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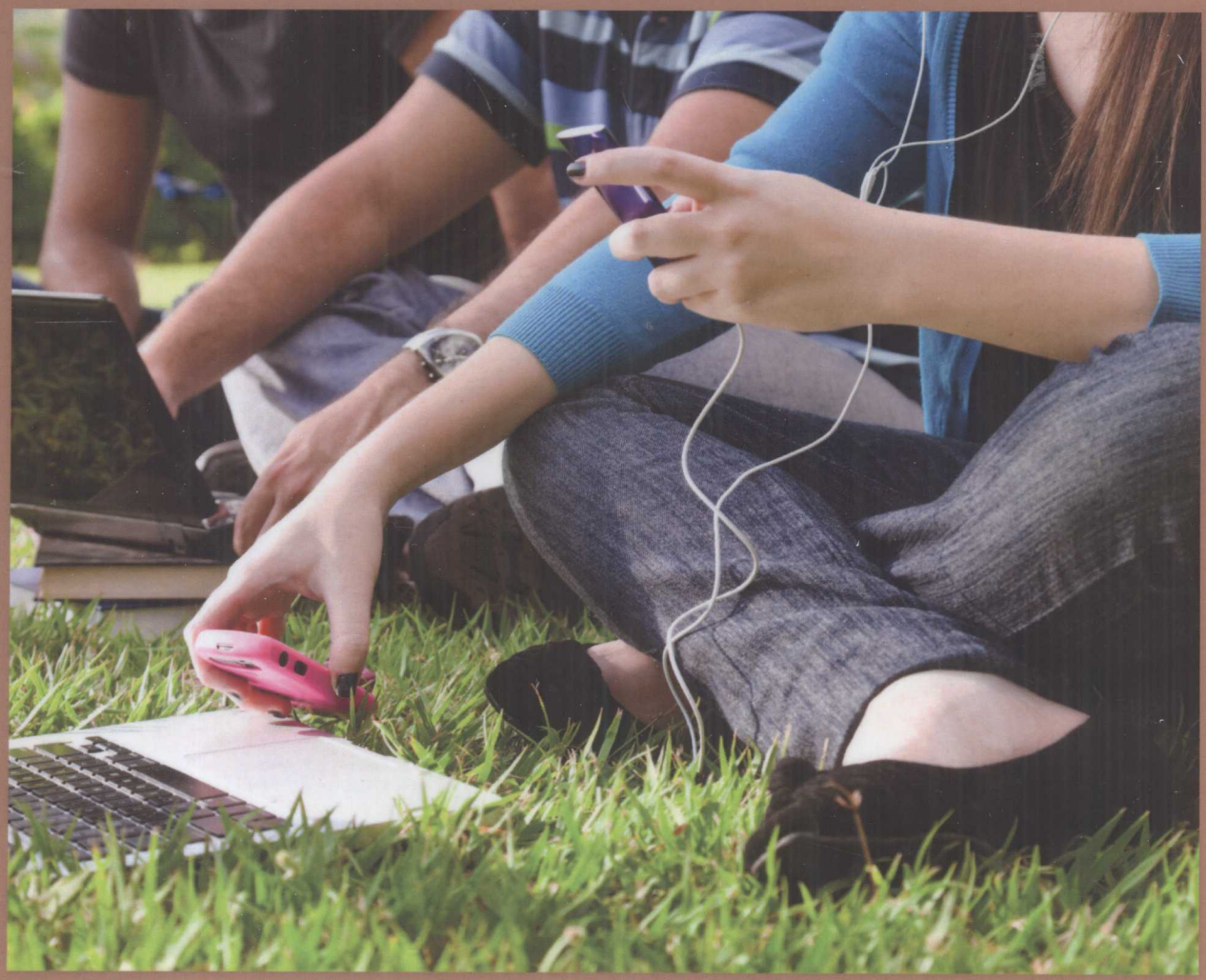
Refining Current Practices in Mobile and Blended Learning

New Applications



David Parsons

Refining Current Practices in Mobile and Blended Learning:

New Applications

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Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Library of Congress Cataloging-in-Publication Data

Refining current practices in mobile and blended learning : new applications / David Parsons, editor.
p. cm.
"This volume draws together all the articles published by the International journal of mobile and blended learning in its second year of publication (2010)"--Pref.
Includes bibliographical references and index.
ISBN 978-1-4666-0053-9 (hardcover) -- ISBN 978-1-4666-0055-3 (ebook) 1. Blended learning. 2. Mobile communication systems in education. I. Parsons, David, 1959 Oct. 13- II. International journal of mobile and blended learning.
LB1028.5.R3945 2012
371.3--dc23

2011046413

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Preface

"I know that you believe you understand what you think I said, but I'm not sure you realize that what you heard is not what I meant" (Robert McCloskey)

This volume draws together all the articles published by the International Journal of Mobile and Blended Learning in its second year of publication (2010). This was something of a landmark year in terms of the sustainability of mobile learning from the perspective of a critical mass of smart devices finding their way into everyday life, supporting learning both in the education sector and in the workplace. 2010 was the year that the first iPad was launched, along with the 4th generation iPod Touch and iPhone. It wasn't all about Apple, however, since it was also the year that Android market penetration reached a critical mass. According to one market analysis, Android was listed as the best-selling smartphone platformv-worldwide in the last quarter of 2010 (Canalys, 2010). Of course such milestones are just small steps in an ongoing evolution of mobile technology that has only just begun to change our learning experiences out of all recognition. However the transformation of the smart mobile device from the top end of the market to the tool of the average consumer may signal, to echo Churchill's famous phrase, the 'end of the beginning' of the story of mobile learning. This sea change in the technology landscape provided the mobile learning community with some new questions about how we might best use these devices for pedagogy. Much of the work presented in this book highlights the serious challenges faced by our current educational systems in the face of the new technological tides constantly sweeping through our societies. However it also provides many examples of how the research community is responding to the opportunities that are unfolding.

I very much welcome the opportunity to bring these articles to the attention of a wider audience than those who currently subscribe to the journal. Being able to bring them together into a single volume also gives me an opportunity, in this preface, to reflect on broader themes than those covered in the editorials of the individual issues, and to present a more coherent view of the current state of the art in mobile and blended learning.

NEW TECHNOLOGIES AND ASSIMILATION – BUSINESS AS USUAL?

As mentioned above, certain tablets and smartphones made major inroads into the market in 2010. Inevitably, these devices found their way, either deliberately or by chance, into the classroom, giving educators some stark choices about whether to try to embrace or ignore their presence. Of course our approaches to learning cannot be driven solely by technological change. This would imply that our un-

derlying pedagogy is constantly changing in an ultimately futile attempt to jump on every new gadget bandwagon that appears on the market. In fact a well-established pattern of learning technology research is that by the time a given device reaches the consumer, its potentials have often already been explored both from a theoretical perspective and with early deployment. This type of work helps us to filter out the best ways to leverage new technology in the classroom. The producers of these devices understand this process only too well, and have continued to give academic researchers and instructors the opportunity to work with new technology before it reaches critical mass in the mainstream. Pioneering examples from the early days of mobile technologies included the Apple Classrooms of Tomorrow (ACOT) project (Grant, 1993) and the Palm™ Education Pioneer (PEP) grants (SRI International, 2000). Through such projects we hopefully gain enough insights to be properly prepared for the changes ahead, though it is perhaps becoming increasingly difficult simply to assimilate new technologies into traditional educational institutions, an issue that a number of chapters in this book address.

Assessing how much technological progress we have made since the early exploratory projects, we might reflect on Sharples (2000) design requirements for mobile technologies for lifelong learning. In that paper, the requirements for these technologies were that they should be highly portable, individual, unobtrusive, available anywhere, adaptable, persistent useful and intuitive. How much better the 2010 device meets these requirements than the typical device of 10 years previously, at the very beginnings of the smartphone era! In a similar way to how the early days of Hollywood mirrored the restrictions of traditional drama, the early days of mobile learning often focused on incremental aspects of porting eLearning to a mobile device (Laughner & Payne, 2009). Now there is the opportunity for more ambitious mobile pedagogy, and new devices may well open the way for transformational, rather than incremental, change. Some evidence from real world deployment of the current generation of devices does indeed suggest that real educational transformation is possible, for example the use of iPod Touches at the Essa Academy in the UK (Chohan, 2011). We should also, however, be careful what we wish for. Despite our best efforts we cannot always anticipate or control the trajectory of new technologies once they enter our educational institutions. To highlight just one possible challenge, we might consider Sharples' requirement to support access to resources and knowledge throughout a lifetime, despite changes in technology. Often the next generation of device renders much of what we have done before obsolete. Notwithstanding the drive towards generic standards in fields such as web services and cloud computing, it is a constant challenge to try to embody the longer term view of a lifetime's education in representations that remain robust, interoperable and reusable. This is mainly a technology issue, but we also face more serious challenges from social changes wrought by pervasive information sources and social media that may already be undermining many of our assumptions about the nature and value of education.

NEW TECHNOLOGIES AND DISRUPTION – THE END OF THE OLD ORDER?

The quote at the head of this preface introduces various concepts of meaning, attribution and interpretation that reflect some of the underlying themes in this book. The quote is attributed to Robert McCloskey, but which Robert McCloskey? The well-known children's author from Boston? Or an obscure 'state department spokesman'? Surf the web and take your pick! The confusion about attribution is ironically supportive of the quote itself. If we cannot attribute a quote to its source or context, or can apply any attribution that we like, how does that change its meaning? Even something properly attributed can easily be taken out of one context and put into another. The implication of these issues to mobile

and blended learning is central; now that information is globally available, how does that information become used and interpreted by the learner? If information is presented as an arbitrary and enormous collection of fragments, how can broader meanings and structures emerge? How can the educator manage the acquisition of knowledge from the information so that, eventually, we might achieve wisdom? To quote T. S. Eliot (1934);

Where is the wisdom we have lost in knowledge?

Where is the knowledge we have lost in information?

The complex debate about whether there is indeed a meaningful difference between knowledge and information also highlights the difficulties we face in trying to turn an increasing mass of potentially unreliable data into something meaningful and useful. Perhaps even more telling for the mobile and blended learning researcher are some other lines from the same work:

The endless cycle of idea and action,

Endless invention, endless experiment,

Brings knowledge of motion, but not of stillness

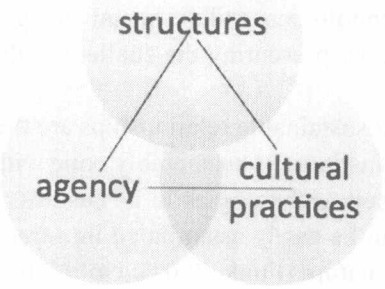
As the pace of change continues to increase, the real challenge for all of us is to try to identify the stillness behind the motion. This requires us to continually develop both our theory and practice to get behind the technology of the moment and understand the fundamental forces at work in the life and world of the learner. One of the contributions of this volume is to provide a number of important perspectives on these forces, within a consistent analytical framework. Many of the chapters included here represent the best work from the Alpine Rendezvous workshop organized by the Stellar network, which gives them a particular emphasis on technology-enhanced learning in the context of technological, societal and cultural transformation. Members of the network are at the forefront of mobile learning research, and provide some valuable insights into the major issues faced by educators in an age where many traditional assumptions about the relationships between technology and education are being challenged and undermined.

Many of the chapters from this group reflect a socio-cultural ecology of mobile learning (Pachler, Bachmair and Cook, 2010), with a triangular relationship between structures, cultural practices and agency (Figure 1).

The interrelationship of these three components: agency (the user's capacity to act on the world), cultural practices (the routines users engage in their everyday lives), and the socio-cultural and technological structures that govern their being in the world, manifests itself as a transformation of society, culture, media, education and technology. This transformation requires pedagogical responses.

In this approach, learning is understood as the process of 'coming to know' and being able to operate successfully in and across new and ever changing learning contexts, as well as understanding and knowing how to utilize our everyday worlds as learning spaces. It is viewed as a process of meaning-making through communication across multiple contexts within the triangle of social structures, cultural practices and agency, increasingly using mobile devices. The actions of learners are not made directly

Figure 1. Socio-cultural ecology of mobile learning



on the world, but mediated by social and semiotic tools such as language, as well as by physical components, including technology.

Responsibility for meaning-making is increasingly being transferred from the state and its institutions to the individual, who has become a consumer of services provided by a global market. Changes in consumption and production, as well as current characteristics of the media landscape, such as participation, distribution, local and global content, ubiquity and multimodality, are central concerns.

Another significant contextual factor is the shift away from traditional forms of mass communication and editorial push towards user-generated content and individualized communication contexts. These structural changes to mass communication affect the agency of users and their relationship with traditional and new media. Learners as media users are actively engaged in shaping their own learning contexts. New relationships between context and production are emerging in that mobile devices not only enable the production of content but also of contexts. They position the user in new relationships with space (the physical world) and place (social spaces). People become content producers who are part of an explosion of activity in the area of user-generated content.

From the above contextual changes arise implications for education, for teaching and learning, for communication and for language. Overall, several of the chapters presented here reiterate the need for a paradigm change in education to enable young people to deal with the implications of ongoing transformations.

The remainder of this preface introduces the chapters in the book under a series of themes; change and challenge in learning and society, mobile learning in real and augmented worlds, challenges in blended learning, mobile learning in the workplace, and researching mobile learning. Within each theme, a brief overview of each chapter is provided to guide the reader regarding their key concerns and contributions.

CHANGE AND CHALLENGE IN LEARNING AND SOCIETY

This section opens with a chapter by John Traxler, the world's first Professor of Mobile Learning. In "Sustaining Mobile Learning and its Institutions", Traxler explores the issue of sustainability in mobile learning and the education system in the context of the sometimes subtle but nevertheless pervasive transformations of jobs, work and the economy, of our sense of time, space and place, of knowing and

learning, and of community and identity. This chapter contains a set of contentious assertions, concluding that the education system is 'broken' and that mobile learning is 'unsustainable'. However, this should not be understood as being a defeatist position. Rather, it is meant as an invitation to readers to engage in vigorous, interdisciplinary debate about the nature of education in a world that is rapidly changing through the introduction of new technologies, and the social changes that these technologies bring. It is therefore a fitting start to this book, by presenting the challenges that address us both as educators and as researchers.

Traxler raises the question, what sustainable relationships are there between user generated content, contexts and learning, and how do institutions sustainably cope with these changes? While we may see our education systems absorbing new technologies in a 'business as usual' fashion, Traxler suggests that while desktop technologies can be easily assimilated into traditional structures, mobile technologies cannot, due to their disruptive nature (Funk, 2004). Unlike fixed computers, mobile devices, with their unique affordances, create simultaneous physical and virtual spaces for conversational interactions, potentially leading to a paradigm shift that traditional learning institutions may find it hard to adapt to. Traditional approaches to education, designed for specific times and places, are less and less well aligned to the needs and behavior of our societies, which are no longer centered around synchronous and collective experiences. These changes challenge how formal education systems partition activities into private study, public lecture, informal learning, work-based learning and social life, while also challenging the formal education system's role as the gatekeeper, custodian and arbiter of knowledge and learning. Rather than the formal curricula of the past, digital literacies embrace small pieces of knowledge that are easily presented, but their relationships are hard to understand, fragmenting and potentially trivializing what learners learn. These issues resonate closely with the concepts of *microlearning* (Hug) and *copy-and-paste* (Adami), outlined elsewhere in this volume. In addressing what the implications of this might be for more traditional educational institutions, Traxler refers to Baumans (2000) concept of *liquid modernity*, where nothing solidifies long enough for institutions to adjust and adapt. He concludes;

"the environment of formal education is also changing and...technical fixes such as mobile learning as negotiated solely between technologists and educators, are no longer credible or adequate. The education system is indeed broken and mobile learning is unsustainable."

While mainly concerning himself with the impact of technological change on educational institutions, Traxler also notes that connectivity to a mobile workforce means greater supervision and increased deskilling. Such arguments may be linked to other questions around the value of traditional forms and contexts of education. For example there is little evidence to support the view that increased education leads to higher economic growth, while the link between education and productivity is weak. As manufacturing productivity increases, a higher proportion of workers are in low skill service jobs needing less education and half of higher education in some countries is wasted in the sense that it is not required for the sorting function of having a degree (Chang, H-J, 2010). Echoing Traxler's comments, Chang states that "*countries need to look beyond the education of individuals and pay more attention to building the right institutions and organisations for productivity growth*". In section four of this volume, 'mobile learning in the workplace', some of these issues are more directly addressed.

Having set the scene by outlining some significant challenges, this section continues with the theoretical chapter 'Appropriation of Mobile Cultural Resources for Learning' by Norbert Pachler, John Cook and Ben Bachmair. In essence this chapter provides us with a distillation of the key concept of

appropriation from the authors' current research, and gives further insights into the significant changes taking place in the educational landscape. Perhaps central to the authors' argument is that "*ownership allows for qualitatively and emotionally very different kinds of relationships with technologies and devices.*" Therefore the concept of appropriation is very important if devices are to be used for learning. Perhaps the significance of this debate can be appreciated all the more when we consider the fact that many mobile learning systems are predicated on the imposition of particular types of device on the learner, which raises certain issues about appropriation. On the other hand, expecting learners to use their personal devices for learning raises other, very different, but equally important, aspects of appropriation. The context of this appropriation is of course also very fluid as society, technology and media continue to evolve. The authors conclude their article with the proposal that such changes "*will lead to there no longer being a meaningful differentiation between media for learning inside and outside educational settings.*" This is certainly a challenge for pedagogy, as educators seek to share that media landscape with many competing demands for the learner's attention.

Elisabetta Adami's chapter, "Mobile Media, Mobile Texts", focuses on the copy-and-paste affordances fostered by digital technologies. These technologies allow us to produce and interpret representations which can be shared in digital and online spaces. The actions behind copy-and-paste are selection and re-contextualization of content in other contexts. This re-contextualization affects the notion of coherence, the semantic relation of the parts to a whole. Because of the copy-and-paste affordance of digital technologies, less effort is needed to produce incoherent exchanges rather than coherent ones, and familiarity with this activity has made incoherent exchanges more and more acceptable. For example, while browsing we mentally copy-and-paste various excerpts of online materials which are variously related to the topic of our interest and, through collage, we mentally re-construct the information we need. Context also has major effects on how the same content is presented, for example the same video may be posted in two places, one with a positive commentary, the other with a negative. For an indicative example of extensive copy-and-paste and re-contextualization, the reader need look no further than this preface, which extensively recycles previous material in attempting to reinterpret a disparate set of resources into a coherent volume.

The re-contextualization of artifacts has a long history, mainly in the arts, but the pace of technological change has implications for education. Re-contextualization has gained impetus as the production 'from scratch' of text has become less important and the notion of communication itself is differently defined in terms of (re)usability rather than of understanding. Thus schools are now asked to consider whether literacy education should enlarge and include a wider range of context-dependent criteria of acceptability in the structuring of texts. In this process, some important questions are raised: What happens to the notion of authorship? In which contexts is copy-and-paste praised and in which is it stigmatized or banned as plagiarism? When is reinterpretation desirable and when is it still conceived in terms of misinterpretation leading to a breech in communication? These are not easy questions and will requires careful consideration within different cultural practices.

In "Mobile Learning as 'Microlearning': Conceptual Considerations towards Enhancements of Didactic Thinking", Theo Hug addresses the concept of *microlearning*. He views this as a relational cross-over concept in the context of technological, societal and cultural transformation and sees it as foundational to mobile learning, identifying flexible and dynamic alternatives needed in the context of change. In addition, Hug proposes some models intended to advance didactic thinking in the area. As Hug explains, microlearning appears at the smallest levels of granularity, for example in minutes or seconds of time, or with content presented as sentences, headlines or clips. A microlearning component

is portable and loosely coupled, and contributes to larger assemblies of learning components (the meso and macro levels). Hug also explains the relevance of mobile technology to micro learning, in that microlearning involves small depictions of content, limited time or attention and integration into contexts, all of which are also characteristics of mobile learning. He provides three examples that include aspects of microlearning; Flocabualry (which uses mobility of mp3 music files), mTrainer, providing mobile training including language learning and Frequency 1550, a location based city game for urban history.

Having explained the concept of micro learning, Hug contrasts it with the meso or macro levels of learning, and addresses issues arising from bridging between these levels. Microlearning has always played a role in institutional learning but the critical question is how microlearning elements can be linked together. We need an understanding at higher levels of structure, to promote meaningful learning. Microlearning requires "*meaningful dedicative settings, on ways of promoting decision making and encouraging meaning-making, and on the models of making use of the use of media.*" Hug presents the concept of education as 'brocolage' (created from diverse resources), but of course there must be some way of addressing the assembly of microlearning elements. To this end, four models are presented that may be useful for the enhancement of didactive thinking: aggregation (grouping of similar elements), conglomerate (grouping of diverse elements), emergence (evolving structures) and the medium/form distinction, (layers of loosely coupled elements).

Margit Böck's chapter, "Mobile Learning, Digital Literacies, Information Habitus and At-Risk Social Groups" addresses the ways that mobile technologies may prove beneficial to social groups that might be characterized as 'at risk', and find themselves on the wrong side of the digital divide. Böck considers whether mobile devices may open avenues for at-risk social groups to expand their strategies for learning and open up new forms of knowledge and competencies. She examines the 'information habitus' (socially learnt dispositions, skills and ways of acting) of social groups at the margins of society and discusses aspects of a pedagogy of social inclusion. The central element of this habitus is the action by an individual to get information via their own agency (which Böck labels as *Holschuld*); contrasted with a reliance on others to bring information to them (labeled *Bringschuld*). The question is whether mobile devices would make it possible for an individual to move from an information habitus of Bringschuld to one of Holschuld. That is, are the affordances of these devices such that they might bring about such a change? In this context, the agency of the individual and her or his information habitus oriented towards Holschuld is crucial.

The information habitus treats humans above all as agents who act meaningfully in their subjectively experienced contexts. Along with this concept, a pedagogy of social inclusion aims to change the horizons of individuals and groups at the margins of a society in order to connect them with groups in the mainstream of society; "*meeting people where they are*". The concept of physical mobility tends to widen social gaps. In contrast, mobile infrastructure can narrow these gaps, by bringing resources and collaborative tools to the user; in learning, providing learning materials and experiences that could not otherwise be shared. Perhaps mobile technologies have the power to reduce the digital divide, rather than widen it, as Böck suggests.

MOBILE LEARNING IN REAL AND AUGMENTED WORLDS

The concept of mobility in its broadest sense concerns not only physical movement but multiple aspects of how this movement constrains or interacts with time and place. Despite many simplistic interpreta-

tions, mobile learning is challenging for researchers and educators, reflecting concerns beyond the mantra of learning 'anytime, anywhere'. The essence of mobile learning is situated cognition (Seely Brown, Collins & Duguid, 1989), whereby time and place, both real and imaginary, provide the context for exploration, collaboration and insight.

Mobility embraces both learner and learning; the learner may move into a context but equally the context may move to the learner. For example we may augment a local reality with one otherwise unreachable, as in the Savannah project, where children learned about the lives of African animals in role play without leaving the school playing field (Facer et al., 2004). The importance of this blurring of real and imagined situation in supporting situated cognition cannot be underestimated. Understanding mobile learning from the perspective of situated cognition can help us to find new ways forward in designing mobile learning experiences.

The chapters discussed in this category cover aspects of mobile learning solutions being embedded in experiences of the world around them; contextual learning and augmented reality. From one perspective they underline the continuing opportunities that technological advances offer the mobile learner, including location awareness, sensor networks and intelligent agents. However there is an equally important aspect, which is the imagination of the educator in applying mobile technology to learning, not only in the creation of the original tools, but also in the contexts in which they are deployed.

In "Mobile Phones as Mediating Tools within Augmented Contexts for Development", John Cook discusses a situated learning environment utilizing augmented reality. He extends Vygotsky's notion of a zone of proximal development in recognition of the socio-cultural, economic and technological conditions of the early 21st century. He argues for the need to re-examine approaches to the design of and research into learning experiences that incorporate mobile phones in learning context and considers the implications of the use of mobile devices for learning in formal and informal contexts.

Cook identifies three phases of mobile learning: a focus on mobile devices, a focus on learning outside the classroom and a focus on the mobility of the learner. There are three important affordances of the third phase: mixed reality learning, context sensitive learning and ambient learning (the latter includes augmented reality). From a theoretical perspective, Vygotsky's notion of a zone of proximal development is extended by Cook to an 'Augmented Context for Development' that embraces the third phase of mobile leaning. Vygotsky pointed out that there is a temporal dimension to development that revolves around attention and perception. There is a center of gravity of the learner's perceptual field, and also a time field; actions in the present are made from the viewpoint of the future (or the past). The notions of time fields and the center of gravity are important and any tools in an Augmented Context for Development should provide the visualizations that assist these underlying functions.

The centre of gravity has a temporal dimension that guides activity across contexts, allowing the learner to dynamically direct attention so as to take into account the past (history), present activities and future planned desires and goals (for a concrete example, see the use of historical satellite data in the chapter by Bannan, Peters and Martinez later in this section.)

With these concepts at play in the background, Cook describes a design research process for an archaeology field trip to a Cistercian abbey in Yorkshire, UK. The elements of the Augmented Context for Development were the physical environment (Cistercian abbey), a pedagogical plan provided in advance by the tutor, tools for visualization/augmentation and collaborative learners' interpersonal interactions using tools and signs. The physical and digital representations provided in the system interacted with and informed one another in real time, linking the past and present, the known and the unknown.

Design research emerged as an important theme in the previous volume of IJMBL papers, *Combining E-Learning and M-Learning: New Applications of Blended Educational Resources* (Parsons, 2011), and is reiterated here. Within the chapter, design research is presented as an approach that tends to have interventionist characteristics, is process-oriented and contributes to theory building. The emerging design research approach provides a frame or lens through which we can examine the unique affordances of mobile learning and this chapter presents important questions and insights for consideration at the intersection of mobile learning and design research.

The second chapter in this section is "Unlocking Lifelong Learning through e-Heritage: Using Mobile Technologies in Genoa" by Krassimira Paskaleva and Maurizio Megliola. Although much of this chapter concerns itself with the technology platform used for the Integrated e-Services for Advanced Access to Heritage in Cultural Tourist Destinations (ISAAC) international research project, it also addresses the underlying intention of this system, which is to support lifelong learning in the context of e-heritage. Using mobile devices to support the learner in a built environment is of course not a new concept, but this work is providing new perspectives and experiences, pushing the boundaries of such systems both in terms of scale and educational ambition. "*By intertwining cultural heritage assets in a rich and lasting personal and shared experience, the ISAAC system allows us to directly address issues related to lifelong learning through heritage, not just its relationship to history and culture but also its social and economic context in contemporary urban environments.*" The authors provide a compelling vision of the interrelated services that can be experienced by the technologically wired visitor to Genoa, enabling them to more effectively weave this heritage experience into their lifelong learning.

Our third chapter in this section is "JAMIOLAS 3.0: Supporting Japanese Mimicry and Onomatopoeia Learning Using Sensor Data" by Bin Hou, Hiroaki Ogata, Masayuki Miyata, Mengmeng Li, Yuqin Liu and Yoneo Yano. This chapter describes the latest generation of JAMIOLAS (JApanese MImicry and Onomatopoeia Learning Assistant System), which attempts to go beyond the limitations of its predecessors to demonstrate a web based learning system based on wide area sensor networks and context aware learning content. The authors go back to first principles in the introduction to their chapter, laying out the relationship between our five biological senses and the various ways that technology can feed into these senses to create context aware learning experiences. For this implementation, the wide area sensor network chosen for the system was the globally available network of weather stations, giving students distributed anywhere in the world the opportunity of context aware language learning, based on their local weather conditions. In this case, the sense of feeling temperature is a key part of the context. The system also addresses other issues of context related to the senses; video files for sight and audio files for hearing. The authors conclude their chapter with the results of some initial experiments that suggest that this type of system can be very beneficial for language learning where the subtle nuances of mimicry and onomatopoeia need to be understood. This is very much work that is looking to the future. "*With developing mobile technology, sensors will increasingly be integrated into each mobile device, so that while the learner is moving with such a device, a mobile system could dynamically support learning by communicating with embedded computers and sensors in the environment.*" The ongoing research at the University of Tokushima reported here is certainly making a contribution towards meeting that future.

The next chapter in this section is 'A Platform for Actively Supporting e-Learning in Mobile Networks" by Basit Khan and Mihhail Matskin. This comprehensive chapter begins with a review of the various architectures suggested by current frameworks designed to support mobile learning, and proposes a new framework, FABULA, that draws from this wide ranging previous work. FABULA makes extensive use of software agents, since "*the system should not only act as a passive medium of pre-defined*

communication patterns, instead it should perform an active role to increase the learning outcome. It can do this by ... personalizing the learning experience for each individual learner." It is the job of the software agents to support this personalized learning experience. Like Paskaleva and Maurizio's chapter, this work considers the role of a mobile learning system in a city wide context. However the example scenario that is explored falls very much under the heading of game based learning. In this scenario, the roles of the various agents and their contribution to the learning experience are laid out in detail. Again, like 'Using Mobile Technologies in Genoa', this work is clear in its intentions to focus on both the pedagogical and the technological, rather than just the technological. Again, the learners' needs are paramount, but increasingly sophisticated software platforms can more effectively meet those needs.

The concept of mobility and context is strongly reflected in a chapter about a learning community of mathematics students from a middle school in Israel. In 'Mathematics Learning Community Flourishes in the Cellular Phone Environment', Wajeeh Daher, reports on the use of mobile Java applications (Midlets) from the Math4Mobile site (http://www.math4mobile.com/) and how these applications were used within a learning community to explore the various dimensions of that community and its impact on the learning process. The primary application used in the experiment was "Fit2Go" which enables the user to draw specified points and then to fit a linear or a quadratic function to them. The application is particularly suited to work done out of the classroom, measuring the relationships between different aspects of natural phenomena, for example finding the relation between the circumference of the trunk of a tree and the circumference of one of its branches. An important feature of the study from a learning community perspective was that the tasks were not designed only by teachers, but that the students themselves developed new activities that they could perform with the mobile applications. Research data was gathered using multiple sources; videos, blogs, diaries and interviews, and the analysis used Schwier's 10 element model to analyze the characteristics of building a community in an online learning setting.

After analyzing the relations and influences among the characteristics of the cellular phone community of learning, the author concludes that it "*encouraged mutuality of the community members' relations, autonomy of the members' decisions and learning, and their active and diverse participation in mathematics learning.*" This chapter provides some encouraging evidence that freely available mobile learning tools that will run on a wide range of mobile phones can be effectively used with school students to encourage mutuality, autonomy, participation and, of course, learning.

In the final chapter in this section, "Mobile, Inquiry-Based Learning and Geological Observation: An exploratory study", Brenda Bannan, Erin Peters and Patricia Martinez explain how mobile and blended learning software supported enhanced and varying views of a geological phenomenon, allowing students to identify and reason about visual evidence of erosion in their local environment. This study reported in this chapter involved the integrated use of mobile technology, computer based collaborative experiences and location-based field study of scientific phenomena. The applications involved integrated iPhone and desktop applications of Google Earth, as well as a customized software application designed to promote geological reasoning. The mix of tools and contexts provided continuity of the learning experience across formal and informal learning spaces, desktop and mobile devices, and didactive teaching and inquiry.

In geology, it is critical for experts and students to get experience in the field, and 2D and 3D visualization abilities are critical in solving geological problems. Supporting these needs, mobile technology enhanced observation and meaning making, helping the students to notice, or see in different ways, geological phenomena. Using the system, students recognized different aspects of geomorphological features of their local environment. An interesting feature of using Google Earth was that the group understood the satellite images as historical data and were able to use it to inform their natural observa-

tions and geological reasoning. This asynchronous aspect of data retrieval (observation in the present, data from the past) was particularly useful for geological study, and relates to the concept of the time field discussed by Cook earlier in this section.

As with many other learning contexts that have blended together classroom and mobile learning, the students gained the cognitive benefits of the interaction of in-class computer-based activities with the field-based, inquiry experience, using the world as their classroom.

CHALLENGES IN BLENDED LEARNING

The chapters in this section both address issues in blended learning. Aleksej Heinze and Chris Procter discuss 'The Significance of the Reflective Practitioner in Blended Learning' while Carolin Fuchs discusses 'Cross-Institutional Blended Learning in Teacher Education'.

Heinze and Proctor's chapter relates to an action research project in the U.K. This was a longitudinal qualitative study where "*emphasis was placed on the perceived benefits and drawbacks of blended learning and how the use of blended learning could be improved.*" The key issue that emerged during the research process was that whilst the original focus had been on issues of how technology might best support a blended learning environment, it became obvious that the role of the practitioner was much more significant. In their evaluation, the authors of the chapter refer to the problem of the Dr Fox effect (Naftulin, Ware & Donnelly 1973), whereby the nature of the delivery of something can be more influential than its actual content, and the effect that this can have on the validity of student feedback when evaluating educational interventions.

Therefore data gathering was triangulated using a number of methods to gather data from both staff and students. One important finding was that the majority of interaction took place in the face to face sessions. Interaction on line was technically available but did not take off on its own. As one of the students in the study commented, 'I think that we expected it to happen and we have not seen it happening.' The important learning that we can take from this as practitioners is that the technology enhanced aspects of blended learning will only work if practitioners act as facilitators to ensure that these tools are used by learners so that they will benefit from them. This does not happen without the practitioner engaging with the online environment. In summary, "*the extent to which the learning advantages are achieved is dependent upon the engagement of stakeholders in the mode of delivery*".

Fuchs' chapter, "Cross-Institutional Blended Learning in Teacher Education: a Case study", describes how student teachers in the U.S. and Germany used web based tools for collaborative work related to language learning, both using and creating learning material. Perhaps the main feature of interest from this study is how it raises a large number of questions about how such collaborations can be made more effective, given that many problematical issues were raised during the research. "*During this process, student teachers were exposed to some of the frustrations such as miscommunication, technological issues, cross-cultural differences, and perceptual mismatches.*" The study highlights issues both with technology and personal interaction, and like the previous chapter, makes it clear that in a blended learning situation both the technology and the human interaction have an important role to play, and we can treat neither in isolation.

MOBILE LEARNING IN THE WORKPLACE

This section contains three chapters that concern themselves with mobile learning in the workplace. These chapters cover theory, conceptual frameworks and supporting tools to try to address the emerging role of mobile learning in the workplace context.

Christoph Pimmer, Norbert Pachler and Graham Attwell, in their chapter "Towards Work-Based Mobile Learning" favor a socio-cultural ecology approach that emphasizes practice, structures and context (hierarchy, power, reward, opportunity), and agency (within a learning territory). This emphasis emerges from a review of the debate about the appropriateness (or not) of activity theory as a theory of mobile learning. The authors point out that many analyses of workplace learning have focused on the cognitive, but not on the situational and social (the community of practice). Further, activity theory considers learning across various communities, and transformations of the activity system, over time. However, issues of hierarchy and power also need to be taken into account. There is also debate about the tacit and the explicit, the formal and the informal. In their review of theory, the authors show how, over time, "*the attention of researchers has shifted from a narrow focus on the learning of individuals to the exploration of socio-cultural contexts with reference to organizational perspectives and the wider political and societal environment*".

In looking specifically at work based mobile learning, this chapter recognizes that mobile learning was initially about technology and content, (see also Cook's chapter in this volume) but now it is increasingly about (changing) context. Mobile technologies transform the workplace, though, as Traxler also notes in his chapter, not always in a positive way, and contemporary jobs often require constant learning, though learning is not an organizational objective and its importance may be underestimated. Ultimately the role of Agency, the user's capacity to act on the world, is an essential component of a successful work based mobile learning model.

Graham Attwell, in "Work-Based Mobile Learning Environments: Contributing to a Socio-Cultural Ecology of Mobile Learning", examines the idea of a Work Oriented Mobile Learning Environment (WOMBLE) and considers the potential affordances of mobile devices for supporting developmental and informal learning in the workplace. Attwell notes a series of studies that have pointed to an increase in work-based learning, which is seen by many as efficient and effective, and facilitating situated learning. However, the physical mobility of access to e-learning is not on its own sufficient for designing a work-based learning environment. The development of technology for learning has been shaped by a traditional industrial educational paradigm, which Attwell claims is now becoming dysfunctional.

The chapter describes three different use cases for a Work Oriented Mobile Learning Environment; one for computer students on work placement programmes where collaborative problem solving is required, another for the continuing professional development of printers, where the integration of work context, mobile learning and online communities enables authentic and immediate learning whenever needed, and a third for knowledge services for careers information, advice and guidance workers. In this use case, distributed access to resources, knowledge services and social networks is important, giving access to specialist databases and to previous work undertaken by colleagues. All three of these use cases have similar features; the need for continuing learning as part of the work process, the need to solve problems as and when they occur, and a requirement for information and knowledge resources. In addition all the use cases encompass access to other people, through social and peer networks, and sharing common knowledge and resources in context.