 3: Supporting affective development

The third group considered two possible projects: "coolness" and affective development, but focused on developing the second. It was argued that affect and cognition should be tightly coupled and the aim was to

“ The idea was not to try to remove the anxiety completely but to make it sufficiently manageable ”

develop ways of supporting affective development as well as cognitive development, in particular to support learners in stressful situations that might lead to disengagement and disaffection. The idea was not to try to remove the anxiety completely but to make it sufficiently manageable (i.e. bring it close enough to the comfort zone) through the use of mobile devices to provide appropriate support to alleviate the stress so that a learner might choose to engage rather than opt out.

One example that was focused on was that of a mobile personal support system – a kind of Hitchhiker’s Guide to the Galaxy – which learners would have available across very different contexts, from the classroom to trying to negotiate public transport in different countries. Support could be provided in a number of different ways: for example by links to others who shared the same problem or fears, by suggesting practical strategies for coping with the situation, or through the anonymity provided by classroom hand-held voting that allow the learner to suggest an answer without being identified as the person who doesn’t know the answer. One of the methods used in this study could directly relate to its affective nature by physiologically measuring stress, with and without the handheld support.

Conclusion

The proposed initial six motivational ‘features’ were a helpful starting point but it should be noted that they are indeed a starting point – they are not necessarily discrete and non overlapping so for example control and ownership are connected and so are learning-in-context and continuity between contexts. >

Being cool and fun are also related. Overall, it was agreed that affect and in particular motivation is a key area for further investigation. In particular, it is important to understand learners' previous and current use of technologies and the wider context in order to start to unravel what might motivate them in using mobile devices for their learning.

The concept of appropriation and the use of Cultural Historical Activity Theory were discussed as being particularly helpful for thinking about the affective issues in the context of the use of ICT in education.

Acknowledgment

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How can we address the conflicts between personal informal learning & traditional classroom education? >

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Most young people in Europe now have one or more mobile computer/communicators (phones, media players, handheld games consoles). Many also engage in rich networking and learning activities at home, through internet browsing, web searching, messaging, chat forums, and online communities.

For example, MySpace is one of the top five most visited websites in the world. It describes itself as 'a place for friends' and provides an online space for people to post their personal profiles, find other people with shared interests and take part in activities ranging from online chat to live events and face to face meetings.

Tensions

Through media sharing and social networking software such as MySpace, Bebo, and Flickr young people are developing transferable skills that employers prize, such as knowledge-working, media production, and collaborative working. Soon they will be able to carry out all these activities on the move, through powerful converged devices that combine personal media player, phone, camera and games console.

Yet, most schools and colleges do not recognise informal networked interaction as legitimate learning and they forbid children to bring phones and personal computers into the classroom. Thus, there are systemic tensions between both technologies and activity systems for informal online social networking and classroom education. At some point soon, these tensions could develop into conflict: when learners own more powerful computer technologies than schools could afford, when they see classroom learning as a distraction from their

rich informal activities, and when schools are unable to adapt to the changing world of mobile and networked interaction.

School Education

From a socio-cultural perspective, this can be seen as a tension between two activity systems. One is the system of school education, regulated by the curriculum and examining, enacted within the arena of a classroom through the mediation of a teacher who prescribes forms of acceptable discourse. These are reified in technology provided by the school with patterns of discourse through software that are tightly regulated and designed to support the curriculum. From the perspective of the school, the unregulated discourse of internet chat is a threat to school order and to the safety of learners.

Social Networking

The other system is that of social networking, mediated by personal profiling and peer interaction software such as MySpace. Children, open source software developers and multinational companies implicitly conspire to create a mirage of social solidarity, free speech, and creativity of language and interaction.

The environment is sustained through peer pressure to participate, its association with youth culture and language, and its impenetrability to adults. >

It is a mirage because regulation appears in many forms, through the design of the software, moderation of internet chat, commercial intervention of advertisements and promotions, and self-regulation of the online community.

Both activity systems continue to survive by mutual exclusion. Schools maintain classrooms as hermitically sealed environments, with all communication to the outside being carefully channelled (e.g. through educational websites and firewalls). Social networking thrives on its apartness from adult culture and its illusion of control by users. The points of tension occur where attempts are made to bridge the two systems. Thus, some schools have made attempts to engage children at home in schoolwork and to monitor their activities, by engaging parents as homework supervisor, with access to the school intranet. Parts of the media have raised the spectre of children falling prey to abuse through internet chatrooms.

Two Domains of Learning

While the two domains are physically separate then these tensions have been contained, but students are starting to bring not only the powerful mobile technologies but also the activities of mobile social networking. The classroom is becoming the arena in which two domains of learning and communication are enacted and opposed: the child-led, commercially mediated, subversive, peer collaborations of social networking, and the teacher-led, curriculum mediated, institutional teaching. By understanding these as systemic tensions rather than a series of individual confrontations, we may be able to find a way to resolve them, or better discover new expansive modes of learning.

Exploring the Issue

The workshop group first explored the issue by polarising it as a debate, on the topic that: "The disruption caused by children bringing personal mobile technologies and activities of online social networking into the classroom, will result in a major breakdown of school education".

Arguments in favour

The technology for social networking is rapidly being developed, by companies marketing new services for young people, and by young people being early adopters of social network technology.

The need to have virtual space for sharing and communication matches the youth culture of making friends, following fashions, and organising a social life.

Schools try to manage technology in a way that fits traditional classroom teaching through teacher mediation and knowledge communication. This clashes with the teenage culture of peer collaboration and knowledge sharing.

Schools are not committed to integrate children's personal technology in an evolutionary way, so the transition is likely to be painful.

There are systemic resisters to fundamental change from the structures of school education, with their emphasis on a common curriculum, and national and international performance targets.

Parents want schooling that is familiar to them. Most are risk averse and many are scared of the dangers of new technology.

Thus, one future scenario is of schools being unable, or unwilling to adapt to the patterns of learning and social interaction outside the classroom, with young people seeing school learning as irrelevant their skills and interests, and disconnected from the skills they value and the careers they seek. The technology will be a focus for that conflict, with schools banning powerful technologies for personal learning and social networking while struggling to provide obsolete computers running software that children don't want to use and that perpetuate an outdated model of content delivery and didactic teaching.

Arguments against

Schools are valuable for childminding, and this is not likely to change in the near future.



“Another future scenario is of schools neither welcoming nor banning mobile technologies and online social networking, but rather adapting to the new technologies and opportunities.”

Students are well able to make the distinction between informal social networking and school education, and they see the need for classrooms as places of formal learning.

Certain forms of knowledge are not accessible (to school-aged learners) without a more formal pedagogic process in which the role of the teacher is crucial. While informal social networking develops certain skills it cannot substitute for formal learning.

Schooling, as an institution, has a long history and online social networking will not change school practices. New technologies and new practices will be integrated into schooling, just as they have been in the past. Schools will manage mobile devices in ways that will harness their power but not their disruption.

Thus, another future scenario is of schools neither welcoming nor banning mobile technologies and online social networking, but rather adapting to the new technologies and opportunities. They may allow children with mobile devices to use them in classrooms under controlled conditions and with regulated access to networks, just as universities are making controlled provision for student laptops. Children will learn how to adapt their networking practices to the school environment, supported by tools for teamworking and collaborative learning. They will gain from owning and managing their own powerful technologies and from the discipline of regulating their interactions between informal and formal contexts. Schools will save costs from students bringing their own technologies and will gain from building on students' skills of networked learning. The digital divide will be bridged as converged

computer/phones become a standard consumer product and schools can afford to loan additional devices to children who do not own them.

Conclusions

The workshop participants came to no firm conclusion about whether and how the tensions might be resolved. There was, however, a general opinion that schools, colleges and universities would absorb and digest personal mobile technologies, just as they have all previous technologies, without profound change. However, it was noted that many pockets of tension were likely between social and educational technology use, and that integration would need to take a variety of forms. Some other important points that emerged are as follows.

Children in general do not want school to intrude on their personal life. There is a danger that the enthusiasm of schools, and some parents to extend school by, for example, parent access to school intranets, bite-sized teaching and revision via SMS, and new technologies such as location-based tracking, may be seen by children as schools attempting to colonise and control their social world. There is a need to discuss where the bounds of the school lie and where it is not legitimate for formal education to intrude on childhood.

There is an urgent need for teachers, parents and policy makers to understand the new technologies and also the new forms of online interaction. They need to debate with young people the issues not only of can these be harnessed for the purposes of formal education, but should they be, and if so, how.

Evaluating Mobile Learning >

What are appropriate methods for evaluating learning in mobile environments? >

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Although there are tried and tested methods for evaluation of specific applications of technology for learning, there are no existing comprehensive frameworks for broader formative evaluation in the mobile environment, largely because of its novelty. Relatively few teachers and learners have experience of working in this way, so we are simultaneously introducing new ways of engaging in learning with new artefacts and evaluating technical and pedagogic effectiveness.

This requires careful consideration so as not to skew the evaluation data gathered from users, who may find themselves fascinated by the new devices in a way which they may find interesting, and even fun, but which produces no lasting valuable impact on their work practices. In addition to this complexity, the mobile environment is eminently suited to supporting learning outside the context of curricula, institutions and timetables.

Our potential subjects of study may be wandering around studying things that interest them, at times that suit themselves, with little or no concern for consistency. The discussion of this issue will involve thinking about methods for identifying, recording, understanding, and evaluating such activity.

Scope of Mobile Learning

Workshop members contributed their expertise in the discussion of problems arising in relation to evaluation. The opening session defined what has changed with learning situations in which evaluators may be trying to carry out their evaluations. It began by discussing with whether 'mobile learning' signified:

- Learning mediated by mobile devices, or
- Mobility of learners (regardless of their devices), or

- Mobility of content/resources in the sense that it can be accessed from anywhere.

Workshop members decided that they preferred the broader concept of learning taking place in the 'mobile age', rather than the use of the narrower term 'mobile learning'. This change in terminology brings a wider view of both the learner's activities, and their various settings or contexts.

Access to Data

The consensus was that, certainly from the point of view of evaluation, it was learners' access to data that had changed, and that this had profound implications for learner activities. For example, students could now take their laboratory notebooks with them into the field not only to upload data they have gathered, but to access additional information to inform their workings, and to share their observations in real time with other students. This enabled a much wider range of activities, but located them 'on-site' and in the field, rather than in a laboratory setting, with associated ramifications for control by the evaluator.

Loss of Control

Loss of control in evaluation settings emerges in a variety of ways. No longer is it the case that the evaluator sits students down at a machine, with a task and time limit for



completing the task. Learners would expect to pick up activities, do them in their own time, in their preferred working environment, using tools of their own selection. When learners decide to use their own mobile phones as part of a group task, for example, it is difficult for evaluators to gather appropriate data, or even keep track of what is going on.

Increasingly Personal

Furthermore, technologies are becoming increasingly personal (intimate) regardless of whether students are the owners of the devices. This has implications for evaluation because participants in evaluation studies may be less inclined to open up their digital resources for inspection by a third party if they regard them as more personal. Or they may have personalised the environment or the resources in such a way that evaluators may find themselves evaluating somewhat different activities across the group.

Evaluation and Design

The relationship between evaluation and design is multilayered (e.g. as in providing formative and/or summative data), but a key notion for evaluation in the mobile age is the urgent need for user involvement in the design process. Cycles of development and testing can facilitate this, as can a design rationale process (e.g. CLAIMS; requirements with test criterion), which allows evaluation to be built in as part of the design process from the beginning.

The increasing personalisation of devices and learning activity means that learners may be encouraged to self-evaluate (learner-centred design encourages this, in fact)

and feedback mechanisms can be put in place within the design process to facilitate this.

Theoretical Perspectives

The theoretical perspective adopted by the evaluation influences what questions are asked. The range of theorising required to cover learning in the mobile age is wider than has traditionally been the case because the learning environment has changed so radically. The current emphasis on 'activity' has stimulated a great deal of evaluation effort focused around Activity Theory, where, for example, emphasis is placed on historical perspectives (learners' past experiences) and how these relate to the technology to be evaluated.

Various techniques are available to support evaluation in this context (e.g. scenario-based design and development; activity theory perspectives; CLAIMS methodology). The key issue is to realise that evaluation may entail the peeling back of multiple layers of activity, and the need to keep track of what has been peeled and what hasn't is essential

The workshop members agreed that there was no single solution to this issue. It didn't matter too much which theoretical perspective was used, but that you needed one to organise your thinking. Similarly, it was not essential to stick to a Grand Theory – a theory of a domain was often sufficient, and in fact often enabled greater agility in adapting to changing circumstance than did dogged adherence to a single monolithic theory. It was also noted that contextual research methods were becoming increasingly popular. >

“Workshop members decided that they preferred the broader concept of learning taking place in the 'mobile age', rather than the use of the narrower term 'mobile learning'.”

“ It is essential to understand how structured learning activities blend with other more social or informal activities. ”

Alternatives

Traditionally, evaluators might relate the success of a design to the success with which learners can achieve pre-identified learning outcomes. The nature of learning outcomes in the mobile age needs to be adaptive. For example, they may relate to the extent to which someone has assimilated information into their own experience and development, rather than how well they can reproduce knowledge in a pre-post questionnaire style study. Success may also be measured by how and how much they use their mobile devices: e.g. do they look for new functionality? Does its use change the nature of the 'talk'?

Other alternative approaches that had been successfully used by the workshop participants included:

- analysis of learner contributions to some externalised construction – then no need for post test;
- statistical analysis of patterns;
- artefact analysis: e.g. looking at quality of a text report;
- log analysis yielding information about interaction;
- giving teachers the means to collect data particularly when it helps/supports their role.

Changing Learners

In the final session, the workshop participants discussed the changing nature of learners. It was agreed that the notion of a compliant, passive learner was becoming less

and less common. Learners were becoming more independent, more assured, and consequently more unpredictable from an evaluation point of view.

It is sometimes problematic to design studies that can successfully anticipate what learners might do, particularly when they decide to introduce their own technology into the situation. Thus, in trying to evaluate group work, choosing who to follow and how to track their activity is hard. However, it is essential to understand how structured learning activities blend with other more social or informal activities.

Institutions sometimes also complicate matters by the introduction of policies which affect the use of technology (e.g. most schools ban the use of mobile phones). Such policy decisions can be inhibiting, although workshop members had identified various methods for overcoming this (e.g. don't activate SIM cards in phones).

Conclusions

We concluded that evaluation needs to respond to the challenges of learning in the Mobile Age, and that the current emphasis on activity analysis (from whatever theoretical perspective) as well as context is the way forward. The fact that learners are increasingly independent is to be celebrated rather than regretted, even though it means that evaluators needed to be more agile and responsive. But it is equally possible for evaluators themselves to take advantage of mobility in gathering data in the field, as well as where possible through instrumentation of devices.

“ The current emphasis on activity analysis as well as context is the way forward. ”



How should learning activities using mobile technologies be designed to support innovative educational practices? >

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The wide spread of mobile devices with Internet capabilities is contributing to the rapid expansion of the wireless Internet. The rapid adoption of mobile and wireless technologies by end users allows them to produce a variety of digital content (images, sound, and video) on the spot.

This latest development brings new opportunities for the implementation of a wide range of new mobile services, as well as new roles when it comes to information providers and information consumers. New patterns of interaction have developed regarding how people use mobile devices and services. Clear indications of this can be found in sites such as www.myalbum.se, www.flickr.com, www.nokia.com/lifeblog. Even in educational settings, students can now easily produce mobile multimedia content during their different learning activities.

Ubiquitous Learning

The use of advanced computing and information technology in educational settings has increased significantly during the last decade. Initially, the use of computer-based training, and later on networked-based learning, mainly due to the development of the World Wide Web, led to the definition of the concept of *e-learning*. Advancements in mobile and wireless technologies have also had an impact in educational settings, thus generating a new approach for technology-enhanced learning called *m-learning* (mobile learning). The rapid development of these latest technologies combined with access to content almost everywhere and every time, allows learners to experience new situations regarding learning in a variety of situations and not only in school

settings. This latest view on technology-enhanced learning supported by wireless technologies and ubiquitous computing is referred to ubiquitous learning or *u-learning*.

Design and Use

All these possibilities of using mobile interactive multimedia and communication in educational settings offer innovative ways for supporting learning, collaboration and communication. While this mobile/wireless computing revolution is having a major impact on the ways people communicate and interact, this transformation does not live up to the promises and expectations when it comes to schools and universities. Consequently, the interplay between design and educational usage plays an important role for mobile technology adoption in educational settings. Thus, there are challenging questions that deserve further exploration, including the one in the title, and also:

Which learning aspects and processes should be considered while designing new mobile solutions? What new scenarios and applications will emerge?

Innovative Educational Practices

The innovative educational practice issue was first introduced having in mind the following aspects: >

Context. In which educational setting (formal or informal) the innovative educational practice will take place.

Challenge. What is the challenge we are facing while trying to design innovative educational practices?

Scenario, activities and tools. Envisaging and designing a specific educational activity supported by mobile technologies that illustrated innovative practice.

A number of on-going projects from different regions in the world (including cases from Taiwan, Chile, Cambodia and Sweden) were used to illustrate existing examples of designing for innovative educational practice. In these examples we tried to identify which were the driving forces behind these innovations while trying to understand the context in which the innovation is taking place.

New Devices

One of the main assumptions we considered as a point of departure for the activities of this session was the fact that in the coming 10 years, whether educators want it or not, more and more students will bring computing devices (with wireless communication) into the classrooms. These devices can be in the form of pocket PCs, notebooks, tablets PC, cellular phones, Smart Phones, GPS devices, mobile DVD players, TI graphical calculators and electronic dictionaries.

After laying out the foundations for discussing the issue of designing for innovative educational practice, the session was initiated by allowing the participants to group themselves into small teams (3 to 4 members in each one) in order to explore the issue under investigation. The different groups were presented with the following tasks:

1. Pick a learning related domain in a specific context and define a relevant problem.
2. Develop an educational scenario and activities that incorporate mobile technologies around this problem.
3. Illustrate and define all the components of this scenario.

Scenario-Based Design

The suggested method for designing innovative educational activities supported by mobile technologies in this section was scenario-based design. Why scenario-based design? According to Carroll (2000), scenario-based design is a technique that seeks to exploit the complexity and fluidity of design by trying to learn more about the structure and dynamics of the problem under exploration. This is accomplished while trying to see the design situation in many different ways, and interacting intimately with concrete elements of it. The main purpose of the scenario is to provide a rich description of the interactions. Based on Carroll's (2000) recommendations, scenarios should have the following characteristics: setting, actors, goals or objectives and actions and events.

Learning Domains

Following these guidelines, the three groups selected three different learning domains to illustrate their ideas, as described below:

1. Enhancing teaching practice with ubiquitous technologies in teacher education.
2. Collaborative mobile learning games in corporate settings.
3. People on the move in a disturbed environment.

Each group developed and set initial design efforts for their specific scenarios. Different working materials such as pencils, markers, paper, post-its and smart-boards were available. The results of the three working groups are graphically documented and the material can be found at:

http://w3.msi.vxu.se/~mmilrad/Kaleidoscope/Milrads_session.zip

At the end of the session, each group had the chance to present the outcome of their work. Different presentation techniques were used (one group decided to use story telling to illustrate the main ideas of their scenario).



“ It is necessary to take an integrative perspective to technology-enhanced learning where pedagogy and learning theory are the driving forces rather than mobile technologies. ”

A final discussion between all participants took place at the end of the session and it was moderated by the session coordinator.

Conclusions

This brief report described the processes related to the activities conducted in this session, as well as the outcome of the results produced by the different groups. Following a practically orientated perspective (inspired by scenario-based design), the results of this session confirmed the claim that the interplay between learning theories, design and educational usage plays a crucial role for mobile technology adoption in educational settings. In order to design innovative educational practices it is necessary to take an integrative perspective to technology-enhanced learning where pedagogy and learning theory are the driving forces rather than mobile technologies. From this perspective, mobile technologies can be used as collaborative mindtools that help learners (both in informal and formal settings) to conduct activities and accomplish results that are impossible to achieve without these technologies.

Thus, it might be beneficial to elaborate a model or taxonomy that can help designers to identify educational situations and requirements in which mobile technologies fill a unique rôle while trying to support innovative educational practice. Table 1 shows the different

components of this possible taxonomy. Further development and implementation of these ideas, can result in guidelines that can be used for the design of technology-enhanced learning environments using mobile technologies to support innovative educational practices. Coming efforts in this direction will include the elaboration of additional educational scenarios (including a survey of existing on-going activities worldwide) plus the integration of the efforts that resulted from those sessions moderated by Sharples and Hoppe.

The results produced by the different groups that participated in this workshop can be found at: http://w3.msi.vxu.se/~mmilrad/Kaleidoscope/Milrads_session.zip

References

Carroll, J. (2000) *Making Use – Scenario-Based Design of Human-Computer Interactions*. The MIT Press, London.

Milrad, M. (2006) *How should learning activities using mobile technologies be designed to support innovative educational practices?* Slides from the presentation given at the "Big Issues in Mobile Learning Workshop", Nottingham June 1st, 2006. <http://w3.msi.vxu.se/~mmilrad/Kaleidoscope/Milrad.pps>

Table 1. Components of a taxonomy of educational situations and requirements for mobile learning.

Domain/ educational components	Cognitive/ social skills	Innovative educational practice	Learning tools and strategies	Contextual content & mobile technology support
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How can we integrate mobile devices with broader educational scenarios? >

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To be sustainable and more than yet another volatile trend in technology enhanced learning (TEL), mobile learning needs to be contextualised in broader, integrative educational scenarios. In these scenarios, mobile devices need to inter-operate with embedded ubiquitous technologies and also with network and server infrastructures, and they need to support well grounded educational functions.

Device Functions

Small mobile devices are unlikely to be a primary interface for visual information processing (such as visual/graphical modelling environments). Here, we should explore how such devices can provide auxiliary functions, e.g. as input devices and note taking instruments. However, there is a central role for smart phones and the like in language learning, or any other type of voice or audio based interaction. Mobile devices have a great potential for educational games, but the educational value of interactive games has to be specified in a global picture of TEL.

Device Profiles

Taking into account the different profiles of different mobile and other devices (including embedded, fixed location devices such as big interactive displays or sensitive surfaces), it is important to define adequate distributions of functionality over these devices and to design and implement interoperability mechanisms. "Interoperability", in this context, includes technical interoperability, i.e. data exchange and continuous

information flow, but also "educational interoperability" in terms of the enabling of teaching/learning workflows and the support of re-usability of emerging learning objects. Here, mobile devices are a relevant facet of a much larger picture.

Language Learning

On the pedagogical level, the idea of mobile learning is often associated with informal learning settings which could be triggered by situational affordances or could just take place whenever and wherever the learners want to. It is an issue as to whether this kind of learning yields the necessary degree of systematisation and coherence (or maybe these factors are over-estimated, based on existing justifications of institutionalised learning?). Once again, language learning appears to be a good candidate for learning in informal settings, but how about mathematics or geography?

One Device Per Learner

On the other hand, there are also suggestions for using mobile devices in institutionalised, formal learning, especially in classrooms. An important prospect in this

“ Language learning appears to be a good candidate for learning in informal settings. ”



“ Knowledge integration was seen as a challenge for learning settings orchestrated by mobile devices.”

view is the availability of one device per learner. This aspect is particularly pursued by the international G1:1 initiative (Chan et al., 2006) and more recently by the One Laptop Per Child (\$100 laptop) initiative (<http://laptop.org/>). The use of personalised devices in institutionalised learning settings raises important (inter-related) questions about the ownership of devices and about the point of using one and the same device across curricular domains.

From the integration point of view, research on mobile learning needs to be connected to other areas of learning and learning support methodologies such as CSCL. It would also benefit from using intelligent technologies to develop improved contextualisation and awareness mechanisms.

Types of Integration

The integration issue was first differentiated with respect to different types of integration, mainly from an in-classroom perspective. The following aspects were distinguished:

Media integration, in terms of information flow and conservation of results across different media used in the learning setting;

Process integration, i.e., the technical facilitation and support for learning processing involving participants in different roles;

Knowledge integration, in the sense of a broader structuring, systematisation and “de-fragmentation” of knowledge.

The different aspects were illustrated with existing research and practice. Interesting examples for media

integration in classrooms are found in current projects in Taiwan, involving PDAs, tablet PCs, response devices for immediate feedback and big interactive screens.

Nussbaum’s project in Chile exemplifies process integration using one type of device (a PDA) with different functions for the teacher and for learning groups. Of particular interest are functions that support supervision and reflection as part of the teacher’s interface.

Knowledge Integration

Knowledge integration was seen as a challenge for learning settings orchestrated by mobile devices, both for formal and for informal types of scenarios. There are a couple of questions which may guide further work: Do we have a problem with fragmented experience and fragmented learning activities in technology enhanced learning? If yes, is the fragmentation problem a particular challenge for mobile learning scenarios? Do we have pedagogical strategies for de-fragmentation which could be supported by adequate technologies?

Mobile Learning Scenarios

After laying out the issue of integration, a technology supported session was initiated in which the participants could suggest integrated mobile learning scenarios or settings of either a formal or informal type. The participants prepared their suggestions on PDAs and sent these to a database together with a reference to one of the two categories (formal/informal). The moderator could import suggestions from this database to a big interactive screen selectively or all at once. This session yielded nine suggestions for each category (with one overlap). Similar suggestions were grouped. >

Scenario Suggestions

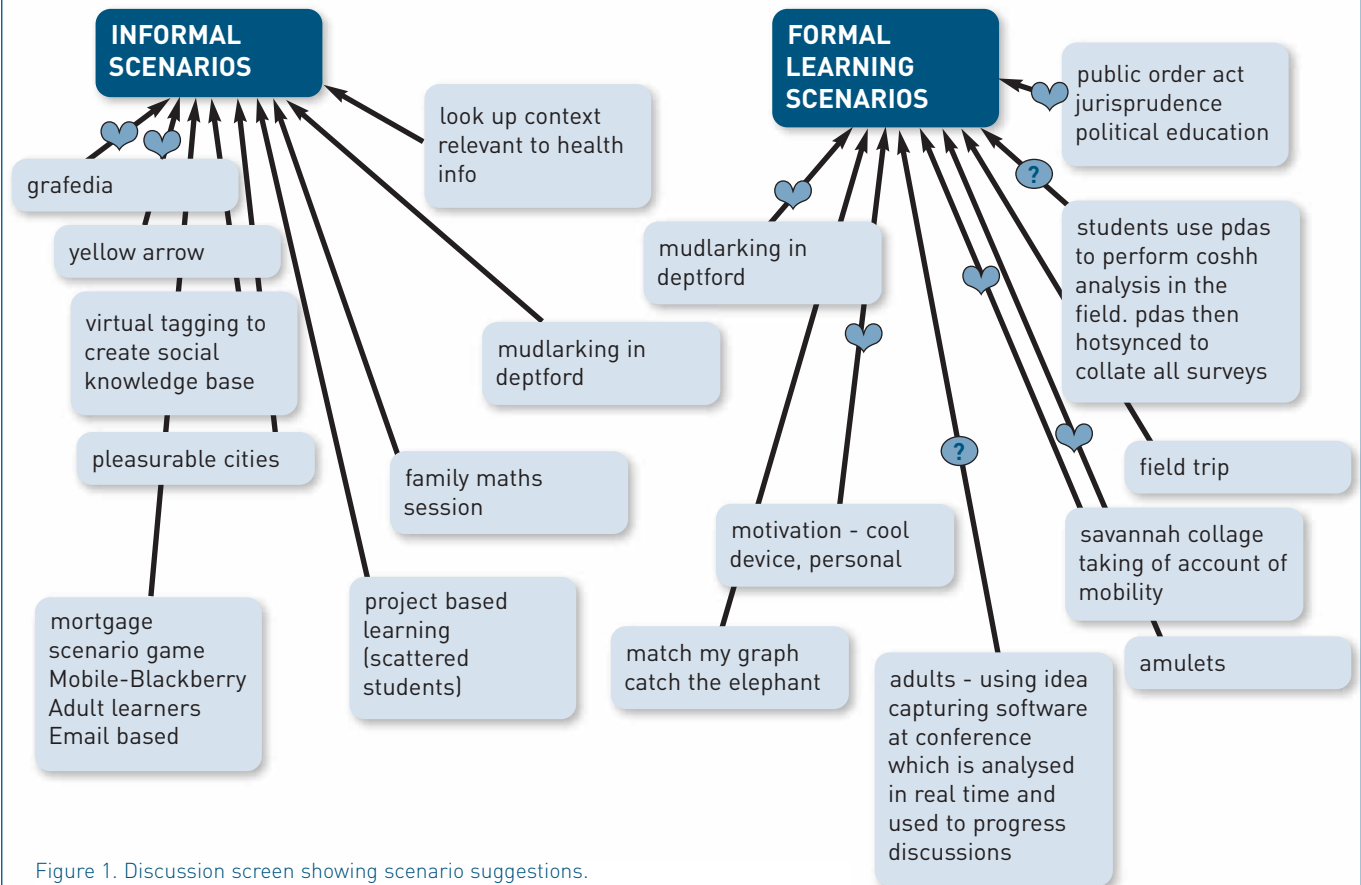


Figure 1. Discussion screen showing scenario suggestions.

Then the participants declared their preferences for themes to be elaborated on in working groups (including the commitment to work in such a group). This led to selecting three scenarios or themes:

1. Digital annotations with location references using location awareness and tagging techniques;
2. 'Judgement of public disorder' as a learning theme and scenario for political literacy;
3. Field trips using location aware technology to support study groups in the field together with communication mechanism to connect to a home base.

The discussion screen is captured in Figure 1.

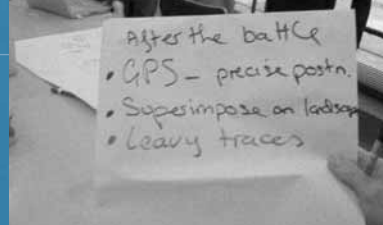
Elaboration

The results of the three working groups are only partly documented. As an example, the elaboration of theme 2 went as follows:

First the target group (no limitation in age, formal as well as informal) and the context (political literacy) were clarified. Next, an existing version of this scenario using paper and pencil as tools and written and audiovisual materials as stimuli was described. Activity phases for the scenario were identified:

Phase 1: intuitive responses to examples presented by the materials.

Phase 2: note taking (in pairs).



“ Detailed design options such as the number of devices used by a pair in phase 2 (two versus one) were discussed. ”

Phase 3: interrogation/discussion of the (whole group or class).

Phase 4: broadening into a discussion of political issues.

Based on this process model, a technical infrastructure, comprising a database of notes and materials with mobile devices (e.g., PDAs or smart phones) as front ends was specified. It was important to see the educational process reflected in a corresponding flow of digital object. Detailed design options such as the number of devices used by a pair in phase 2 (two versus one) were discussed. Another issue was an adequate conceptual model of the database (types of objects, connection to external sources).

This example shows the typical interplay between the original educational idea and the technical orchestration. Putting this scenario into practice would most likely generate new possibilities or affordances for meaningful learning activities on the level of process and media integration. The phase model itself is designed for knowledge integration and systematisation, yet no specific technology support for this aspect was identified.

Conclusions

Following a practically orientated approach, this session corroborated the claim that it is necessary to take an

integrative perspective on orchestrating technology enhanced educational scenarios. Although theory was not in the foreground, the scenario development illustrated that theoretical underpinnings (such as activity theory) may provide a reference frame to describe technology and education in a common context. From the elaboration of the second theme we can conclude that an adequate integrative design for mobile learning needs also a deep understanding of the affordances and inherent functional constraints of the technological components, and that this would not come as a consequence of the theoretical underpinning. So, an elaborate model of the educational situation and requirements, theory based structuring principles and technical expertise about the available and adequate technologies are all needed in a synergetic approach.

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“ Adequate integrative design for mobile learning needs also a deep understanding of the affordances and inherent functional constraints of the technological components. ”

Contributors

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Ulrich Hoppe holds a full professorship for Co-operative and Learning Support Systems at the University of Duisburg-Essen (formerly University of Duisburg), Germany. He is the director and founder of the COLLIDE Research Group on Collaborative Learning in Intelligent Distributed Environments. His main research interests are (1) Ubiquitous computing in learning environments for schools and academia, (2) Analysis and modelling of interactions in collaborative learning processes and (3) Computational methods to support collaborative learning and learning design.

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Kevin Walker's current research interests include personalised learning trails and games. He also designs interactive museum exhibits and multimedia software. He holds a BA in anthropology and mass communications from the University of California, Berkeley, and a Masters in interactive telecommunications from New York University. A PhD is in progress at the Institute of Education, around learning trails, specifically having learners use iPods both to record their visit, and to create audio tours and trails for others.

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