m-learning

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MLEARN 2003

learning with mobile devices

www.LSDA.org.uk/events/mlearn2003

book of abstracts

for the second annual MLEARN conference
19–20 May 2003

edited by Jill Attewell, Giorgio Da Bormida,
Mike Sharples and Carol Savill-Smith

Conference organiser

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Published by the Learning and Skills Development Agency

www.LSDA.org.uk

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Registered with the Charity Commissioners

Designers: Dave Shaw and Joel Quartey
Cover illustrator: Joel Quartey
Cover photographs used with the permission of Creatas (Stockbyte: *Student daze*) and IPM Group (*'My friend' e-book reader*)
Printer: Stephen Austin and Sons Ltd, Hertford, Hertfordshire

1421/05/03/550

ISBN 1 85338 855 6

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This publication was supported by the Learning and Skills Council as part of a grant to the Learning and Skills Development Agency for a programme of research and development.

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Foreword

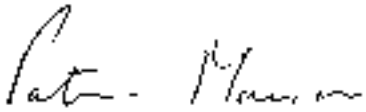
Welcome to MLEARN 2003, the second annual MLEARN conference. I am delighted the two Information Society Directorate-General supported mobile learning projects – m-learning and MOBIlearn – have collaborated to organise this conference. In addition to disseminating their own work it provides a showcase for everyone carrying out research and development work in the fascinating new area of mlearning.

The Information Society Directorate-General is playing a key role in implementing the 'vision', set by Europe's heads of state in Lisbon in 2000, to make Europe the world's most competitive and dynamic economy, characterised by sustainable growth, more and better jobs and greater social cohesion, by 2010. The eEurope action plan recognises that to realise this vision advanced and easily accessible Information Society Technologies (IST) will have to permeate European business and society. Strategies being employed by the Directorate-General to achieve this include stimulating research into Information Society Technologies which can be integrated into the citizen's everyday environment, business and administration and supporting initiatives that encourage and enable all European citizens to benefit from, and participate in, the Information Society.

Those working in mlearning share a vision of citizens enabled to take part in learning activities in any location at any time and to engage in that learning singly or collaboratively at a pace that suits their particular circumstances and needs. This complements the vision of the IST programme that our surroundings can be the interface to a universe of integrated services enabling EU citizens to access IST services wherever they are, whenever they want, and in the form that is most 'natural' for them.

The Technology Enhanced Learning Unit concentrates on promoting the value that information technologies and new media add to learning processes, through the research projects funded under the IST programmes. Our work marries technological, cognitive, pedagogical and organisational aspects, with the emphasis on technology as facilitator of the learning process, across different formal and informal learning contexts, whether in schools, universities, industry, or for lifelong learning. Our specific vision is that of empowering individuals and organisations to build the competences needed for them to perceive and exploit the ubiquitous learning opportunities of tomorrow's knowledge society. I am therefore particularly pleased to find commercial companies, including experts in content development, represented among the conference presenters and delegates.

I hope you will find the MLEARN 2003 conference stimulating, rewarding and informative and that you will all meet again at MLEARN 2004, which the m-learning and MOBIlearn projects are planning to hold in Rome next year.



Patricia Manson
Head of Unit, Technology Enhanced Learning
European Commission Information Society Directorate-General

Introduction

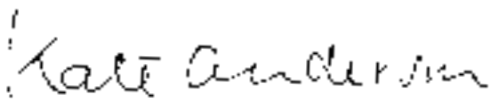
On behalf of the Learning and Skills Development Agency (LSDA) a warm welcome to MLEARN 2003 – Learning with mobile devices. LSDA has led the organisation of this conference in collaboration with colleagues from the MOBIlearn project. LSDA is the coordinating partner of the m-learning project, which is developing and evaluating prototype mobile learning products, services and support mechanisms for young adults who are not currently engaged in education or training, many of whom have literacy and numeracy development needs. LSDA is a strategic national resource for the development of policy, practice and research in post-16 education and training in the UK. Our work is supported by the UK government's Department for Education and Skills and the Learning and Skills Council in England.

I am very happy that we have been so successful in achieving our main aim for the conference, that of bringing together practitioners, developers and researchers from educational and commercial organisations around the world who share an interest in learning with mobile devices.

I would like to take this opportunity to extend my thanks to the conference programme committee for all their hard work in putting together the very exciting conference programme. This includes research papers and sessions in which developers present and discuss their achievements and work in progress. Alongside the conference sessions you will find exhibition stands showcasing the work and products of various organisations active in mobile learning.

Summaries of all conference sessions can be found in this book of abstracts and full papers will be published in the MLEARN 2003 conference proceedings. Contributors were asked to submit abstracts around the themes of: researching and/or evaluating mobile learning; innovation in concept, design and pedagogy; supporting and engaging the mobile learner; ambient intelligence; the development of content and learning materials; learning management systems; the development of international standards; contextual learning; situated collaborative learning and blended learning. As a result we have a varied and interesting range of content for both the conference and later publication, thus ensuring continuing debate after the event.

I hope you will enjoy the conference, find it inspiring and take the opportunity to network and to share and discuss new ideas and developments in mobile learning.



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m-Learning and Social Inclusion – Focussing on Learners and Learning

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Abstract

This paper describes how technologies in the hands of young adults (16-24), now and in the near future, might be used to engage them in learning activities, start to change their attitudes to learning and contribute towards improving their literacy, numeracy and life chances. The authors are part of the m-learning project.

Keywords:
m-Learning, mobile phones, handheld devices, social inclusion, basic skills

1. Our starting point

In 1999 in the UK one in five adults was found to have "less literacy than is expected of an 11-year-old" (Moser, 1999). Two years later UK government figures revealed that "of the 580,000 or so 16-year-olds who leave school each year, around 150,000 are below Level 1 in both Maths and English" and "22% of these young people do not go on to training or work after they leave school" (DfEE, 2001). The statistics illustrate that this is an intractable problem and imaginative and innovative approaches are needed to bring about improvements. One such approach could be m-learning.

2. Early investigations

The m-learning project includes several research strands. In phase one the LSDA research included:

- Research reviews focussing on the use of mobile phones, palmtop computers and computer games
- A survey of 746 young adult mobile phone users across the UK exploring users' attitudes towards their mobiles and initial reactions to a phone-based game which might help them with reading, spelling or maths.

Research by other project partners has focussed on technologies, standards, learner and knowledge modelling, small-scale user trials of learning materials and user interfaces/microportals.

3. Our findings

The research review highlighted the universal spread of the mobile. The overwhelming majority in our target age in project partner countries (UK, Italy and Sweden) own mobiles (Brown et al, 2002). Internationally many developing countries are leap-frogging conventional fixed line telephony to adopt mobiles (Townsend, 2000) and within these countries mobile users are not only the wealthy but include some very poor and excluded groups (Mutula, 2002).

The personal nature of the phone, its constant presence on or about the user's person, the types of communication it enables and its importance to teenage identity and friendships (Ling et al, 1999; Eldridge et al, 2001) all support our belief that its popularity is not just a short-term fad. The role of mobiles and messaging in friendship, gifting giving rituals and the sharing of phones and content (Taylor et al, 2002) highlights their potential as a collaborative learning platform.

It is frequently suggested that SMS inhibits the learning of correct spelling and grammar.

However young people who would not normally write messages are often enthusiastic texters and there are suggestions that the verbal skills of some usually reticent teenage boys are improving as they chat on their mobiles (Plant, 2001). This encourages us to believe that mobile devices are uniquely placed to contribute to improving young people's literacy.

The LSDA survey found that the greatest interest in using mobile phones for improving skills was expressed by girls, 16-19 year olds and young adults educated to Levels 2 or 3 (GCSE or A-level, or the equivalent). But these young adults stressed that learning games must be appealing, relevant and fun, even addictive (in the case of maths) if they were to sustain interest, indicating that getting the design and content of learning games right is crucial.

Almost half of young people expressed an interest in using phone-based games to improve their spelling and reading (49%) and maths (44%). A few also expressed in using phone-based games for learning a foreign language or for English as a foreign language.

4. Further exploration

In the current phase of the project we are working with community, voluntary and education organisations, and the young people they support, to explore:

- How different groups of young adults interact with, and experience, the learning materials and systems designed by the project
- Whether their enthusiasm for learning appears to be improved by their mobile learning experiences
- Whether learning gains are made, including young adults' perceptions of their progress
- Different models of learning and support, eg collaborative learning, individual learning (with or without peer support), online tutoring, blended learning and standalone units of learning etc
- How m-learning might contribute to addressing government targets for improving basic skills and engagement in education and training.

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The m-learning project is supported by the EC Information Society Technologies Programme. See website at http://www.m-learning.org

Evaluating Non Functional Requirements in Mobile Learning Contents and Multimedia Educational Software

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Abstract

We developed a scheme for representing critical non functional requirements , and apply it to the domains of Mobile Learning Contents and Multimedia Educational Software to validate it.

Keywords: Non Functional Requirements (NFRs), Mobile Learning Contents (MLC), Multimedia Educational Software (MES).

1. Background

Mobile Learning is so new that we are only beginning to see the potential of mobile devices in training and performance support.

The small screen size of mobile devices (a NFR) makes some people question their worth as e-Learning delivery tools. Some critics also point to the restricted input capabilities (another NFR) of some of these devices, questioning students' ability to enter large amounts of text into a device to take notes or answer an essay-type question.

Many of these devices, however, are extremely adaptable (a NFR) and can be attached to a full-size folding keyboard that makes entering large amounts of information every bit as fast (a NFR) as with a conventional computer.

Furthermore, users cannot appraise MLC because they are not able to evaluate their characteristics, potentialities, and limits (Avellis & Capurso, 1999a).

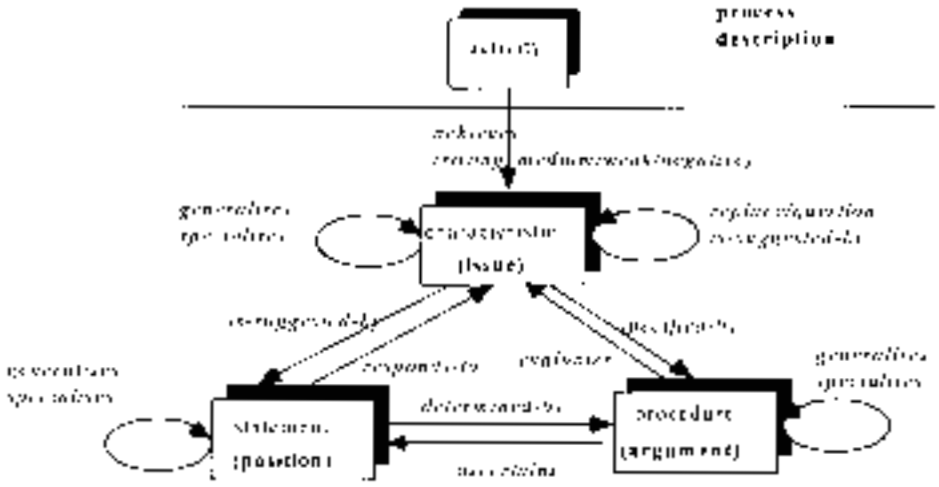
2. A Scheme for Critical NFR Representation

There is a need to develop techniques to express NFRs, which include quality requirements (Finkelstein, 1994).

This underlines the centre of the development process, the "generation of a value model", such as in classical engineering disciplines. That is, a key component of the system development process is achieving a model of *what is valued* in the resulting system. In this view, quality characteristics are not externally imposed on a development process but "constructed" within it.

The scheme developed to express NFRs is based on the work done by (Conklin & Begeman, 1988) on the "issue-position-arguments" model, where in our scheme an "issue", that is a problem to solve, is a *NFR or quality characteristics /sub-characteristics to evaluate*, an "argument", that is a supporting justification is a *procedure* which helps to determine which design alternative to choose to implement the related non-functional requirements. Finally, "position", that is a solution to the problem, is either a *statement* of NFR, which gives a quality goal to be supported by the final design, or *design alternatives*. Statement is an ascertainable property (possibly measurable characterising a NFR). The set of links is given in the following:

Figure 1 - Non Functional Requirements Representation scheme



In the following we give some examples of the application of the scheme above to MLC and MES.

A NFR related to MLC can be "*the MLC should fit the subject/topics and learning objectives of my course*".

The activity related to this example is "*evaluate the educational aim of the MLC package*", which *strongly* achieves the quality characteristics "*educational features*" .

"*Educational features*" quality characteristics has several sub-characteristics to be taken into account, such as "*instructional characteristics*", which is suggested by the requirement statement "*appropriateness of learning objectives suitable for age and competence of target users*" and is measured by the procedure "*verify that content and learning objectives are consistent with the national curricula requirements*".

The last example is the NFR "*the MES package should be easy to operate*".

The activity related to the second example is "*understanding the usage of a MES package*", which achieves in *medium* form the quality characteristics of "*usability*".

This in turn, can be further specialised into the sub-characteristics "*ease of use*", which is suggested by the requirement statement "*the way software operates*" and several procedures to measure usability "*What are the IT skills required to operate the software? Is on-screen help available? Are directions clear and accurate? Are directions available at all times? Is management of assessment instruments easy?"*.

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Self-produced video to augment peer-to-peer learning

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Abstract

This paper describes how self-produced videos, made with a digital video camera and later viewed on handheld mobile computers, support informal learning at an Intensive Care Unit. The learning process supported is peer-to-peer learning where colleagues use mobile IT to communicate and learn from each other. The handheld computers are equipped with barcode readers, which give easy access to the learning videos. These handy and mobile computers also make it possible to configure where and when the learning situation is going to take place. The staff themselves decide the content and how to produce the videos. Examples are given of how the spatial work environment is important in facilitating both the production and usage of the videos. The success of the peer-to-peer learning process seems to be that the person on the video and the colleagues watching it all share the same social and cultural community of practice.

Keywords: Peer-to-peer learning, self-produced learning material, video-films, handheld computers, barcodes, context and health care.

1. Peer-to-peer learning

We are inspired by Lave and Wenger's notion of situated learning and how communities of practice are established and maintained (Lave and Wenger, 1991). We have developed a mobile IT concept to support informal learning between colleagues. It is based upon viewing the staff as peers in a learning process where many communicate with many, and where they themselves produce learning materials for each other. The learning concept contradicts more conventional learning schemes where the content of the learning material is fixed and conducted in a format where one person teaches many others.

2. Mobile computers with video

2.1 The KLIV project

For two and a half years the KLIV research project has studied how learning at an intensive care unit can be supported with mobile devices (Björgvinsson and Hillgren, 2002, Brandt et al, 2002). KLIV is the Swedish acronym for 'continuous learning within healthcare', and is a project carried out in close collaboration between the Intensive Care Unit at the University Hospital in Malmö and the Interactive Institute. The research showed that the Intensive Care Unit's daily oral learning was a vast resource in the development of the staff's professional competences. This is in line with Orr's observation of the importance for technicians to share oral stories to sustain and develop their community memory (Orr, 1996). The staff now augment the oral resource by producing short videos around patient care and medical devices with a digital video camera. Passarge and Binder, who involved machine setters in documenting their best practice on video, have influenced our work (Passarge and Binder, 1996). Their videos were used for

learning out in the workplace environment viewed on a traditional stationary computer with a laser disc placed on a mobile small table. In our present research, the staff themselves produce the videos. There are no professional cameramen involved. Another difference is that the videos are viewed on handheld computers by scanning a barcode card placed at strategic places in the work environment. In the movie a colleague shows how the task is carried out including practical tips gained from experience. The process of making the video films is a collaborative learning process in itself starting when the films are to be recorded. Here the people involved start reflecting on how the task is best carried out. The reflection continues when they together with colleagues to review the video.

2.2. Self produced learning material

The advantage of producing their own learning material is that the content reflects experiences made when working at the unit: for example what to be observant about and what can be difficult to do. The people that figure in a video are from their own work environment and they know what most staff members need to know. This makes it possible to tailor the videos so that only what seems highly necessary is included.

The fact that the videos are produced where the tasks are carried out also makes them easier to make. The situation seems to help 'guiding' the staff in how to carry out the tasks and what to emphasise.

2.3. Using mobile video

The staff appreciated that the movies are contained on small mobile computers because they are flexible and give them the possibility to configure the learning situation themselves. It makes it possible to seamlessly incorporate them as support in their work context. An example of this is when two physiotherapists use a video about the process of assembling extra equipment to a ventilator. They start their session by moving a critical part of the equipment to a stationary computer to compare it with the video available there. When they feel confident about this part they go out to where the ventilator is and start the process of putting the equipment together. The equipment initially gives them clues about how to go about, but suddenly they get stuck. After some time they get help from the same video but this time via a handheld computer. In the first part they move the equipment to the video and in the second part they move the video to the equipment. Both are examples of ways to configure context for the learning situation. However, the notion of context is not only a matter of space and time. The context is as much a matter of socio-cultural circumstances where, for example, the fact that it is a known colleague acting in the video creates a confidence in what is told.

3. Conclusion

The KLIV project has shown that self produced learning materials in the form of short videos augmented peer-to-peer learning among colleagues at the intensive care unit. The collaborative production and use of the video films has made their work practice visible for more colleagues and thereby accessible for reflection, which contributes to a continuous improvement of their work practice. Watching the videos on mobile and handheld computers provides the possibility of configuring the learning situation independent of a specific place. This was highly valued by the staff. Using cards with barcodes gives easy access to a specific video and was appreciated too. The spatial work environment is important in facilitating the production and usage of the videos. Most importantly what makes the videos relevant seems to be the shared social and culture context. The highly collaborative making of the videos contributes to the content being particularly relevant.

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Individualised Revision Material for Use on a Handheld Computer

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Abstract

This paper introduces an adaptive learning environment for use on a PC and a handheld computer. At the end of the PC session, revision material tailored to the needs of the individual and appropriate for viewing on a handheld computer are recommended for synchronisation to the handheld device. Thus the student has access to additional individualised mobile revision material for use at times and locations where it would not normally be possible or convenient for them to study, but where they might nevertheless welcome this opportunity.

Keywords: learner model, revision material.

1. Introduction

With some exceptions (e.g. Ketamo, 2002), there has so far been little consideration of the potential for individualisation in mobile learning.

Figure 1. The PC-based tutoring system

This paper addresses this issue, presenting an adaptive learning environment for use on a desktop PC and handheld computer, designed as a support for an undergraduate mathematics course. Students use the PC version of the system to review and practise material taught during lectures, and to obtain individualised feedback on their responses (Fig 1). They may then take away tailored revision material on their handheld computer for later consultation.

2. Learner Modelling

As the student answers questions in the PC component of the system, it automatically builds a model of their knowledge and of their misconceptions. This learner model is used in part in the conventional manner, as information to allow system adaptation to the needs of the individual. It is also used at the end of the session to suggest suitable mobile revision material that the student can synchronise to their handheld computer: material that is tailored to their specific current learning requirements. This enables the student to continue learning away from the PC, at times and locations where individualised interactions would not normally be possible, but where the student might nevertheless welcome the opportunity for further study. Roy et al (2002) also argue for learning materials based on student responses to questions. In addition to dividing the interaction between the desktop PC and handheld computer, our system extends this notion by offering tailored revision materials according to a student's learner model, the materials aiming not only to help the learner

understand areas of difficulty, but also explicitly addressing their misconceptions. The learner model can also be synchronised for viewing.

3. Mobile Revision Material

If a student appears to be having only minor difficulties, the mobile revision material (Fig 2) is quite brief, having the function of reminding the learner. However, more detail is provided if the learner model contents indicate more serious problems or misconceptions, and if possible includes descriptions referring to concepts already known, to support explanations.

Figure 2. Tailored mobile revision material

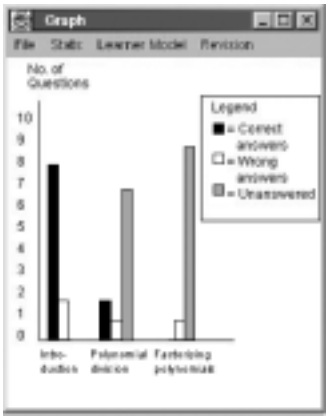

Figure 3. Mobile open learner model: overview

Figure 4. Mobile open learner model: details

The mobile learner model can also support revision as it may be viewed. The learner may see an overview of responses in the form of a graph illustrating their performance (Fig 3), and also specific textual descriptions of topics they know, and explanations of likely misconceptions (Fig 4). The open learner model is designed to help students plan their learning, and prompt reflection on the learning process. It is based on a study exploring the contents students desire in a mobile open learner model (Bull, 2003).

When a student returns to the PC, they are given a brief test on the revision material in order to update the learner model to ensure that the new PC interaction will be adapted appropriately for their current understanding.

4. Summary and Further Work

In-depth maths tutoring takes place on a PC, where it is easier to interact with information and obtain a well-structured overview of each topic. The mobile revision material based on the student's performance, and the mobile version of the learner model, are intended as an additional interaction to the main computer session for review at a convenient time and place on a handheld computer. All mobile learning content is tailored to the specific needs of the individual.

Future work will involve evaluation of educational and usability issues of the desktop PC system, the mobile revision materials, the two versions of the open learner model, and the effectiveness of uniting the two components of the learning environment in a single system.

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Take a bite: Producing Accessible Learning Materials for Mobile Devices

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Abstract

Writing basic skills materials for use on a handheld device is challenging. The m-learning project is attempting to meet the challenge by producing a set of innovative games, materials and activities which will not only motivate reluctant young learners but also give them an opportunity to improve their basic maths and English skills in a way which complements their disconnected, mobile lifestyles.

Evaluation is another important area, especially relating to cognitive, meta-cognitive and affective changes which may come about in learners as a result of using their materials and systems. Various techniques and activities, eg VXML and SMS, are being used to discover how the target group approach and experience learning using mobile devices in terms of developing their skills and motivation for learning in general.

Keywords: basic skills, games, learning materials, evaluation

1. Developing Content

What are the pedagogical issues affecting the creation of basic skills materials to be used on an electronic device?

There has been considerable research into the positive benefits of improving basic skills using a computer: issues such as maintaining privacy, avoiding stigma, working at your own pace have been well rehearsed. The challenge that the m-learning project sets itself is attempting to maintain these benefits whilst shrinking the materials themselves down to fit comfortably and accessibly in a hand-held device.

The project's aim is to capitalise on the obvious benefits of using the technology whilst developing innovative materials which maintain a clear perspective on the learning goal. Materials produced by the m-learning partners combine sound basic skills pedagogy with ground breaking use of new technologies and devices.

We are currently in phase 2 of the project. We have been able to trial several different approaches with a wide range of learners. Now, with many lessons learned and remarkable improvements in technology, we are busy developing a new generation of materials and templates to help us take these lessons one step further.

2. Working with palmtops

Fig1. IPAQ showing m-learning material

Palmtops have the advantage of a relatively large screen so that graphics, animations and video-clips are feasible. Scaled–down quizzes on sports themes were devised and proved popular in trials. Palmtops also link the learner with the internet and, therefore, with a potentially rich field of other learning materials. However, they are expensive: more executive toy than simple, practical communication

device. They do not feature large in the landscape of a mobile youth lifestyle.

3. Working with mobile phones

Mobile phones are used by an enormous number of young people as part of their social and cultural life. They are relatively cheap and easy to use. However, designing content that can either provide or stimulate learning requires ingenuity, knowledge of the technological constraints and the ability to think inside a fairly small box. The m-learning partners are working on materials that permit interaction between learners. Ways in which attitude to learning can be assessed via a mobile are also being investigated.

4. Themed learning

How can we make these tiny bits of content part of a larger whole? In phase one we developed themes of content (in conjunction with trial sites and project partners), spanning all the available technologies. These themes were:

An Urban Soap opera involving two young characters moving into a new flat. The characters were introduced using a Flash movie (iPAQ), and daily updates to the story were available via the phone (VoiceXML). Matching learning activities were delivered via the iPAQs.

Football refereeing. This was timed to coincide with the World Cup. Animated quizzes on the iPAQs were used, as was a daily quiz of five questions via the phone (VoiceXML).

In the second phase we are extending this to cover more themes, as well as a wider range of technologies

5. Working together

Whilst the use of a mobile or palmtop might seem, on the surface, to be an extremely isolated, individualistic activity, research has shown that young people communicate with each other quite successfully in the process of using the devices. Thus, materials, especially games (see the work of Prensky, 2001) can be developed that are usable by groups as well as by individuals.

They are a key feature in many activities carried out by young people: making arrangements, passing on information, passing on gifts in the form of jokes or graphics, sharing and comparing ringtones, texting each other using a still developing new language.

6. Evaluating progress

Being able to evaluate progress made in learning via a mobile device has its own set of challenges, especially when the devices themselves are used in the evaluation process. The project has looked at which other aspects of the learning process also need to be evaluated:

How do mobile devices motivate learners to progress to other learning opportunities?

Do materials presented on mobile devices attract a different type of learner, one who is less likely to go for a more conventional approach?

Is it possible to identify changes in attitude to learning when mobile devices are used, and can the devices themselves be used in the evaluation process?

In phase one the trials were limited. They were conducted in four separate centres and involved the presentation of materials to 34 learners (19 males, 15 females).

The small scale and limited timescale of the pilot precluded any attempt to produce quantitative results, such as a measurement of learning gains. The evaluation methodology was therefore qualitative and based on:

- learner observation
- interviews with learners
- questionnaires completed by learners and their tutors.

For phase two we are trialling materials with a much larger group of learners, and need to be able to show more measurable gains. The m-learning partners are trialling evaluation tools that can, perhaps, provide answers to some of these questions.

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Participatory Design in Development of Mobile Learning Environments

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Abstract

The paper explores the concept of Participatory Design in development of mobile learning environments. Access to learners' reflections and interaction patterns through personal technologies has been attained. The study brings us towards the justification of Learner Centred Design, LCD, since traditional methods in User centred design, UCD, are limited in scope to support development of educational technologies. In our case LCD gives a deeper level of contextual understanding through user involvement.

Keywords: Participatory Design, Personal Technologies, Mobility and Learning.

1. Introduction

Observations of student interaction in mobile learning environments can offer challenges to designers who strive to develop supportive resources, as the students' learning activities are distributed both in time and space (Hedestig et.al 2002). It is essential to understand the users and their social context. Development of learning environments are traditionally characterized by a teacher centred perspective (Carroll et. al 2002). Our point of departure is based on previous work with a focus on students' interaction patterns in their everyday activities.

The users involved in the study are off-campus students within higher education who have good or great knowledge of personal technologies. A bottom-up approach is suitable to obtain an understanding of the mechanisms within the students' learning context.

2. Personal technologies in learning settings

Since the late 90s there has been an increased use of mobile phones among all age groups (Ling and Vaage, 2000). Recently there has been a growing interest in the use of personal technologies in education and a number of pilot projects tried to find out how personal technologies can be integrated into learning settings (Chen, Myers and Yaron 2002, Roschelle and Pea 2002, Lundby 2002). The project undertakes the study of personal technologies and those various subsets of technology embraced by the definition, i.e mobile technologies and Internet technologies (Sharples, 2000). The aim of the project is to understand existing communication patterns and use of mobile artefacts among undergraduate students and how this knowledge can be used to inform design of learning environments for distance and decentralised education. The project has adopted a bottom-up approach, that is, to view learning from a student's perspective (Hedestig, Orre, 2002).

3. Participatory Design in Learning Settings

One method that supports a bottom-up approach is Participatory Design (PD). According to the method users are seen as experts in a specific context of development and therefore PD contemplates a more substantial process of users and designers working together during an extended period of engagement. This, to exchange perspectives, to learn about each other's skills and values, and jointly identify an appropriate set of requirements (Carrol et al 1998, Kensing & Munk-Madsen 1995).

PD scenarios can be used to characterize workflow and breakdowns, and further be employed as conversational props in user-developer workshops. Users need not understand the underlying design or implementation in order to provide highly specific change requests when these are given in the form of a scenario. In the work with scenarios designers also have the opportunity to articulate and confront their design suggestions and models towards real users, and thereby, test and evaluate their relevance for the specific context (Carroll et al 1998).

However, User-Centred Design (UCD) and PD have had limited impact on the design of educational technologies. One reason is that learning settings have not yet been able to develop strategies for technology use and pedagogical models. An alternative approach to UCD is Learner-Centred Design (LCD). The approach is a movement beyond usability issues and instead explores the challenges of developing computer systems that support people in a learning environment, i.e. the learners' development of expertise in new and unknown work practices (Soloway et al 1996). Within LCD the goal is instead to help learners (novices in a given work practice) to learn new practice.

In our project we adopt an LCD perspective, which contains learner involvement through various techniques and/or workshops such as interviews and development of scenarios. Our application of PD strives towards a sequential development to support learner involvement in order to be able to grasp the complex interdependency between learning, users and tools.

4. Conclusions

Our study shows that there is a prominent difference between traditional UCD approach and LCD. *Firstly***,** users within UCD are homogeneous while learners are to be seen as a heterogeneous group. The learners might not share a common culture or level of expertise in the work practice and this diversity must be taken into account in the development process. *Secondly*, within LCD the goal is to help learners (novices in a given work practice) to learn new practices. Thus the primary goal when we are set to develop educational software should be to support the learning process rather than, a predisposed process to accomplish a specific task as articulated by UCD. *Thirdly*, to take into account the private use of personal technologies while integrating these technologies in public learning settings.

Finally, our studies show that the students' knowledge of personal technologies defines them as expert users, and that their participation illuminates situations and interaction patterns that reveal concealed use of personal technologies in the learning environment. Knowledge that level out the relation between learners and designers and stress a deeper level of user involvement in the design of mobile learning environments.

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Using Mobile Devices for the Classroom of the Future

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Abstract

Face-to-face learning scenarios are characterised by rich forms of cooperation including natural speech, gesture and other visual communication. However, with a growing number of participants the cooperation needs to be coordinated and the individual participation in the cooperation decreases.

Using mobile devices like PDAs, interactivity and cooperation in such scenarios can be enhanced. But the design of such a technical system must also carefully preserve the traditional advantages of face-to-face scenarios. We present ConcertStudeo, a platform which supports interactions such as brainstorming, quiz, voting and others by using wirelessly connected PDAs in combination with an electronic blackboard. The design and implementation of the system and evaluations are described. We discuss advantages and constraints of using ConcertStudeo as an innovative face-to-face learning approach.

Keywords: Interaction and cooperation support, Computer-Supported Collaborative Learning (CSCL), face-to-face learning, PDA

1 Introduction

The focus of this paper lies on face-to-face learning scenarios such as workshops or classroom trainings. Advantages of these scenarios in comparison to individual or distributed learning are based on richer communication including gestures, mimics, body language etc. With a growing number of participants communication problems can arise leading to fewer contributions per participant.

In this paper we describe how a technical system can improve face-to-face learning scenarios with respect to enhanced interactivity and cooperation.

2 Requirements for a Face-to-face Learning Support

A technical system for face-to-face scenarios needs to keep as many advantages of the traditional scenario as possible and provide functionality to enhance the interactivity and cooperation (Roschelle and Pea 2002a, 2002b). In this section the advantages of traditional systems are summarised and supplemented by new requirements to enhance interactivity and cooperation.

3 Interaction and Cooperation Design

We discuss designing enhanced interactivity and cooperation for face-to-face scenarios. Using the brainstorming method as an example we tackle design questions such as: How can the process be structured? Which information is visualised on the blackboard, which on the learners mobile device? What actions are carried out when and by whom?

4 The ConcertStudeo Platform

We present ConcertStudeo (Wessner *et al.* 2003; IPSI 2003), a platform providing configurable tools for spontaneous and planned interactions such as brainstorming, quiz, voting and other typical face-to-face methods.

The design and implementation of the system is explained in detail.

5 Experiences and Outlook

Practical experiences of the usage of ConcertStudeo in a course at the Technical University Darmstadt (Germany) are presented. Furthermore we talk about the lessons learned from the usages in such academic settings. In

particular we discuss the need to carefully integrate the usage of ConcertStudeo in the instructional design of a lesson.

Finally we give an outlook to the further development of ConcertStudeo.

***Figure 1**. The usage of ConcertStudeo in a university course*

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A 'learning space' model to examine the suitability for learning of mobile technologies

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Abstract

Mobile Learning is an emerging paradigm that has yet to be clearly defined. To better understand the nature of mobile learning we propose a multi-dimensional learning space model that can be extended as new technologies and new ways of using existing technologies are developed. The potential use of a specific technology for a particular type of leaning within the space is evaluated by using the Quality Function Deployment (QFD) set of tools. It is hoped that the model will help to identify and classify types of learning facilitated by mobile environments and to explore particular combinations of learning and technology.

Keywords: learning space, mobile technology, Quality Function Deployment, m-learning, e-learning.

1. Three dimensional learning space

We propose a 3-dimensional learning space defined by the axes (1) type of learning, (2) software application, and (3) technology. Axis 1, 'Type of Learning' portrays three types of learning: curriculum – supported learning, problem-led learning, and serendipitous learning (sometimes called learning on demand). Axis 2, 'Software Application', lists the software applications that could be available to meet different learning needs. Axis 3, 'Technology' lists the technology that can support the user's learning requirements.

This learning space can be broken down into a series of matrices that enable the learning activity and pedagogy facilitated by that particular space to be defined. The break down is done as follows: for each type of learning we examine three aspects: (a) communications, (b) context and content management, and (c) learning organisation. We then identify different activities that concern each aspect. For example, for learning organisation the activities include mind-mapping, recording of learning events, and time- and place-stamping of learning events. For each of the three aspects of each type of learning we then produce a two-dimensional matrix, where the activities form the rows and candidate technologies to support them form the columns. The suitability of the technology for the learning is then quantified using Quality Function Deployment, (QFD) (Lowe and Ridgeway, 2000).

2. Quality Function Deployment (QFD)

QFD is as a set of development tools designed to bring quality control concepts into the process of new product development. In this paper we describe an adaptation of the method for the evaluation of different technologies and/or applications to facilitate particular types of learning.

The "House of Quality" matrix is the most widely used form of QFD (Hauser et al.,1998), The general format of the "House of Quality" is made up of six major components:

1. Customer requirements: defines the customer needs

2. Technical requirements: describes the product
3. Planning matrix: quantifies the importance of a particular functionality
4. Interrelationship matrix: quantifies the suitability of the technology for the purpose
5. Targets: quantifies the relative merits of a technology for an application
6. Roof: Indicates if devices could be used together

In our case, we produced the different components with regard to different types of learning, more specifically curriculum-supported learning, problem-led learning, and serendipitous learning. The result of the analysis can be used to evaluate the relative merits of different technologies or applications for different types of learning.

Table 1 contains the interrelationships matrix produced for the learning organisation aspect of curriculum-supported learning. The first column corresponds to the 'Customer requirements' – in this case user/learner requirements – for the organisation of learning when curriculum supported learning is taking place. The 'Technology' row indicates different devices that might be used to support curriculum-supported learning:

- Handheld1: Handheld computer without communications technology
- Handheld2: Handheld computer with communications technology
- Com1: Mobile phone without multimedia functionality
- Com2: Mobile phone with multimedia functionality
- Laptop1: Laptop or tablet pc without communications technology
- Laptop2: Laptop of tablet pc with communications technology

Technology	Handheld1	Handheld2	Com1	Com2	Laptop1	Laptop2	**Planning Matrix**
Mind Map	L	M	L	M	L	H	4
Record Learning Events	L	M	M	M	L	H	4
Time stamp learning events	M	M	L	L	M	H	3
Place stamp learning events	N/A	M	M	M	N/A	H	2
Targets	17	39	25	33	17	117	

Table 1: Interrelationships matrix for learning organisation in curriculum-supported learning

The interrelationships matrix in this case indicates how well the device will support the learner requirements. A grading scheme is applied where the values are: High (code H, score 9), Medium (code M, score 3), Low (code L, score 1), and Not/Applicable (code N/A, score 0). The end column titled 'Planning Matrix' gives a weighting to each of the learner requirements indicating how important they are thought to be. These values have been informed by a review of the literature. Each value in the interrelationships matrix is now multiplied by the corresponding value in the planning matrix and the values in a column are added to give the final figure in the Targets row. The numbers in the targets row give a relative measure of the suitability of a particular device for 'Learning Organisation'. It should be noted that the 'Roof' of the 'House of Quality', which is used to indicate where devices could complement each other, is not shown here for simplicity.

This is only one of the matrices that will need to be consulted when considering the 'Learning Organisation, Curriculum-Supported Learning' learning space. The result of a complete analysis is a series of numbers that can be used to evaluate the relative merits of different technologies or applications for different types of learning.

It is hoped that this approach will enable developers and teachers to design learning programmes that make effective use of mobile technologies and applications.

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A wireless and adaptive navigation site to educate ICT college students

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Abstract

This paper describes a "wireless and adaptive web site" developed for use by ICT students at a college in North Tyneside so they can look at course information anytime and anywhere. The site uses Adaptive Navigation Support (ANS) techniques usually found within Adaptive Hypermedia Systems (AHS) that personalizes the students web experience by highlighting links of interest through direct guidance, hiding of irrelevant links, and sorting of links. Through these techniques and with the use of user models and a Markov model we cut down the cost and effort and improve the time it takes students to navigate the site.

Keywords: Adaptive, wireless, ICT, learning.

1. Introduction

Navigation on wireless devices is cumbersome and time consuming due to limited screen size and bandwidth. As a result, methods are needed to facilitate the navigation based on user-models to enable users to gain fast and efficient access to relevant information.

In this paper we discuss a 'wireless and adaptive site' developed for a mobile device that personalises the web experience for ICT students at North Tyneside College.

In a recent survey by the Learning Skills Development Agency (LSDA) it was reported that 85% of the 16 to 24 year olds interviewed use the Internet, 54% are in education, but only 4% of them used the 'Internet' on their mobile phones (LSDA, 2002). It is our aim to bring the three together and produce a personalised web site that contains course information that can be accessed any time and anywhere using a wireless device.

2. Web personalisation

To improve the web experience we must have some idea of what motivates each visitor and what their interest and goals are. For example, a student looking for the location of their class. We call this behaviour "goal-directed browsing", as the visitor's behaviour is single-minded. The visitor is not interested in diversions, they are only interested in finding their goal, and therefore personalisation would be used to directly link to the information sought by predicting the user's current goal. Through personalisation we can help solve disorientation and information overload by improving the sites navigation by applying Adaptive Navigational Support techniques (ANS) usually found within Adaptive Hypermedia Systems (AHS). These techniques help students to find what they are looking for by personalising their experience in respect to their knowledge, background and goals by highlighting links of interest, hiding irrelevant links, and by sorting links.

3. Adaptive Hypermedia Systems

The goals of adaptive hypermedia systems are "to build a model of the goals, preferences, and knowledge of each user, and use this model throughout the interaction with the user, in order to adapt to the needs of that user" (Brusilovsky, 2001).

Our system uses typical AHS functions and maintains a model of the user's knowledge by keeping attributes such as 'has the user read about this concept' by observing their actions whilst they are 'browsing' the site.

A user model is also applied to classify all nodes (pages) into several groups according to the user's current knowledge, interests or goals.

The system uses this user model to manipulate links to guide users towards interesting and relevant information using a technique which Brusilovsky calls Adaptive Navigation Support (Brusilovsky, 1996). Depending on the class of the node a link leads to, the link could be specially annotated, ordered, disabled, or removed. The manipulation of links is done in the following ways within our system:

Direct guidance: A "next" or "continue" link is shown. The destination of this link is the node that the system determines to be most appropriate.

Sorting of links: A list of links is sorted and presented from most relevant to least relevant. This technique is usually found in goal oriented educational systems (Hohl, Böcker and Gunzenhäuser, 1996).

Link hiding: Links leading to inappropriate or non-relevant information are hidden.

4 User Modelling

In our work, we model the navigational behaviour of a user by observing what documents they view and store the information in one of three stereotypical user models: beginner, intermediate or expert. We use this stereotypical model to build a model of the goals and preferences of each student, and use this model throughout the interaction with the student, in order to adapt to their needs.

We train user models so that if a visitor is new to a particular part of the system, but another visitor with the same user model has (either beginner, intermediate or expert), then a reliable prediction about future navigation can be assumed with the help of the Markov model.

The Markov model comes from Markov chains, which are sequences of random variables in which the future variable is determined. A Markov model contains a single variable, the state, and specifies the probability of each state and of transiting from one state to another (Anderson, Domingos and Weld, 2002).

Using this model, the students' goal is predicted and an 'index page of predicted links' is dynamically produced and displayed on their wireless device which the user can access at any time allowing for a fast and efficient way to access the work they are looking for.

5 Hybrid system

However, automated approaches may not always correctly predict the user's goal as discussed by Perkowitz and Etzioni (2000). The best approach, as used in our system, is to use a hybrid system where personalisations are generated automatically and the web designer optionally provides guidance to enable a correct model is used.

The use of the hybrid system can be useful when the models have to be slightly changed. For example, an assignment is given out and the tutor would like it to be seen by all their students as soon as possible. Here you can change the popularity of the file so that it is displayed in the 'index page of predicted links' even if it has not been viewed before.

6 Conclusion

In conclusion, web sites that are designed for viewing on wireless devices require careful content management as these devices are characterised by their high operating costs, limited screen size and limited navigation capability (Jari, Harri and Multisilta, 2000). By using personalisation and adaptation it is hoped that students don't waste time and effort looking through course material and that the goal (the information they are looking for) is reached as quickly and efficiently as possible without the risk of presenting the user with potentially useless information.

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Using Portable Technology in UK Schools for Teaching and Learning

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Abstract

This paper outlines the presentations to be made by 2-3 schools in the Toshiba E-Ambassadors scheme, in order to provide insight into some of the opportunities and challenges faced by teachers and learners in a mobile learning environment

Keywords: Toshiba, portable computers, portable ICT

1. Introduction

As with any form of ICT, positive impacts relating to portable ICT devices depend on ways in which they are used. There are potential benefits for learners, teachers, parents and employers. Improvements in cognitive capacity, creative or critical thinking, will inevitably be reliant on the capacity of learners and teachers to use ICT as an effective pedagogical tool in pursuit of wider learning objectives

2. School Presentations

Presentations will be given by 2-3 schools in the Toshiba E-Ambassadors scheme which use portable technologies (ie laptop and notebook computers). Such presentations will seek to build on the knowledge gained in recent research reports published by BECTa, namely on teaching and learning and portability (BECTa, 2003), and the impact of Information and Communication Technologies on pupil learning and attainment, commonly referred to as ImpaCT2 (BECTa 2002).

2.1 Variety of formats demonstrated

- Djanogly City Technology College, Nottingham.
- The Arnewood School, New Milton
- Leigh City Technology College, Kent

The teachers and learners from 2-3 UK schools will demonstrate a variety of formats when using portable learning devices

2.2 Teaching and learning

Insights into the opportunities and challenges faced by teachers and learners will be outlined and discussed. These discussions will be predicated on the recent DfES report "Transforming the Way We Learn - A Vision for ICT in Schools" (DfES, 2002).

The workshop will provide participants to interact with learners and teachers using mobile technology in a variety of learning environments, where "portable devices do not dominate in the same way desktop computers can, and may be more readily integrated into classroom use across the curriculum with the minimum of disruption to existing practices" (Moseley and Higgins, 1999)

2.3 "Hands-On Experience"

"Hands-on" experience will be provided to the audience related to the themes provided in the conference literature, such as contextual learning, situated collaborative learning and blended learning. These raise issues for using a mobile learning environment with real people, in real time, in real mobile learning situations.

The session will demonstrate the benefits of portability for users, ie for learners, teachers, parents. They will also provide an insight into the factors required for effective use of portable ICT.

3. Outline of the "Best Practice Research Programme"

Toshiba has recently introduced a "Best Practice Research Programme" to support teachers in their efforts to raise achievement in a sustainable way and enable teachers to conduct small-scale research into their own practice about how ICT can affect learning in the classroom. Some outcomes of this research programme will be outlined alongside the BECTA case studies from the E Ambassadors presenting.

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Knowledge Management within M-learning Environments

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Abstract

In education a key function is to impart knowledge. Likewise within business, knowledge has been recognised as a key to providing strategic advantage within modern organisations. Is it possible then that we can derive solutions to managing knowledge within m-learning environments from lessons learned in the world of business? Can we extend this competitive advantage which has been seen in the business world to propel m-learning forwards providing the best experience for the end user as well as serious competitive advantage for educational technology and platform instigators? This paper examines how we can use knowledge management principles that have been successful in business to enhance and exploit the full potential of m-learning environments.

Keywords: learning, m-learning, knowledge management,

1. Introduction

In using m-learning as a delivery platform, we lose many of the social opportunities people have to engage in face-to-face interactions. Many of the social, cultural, language and contextual cues found in teacher-to-student and student-to-student communication are misplaced (Walther, 1996; Oblinger et al, 1998). Consequently a requirement for successful m-learning delivery is to manage these problems thereby encouraging trust, knowledge sharing, collaboration and community within the m-learning space. What we need to do therefore is look elsewhere to see where these types of problems have already been tackled. One such place is the world of business where many organisations have already been through this process in their Knowledge Management (KM) initiatives.

In the business world organisations have been driving to improve efficiency and effectiveness in the creation and sharing of knowledge for some time (Nonaka and Takeuchi, 1995). M-learning must also enter this transition zone if it is to combat many of the issues that this type of learning medium is likely to create. In applying the concepts, tools and techniques of KM to the conveyance of knowledge within m-learning environments we can potentially remedy m-learning exploitation concerns. Where before the meaningful dissemination of knowledge within the environment proved complex we can now use the tools and techniques of KM to help promote a sense of community, build solid collaboration between students and teachers, and foster trust and knowledge sharing.

2. Applying KM

In applying KM to m-learning environments we need to consider the tools and techniques which would be used to facilitate this transfer. Sophisticated m-learning environment tools will be required to cater for the demands of a mobile learner. Enhancing the learning experience through greater interactivity can potentially contribute to increased levels of trust and commitment amongst learners. As m-learning technologies steadily increase in technological sophistication, enhancement will be seen in the level of interactivity amongst learners. Mobile computing picture messaging, video, online forums, mobile weblogs, instant

messaging and interactive media such as mobile whiteboards for example will all add to a sense of identity, commitment and trust. This in turn will encourage collaboration and a willingness to share knowledge between mobile learners (Luff et al, 1998).

The techniques of KM also need to be considered in m-learning environment provision. Both process and space management will constitute key elements in the development and ultimate achievement of producing an effective m-learning environment. Within process management we will see an evolution of support for the mobile learner in the creation of structures encouraging knowledge generation, sharing and use. Organisational structure should give users an appreciation of the knowledge interdependencies easily (Fagrell et al, 1999). Within space management, we will want to see an environment that fosters collaborative relationships between learners. Such an environment will also need to break down barriers created through language and disparities between learner perception of wants and needs. What is required is the establishment of social capital, the creation of multiple weak ties between individuals and the formation of a sense of 'place' within which everything can happen (Lester, 2003).

One of the biggest problems in corporate KM is that of fear of loss of control and influence in sharing knowledge with others. M-learning environments need to be designed in such a way therefore that will foster knowledge sharing. As learning is typically a competitive experience, learners need to be shown the benefits of collaboration in learning. The new generation of mobile learners in particular will bring with them extensive experience of the platform, as well as an inherent interest in these new technologies. This may form a useful catalyst in the formation and utilisation of mobile technology delivery platforms for learning.

3. m-Learning in Practice

M-learning environments are now beginning to move away from the traditional KM view of a repository of knowledge. This can be seen in the transition toward more sophisticated forms of m-learning environment provision. IBM's Pervasive Web Lectures for PDA's offered a simple example of presentation knowledge dissemination amongst partners and employees (IBM, 2001). The move towards collaborative knowledge manipulation has been seen with recent initiatives by Unbound Medicine, which has lead to the adoption of m-learning platforms by the healthcare market for domain specific knowledge propagation between medical practitioners (Unbound, 2002). Such systems typically encourage knowledge sharing through forum areas, promote question and answer upload from learners and give access to complex (medical) knowledge on the move.

4. Summary

The successful exploitation of KM principles within m-learning environments is paramount if m-learning is to enhance the overall teaching and learning experience. Through the utilisation of KM tools and techniques as applied to m-learning environments we will begin to see benefits for both learners and instructors.

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Collaboration and Roles in Remote Field Trips

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Abstract

In order to ensure that classroom based pupils benefit from the experience of a field trip being undertaken by their peers, investigations are underway within the RAFT project to provide a cooperative learning environment spanning the field trip and the classroom. Various roles are being explored to ensure that all participants are fully engaged in the event. The background to this investigation is the need to embed the experience within the curriculum, and to explore the event within the peer based learning, situated learning (Lave and Wenger 1991) and vicarious learning pedagogic principles.

Keywords: Field Trips, Cooperative Learning

1. Introduction

The Remote Accessible Field Trip (RAFT) project is implementing a method of spanning field trips and classroom based learning situations in order to provide an integrated event for the set of pupils involved. This will take the practice of mLearning into the realms of fully cooperative and collaborative learning.

In order to ensure that all pupils are fully engaged in the event, the project team is exploring a range of roles that could be taken by the pupils. The scope of these roles is being explored, together with the qualities that will be developed within the pupils taking these roles.

2. Method

A variety of scenarios are being explored, focusing on the areas of Biology, Art and History. The curriculum is being considered within the secondary education systems of Canada, Scotland, Germany and Slovakia.

Prototype systems are being constructed based on innovative classroom technologies and on mobile devices in the field. A variety of simple scenarios are being enacted with school pupils to explore the nature of the roles that might be necessary, and the functionality required of the systems to enable these roles to be enacted. In addition trial field trips have taken place in order to explore the interactions between the classrooms and the field trip and the capabilities of the current wide areas technologies, whilst anticipating the capabilities of the future infrastructures.

This paper will report on this work, and will highlight the nature of the collaboration being explored and the place of roles within the mLearning situation.

3. Acknowledgements

This work is part funded by the Commission of the European Community under the IST 5th Framework Programme.

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A Framework for Managing Rights for Mobile Learning Content

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Abstract

Managing rights over mobile content for learning provides unique challenges involving the application of Digital Rights Management, Mobile technologies and eLearning standards. Part of the effective management of any content (even in the wired fixed space) is the degree of treatment of intellectual property rights. Within the eLearning sector, rights management of content enables reuse, fair use, return on investment, attribution, royalties, and usage control. Applying these features to the mobile space poses serious questions for interoperability. Standards are now emerging from the mobile sector to manage very simple rights. Moving to a complete architecture supporting end-to-end management of elearning content will involve additional research and integration of the standards from both the learning and mobile sectors.

Keywords: Digital Rights Management, Open Mobile Access Abstract Framework (OMAF), Open Mobile Alliance (OMA), Learning Object Management Systems, Open Digital Rights Language (ODRL)

1. Introduction

The issues and solutions of managing the rights over eLearning content has become increasingly urgent as all players in the value chain – from creator to consumer – realise the impact and balancing needed between copyright and access to content. Solutions for the Internet are emerging (Iannella, 2003) but delivery over the mobile space open up entirely new possibilities yet face additional constraints and requirements.

A number of "Abstract Frameworks" have been proposed to manage the complex models for learning content management systems. The key to effective management of rights in such frameworks is the ubiquitous understanding of rights information at the many layers and across the many modules. Without this, DRM services cannot be guaranteed.

2. Mobile Rights Language

The Open Mobile Alliance (OMA) released a rights expression language (REL) specification for rights management of mobile content, based on the Open Digital Rights Language (OMA, 2002). The OMA REL is a smaller subset, or profile, of the complete ODRL since mobile devices and their expected types of content are limiting. The OMA REL has chosen the core semantics for the permissions and constraints that should be applicable to mobile eLearning content. With the release of the OMA REL, mobile devices will now be appearing that can understand, and importantly, honour, the rights information attached to the mobile content. This will provide some of the assurances that rights holders are looking for in DRM solutions.

3. Discussion

There are a number of issues to address for the success of DRM for mobile eLearning content. Some of the outcomes include:

- Does the semantics of the OMA REL cover the initial requirements of the eLearning mobile community?
- Can Internet-based DRM systems be transformed to handle mobile content?
- Can DRM be directly supported (and specified) as an integral part eLearning frameworks?
- Are there additional (or modified) technologies that are missing from the overall framework and requiring standardisation?

One of the first activities is to develop and/or integrate DRM into existing eLearning frameworks to provide the necessary infrastructure for these services. The eLearning community has some robust standards for content description and packaging which would need semantic additions to support the behaviour of rules covering rights information.

Overlaying the mobile architectures and protocols, such as the OMA REL, will provide insight into current levels of support for DRM functions. Additionally, mobile standards for content notification and distribution will need to be investigated against the framework.

The final result should include an enhanced eLearning framework that caters for the management of rights over mobile content and addresses some of the outstanding issues still required.

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Learning Can Happen Anywhere: A Mobile System for Language Learning

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Abstract

The Societal trend towards learning during leisure time and the rapid development of advances in mobile technology trigger the vision of enabling consumers to learn anytime anywhere. However, there have been relatively few attempts systematically to explore learning opportunities presented by mobile devices. This article investigates the importance of starting from the mobile user's perspective with a conceptual framework when developing mobile applications for learning. The results of a mobile commerce expert survey, carried out by IAMSR Research in five different countries, illustrates the impact of cultural differences in user behaviour on the potential success of mobile learning applications. Time, information and location dimensions delineate the impact on users' contexts and the selection of innovative mobile technology, with our results suggesting the design of a mobile system for language learning.

Keywords: mobile system, overlapping contexts, leisure and learning

1. Leisure and Learning Society

It is both evident and ironic that progress in information technology has denoted more work in our society (Leggiere, 2002). The rising level of education is another powerful variable shaping very distinct consumer and organisational behaviour (Falk and Dierking, 2002). Learning during leisure time has become very pervasive in our knowledge society, which is more likely to be characterised as time-poor and money rich (Lindskog and Brege, 2003).

2. Conceptual Framework

High added-value applications in mobile commerce is becoming one of the most popular topics of interest in IS research, and is a core activity for many businesses operating in the wireless world. Different scholars exploring mobile markets in different countries are likely to have different perceptions on what kind of mobile services will be most popular. Conversely, they share quite similar views on the mobile products service success: designing from the customer's perspective. To develop an in-depth understanding of the widespread success of mobile applications, we need to appreciate the conditional elements of System Theory. Analysing relationships between the different success factors of information system artefacts, we present a conceptual framework that can be used to design the mobile system for users to learn a language. Within this framework, a special emphasis is given to justify the most appropriate context of mobile learning. The area which has been researched the most in mobile context studies is the physical location of the mobile user. The main conclusion which has been derived from these studies is that context of use should be governed by the overall user's ecosystem (Groot and Welie, 2002), rather than affected by the physical location alone.

3. Contexts of Mobile Learning

Figuring out the right contextual model is a starting point for designing any mobile system for consumers. We discovered that a typical mobile user is involved in a number of different overlapping contexts, thus any activity and experience that results is influenced by the interactions between these contexts. The definition of an overlapping context is not new

(Falk and Dierking, 2002), though it has not been emphasized in information systems research. Our suggestion is that three overlapping contexts – the Personal Mobile, the Learning Community and Cultural - contribute to the design of experiences that people have when engaging in mobile learning.

We have chosen to describe the freedom of learning as a process, evolving within different dimensions of time, information and location. Our basic assumption is that the nature of time, information and place has implications for the learning society, which is eager to transfer and share it effectively by the help of mobile communication technology. The three underlying parameters of mobile communication assists in analysing different contexts of use in mobile learning.

The contextual model presented in this paper emphasises on one hand the personal attributes of the user operating in a mobile context and, on the other hand, the community attributes which are essential for the virtual learning context. Another important aspect which needs to be considered when designing a mobile system is a cultural context of use. We present the results of a mobile commerce expert survey, carried out by Institute for Advanced Management Systems Research (IAMSR) in five different countries, which suggests that cultural differences in usage behaviour characterise the potential success of mobile learning applications. The respondents from Finland and Honk Kong judged differently their perceptions of mobile learning, having their origins in different cultural contexts and well-defined educational systems.

The overlapping of contexts opens up a variety of different features and attributes that influences the correct definition of the user requirements and appropriate design of the overall mobile system.

4. Innovation with Voice Technology

The sharing of extensive information within a non-specified time frame does not require the co-presence and co-location between the sender and receiver. Using voice technology to provide a rich media content for the user solves the current limitations of input and output mechanisms of mobile devices. Moreover it is an innovative solution in terms of mobility and contextual learning.

The main results of the study could be translated into a general prototype of mobile system for learning Finnish language – as per Figure 1 below.

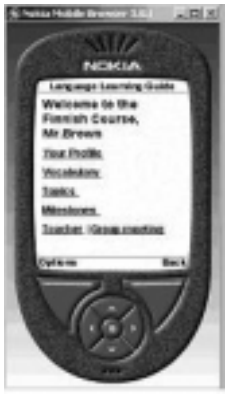

Figure 1 – Screenshot of the service interface (Nokia 7650 mobile device)

The system above has a multilingual content, but the information used is in a single language specified by the user when subscribing to the profile. Through mobile headphones a 'Language Learning Guide' is able to explain the main grammar rules within the vocabulary section, in order to introduce each of the contextual topics according to the personal profile that each user subscribes to in advance; push technology enables the user to post the most recent news in a teacher's and group sections, where SMS alerts are expected to be used for retrieving problematic or time-critical information.

In an ideal case, the user may freely move within the different environments in accordance to the context of the selected topic, and listen to the correct pronunciation of the language through his/her personal earphones. An implementation of such a mobile system, designed to meet the particular needs of leisure students, requires further research before a freedom of learning can be realised.

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Designing for learning or designing for fun? Setting usability guidelines for mobile educational games

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Abstract

While this paper looks at the definitions of heuristics and usability as they apply to digital games, its primary focus is expanding the usability dialog into the arena of mobile educational games. It seeks to define the differences between conventional game design and educational game design and to answer the question of whether it is necessary to modify existing game usability criteria when designing educational games for mobile devices.

Keywords: mobile educational games, mobile learning, games, heuristics, usability, learning, education, motivation

Usability guidelines for mobile educational games

This paper attempts to outline and evaluate the game industry's approach to usability testing. It considers the potential application and appropriateness of industry practice to the development of mobile educational games and, in order to account for the differences between conventional game design and mobile game design, it argues for an expansion to the definition of game heuristics.

The development of a set of educational game heuristics, or usability guidelines, is a useful undertaking not only because it serves to create a guide for the investigation of usability issues, but also because, once identified, game heuristics can help developers avoid usability problems in the first place.

Heuristics is grounded in a process of inductive reasoning. Heuristic principles are developed through problem solving—situations are examined, experiences are drawn on, and usable solutions are uncovered through trial and error. Usability, therefore, is, in a sense, the extent to which heuristics can successfully operate.

Heuristic evaluation—traditionally, evaluation in which a small team of independent evaluators compare user interfaces with a set of usability guidelines, the "heuristics"—has been recognised as an effective method for the formative evaluation of educational software (Quinn, 1996; Squires & Preece, 1999; Albion 1999). Heuristic evaluation using six evaluators uncovers 75 percent of usability problems (Nielsen, 1994) and is considered a cost-effective method of evaluation that yields reliable results for minimum investment (Quinn, 1996).

But, while heuristics has gained some attention as a beneficial tool in the educational software arena for examining user interfaces, usability, in general, is still a relatively foreign concept in the game development community (Federoff, 2002). Furthermore, a comprehensive list of heuristics dealing with the usability of digital educational games, not to mention those available on mobile platforms, is virtually nonexistent.

Recent discussions of game heuristics have made some useful connections between Nielsen's and Malone's heuristics, and Csikszentmihalyi's flow theory, and conventional game development theory and practice (Federoff, 2002; Mayra 2002). This paper expands the usability dialog, beginning where these discussions have left off, and draws on interviews with educational game developers, game design theory, and educational software design guides to compile a list of usability guidelines intended to be useful for the development and evaluation of mobile educational games. Within the paper, we will look at the tensions that arise when curriculum is introduced into conventional gaming practice and discuss the implications these tensions have for educational games. Further, we will contextualise the guidelines by providing a practical account of how key usability considerations can be used in the analysis of both conventional and mobile educational games.

It has become increasingly apparent that educational games succeed when the fine balance between designing for function and performance (learning), and designing for player pleasure (fun) is attained. What makes an effective educational game, whether — and how — curriculum should be incorporated, and what aspects of a game should be evaluated are fundamental questions that need to be addressed by educationalists using games in learning situations. Setting usability guidelines is an important first step in this process.

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Mobile Learning as a Tool for Inclusive Lifelong Learning

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Abstract

This paper and presentation describes Ufi's purpose and objectives in developing an M-learning capability; the work we have done so far; and how we propose to test the applicability of M-learning to an inclusion agenda. It discusses the need for a cautious approach to the assumptions and claims about mobile technologies and their users. The work carried out already on feasibility are placed in the context of a managed approach to ICT architecture investment and development. Finally it describes our pilot and evaluation based approach aimed at proving feasibility, testing assumptions, and identifying delivery options.

Keywords: SFL (Skills for Life), Inclusion, Mobile Technology, ICT architecture, Lifelong learning, feasibility, evaluation, assumptions

1. Introduction

1.1. Objectives

Ufi's remit is to extend the lifelong learning habit. The aim of the work we are doing is to:

- establish technical feasibility;
- identify learning contexts and preferences;
- explore how to use mobile technologies to support lifelong learning;
- identify the means and methods for delivering m-learning in a commercially sustainable way.

The focus of our work will be on Skills for Life content, and will include a games perspective as part of the engagement objective.

1.2. Starting Assumptions

Our short intensive experience in e-learning have demonstrated two things. First using technology to deliver learning opportunities is a hugely effective way of engaging non participant, excluded populations. Second, this is new territory. Assumptions and claims must be tested before risking significant investment. Our starting position is:

- mobile devices are popular within our inclusion target groups. They are more likely to encourage a positive response than unfamiliar desktop technologies;
- mobile devices will have the capability of delivering high quality, multi-media content at affordable prices within the next two years;
- e-learning content will not automatically translate from a desktop to a mobile delivery medium. It will lack functionality and the learning experience will not be suitable for a mobile context;
- there will be surprises. All assumptions, including those above, need to be treated with appropriate caution.

However, we need to be brave and innovative. There are always sound reasons for not doing new things, but opportunities are not realised through inertia.

2. Mobile Learning Projects

In order to make realistic decisions about what we can achieve and the investment needed we must: develop mobile capability, evaluate the mobile and learning experience, and implement an m-learning offering within the **learndirect** service.

2.1. Mobile capability

Ufi's ICT strategy is to build a multi channel architecture. This includes hardware, backend systems, development tools and methods, and standards. Our approach is:

- establish feasibility;
- build the architecture model;
- demonstrator pilots to identify issues and develop knowledge and awareness internally.

We built simple demonstrators of **learndirect** content on a range of mobile technologies. We are now building mobile capability into our ICT architecture.

2.2. The mobile experience

Activities aimed at developing our understanding of mobile users learning behaviour and preferences are : involvement in the MOBIlearn project where we are responsible for gathering content and conducting evaluations; and working with the Institute of Education to develop an evaluation regime which will operate within a mobile context.

2.3. Implementation

By the end of this feasibility and evaluation process Ufi will have:

- proven technology and methods for delivering content through mobile technologies;
- a reliable indication of the potential of mobile technologies to further our inclusion objectives;
- a knowledge of what content is best suited to meet those objectives;
- a route for turning this knowledge into an effective, and commercially affordable, mobile learning service.

This activity will enable Ufi to assess and respond to the wider opportunities for m-learning, supported by greater knowledge of mobile learning and the technological capability to deliver that content.

Text Messaging in Practice

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Abstract

Further Education (FE) tutors who are interested in the practical application of text messaging to learning and communications will be interested in the work of these two practitioners who actively encourage its use with students.

Students appear to appreciate the additional communication channel with their tutor that text messaging opens up. However, experiments with texting students formative assessment questions produced some interesting results and some unforeseen problems. Feedback from the students will help to inform our approach in designing future SMS quizzes.

Keywords: FE, pedagogy, game, ambient learning, communication skills

1. The basic technicalities

It is generally accepted that young people in the UK are hooked on text messaging (BBC, 2001a). The rise in the use of text messaging was partly due to the perception that it is cheaper to text than to make a phone call on the phone. Students were also hooked on this form of asynchronous communication (BBC, 2001b). Having sent a text message, you could anticipate the reply and look forward to it popping up on your phone at any time. This was somehow more special than just talking to someone at the end of the phoneline.

Teachers are trying to discourage the presence of mobile phones in class because too many students are being distracted by incoming text from boyfriends/girlfriends instead of concentrating on their lessons (BBC, 2001c). The annoying ringtones adopted by some users set at the loudest volume possible for their phones to emit is another major disruption to the class. Students sometimes even leave the lesson to answer a call.

But, do we fight this trend or should we work with it and embrace it to our own advantage? History has shown that resistance is futile. You can never turn back the tide of technology, especially for communication (BBC, 2001a).

There is no doubt that the use of text messaging can improve our communications, not just with hard to reach students, but also with their parents (BBCi, 2002).

This workshop aims to showcase examples of text messaging in practice by exploring cases available on websites as well as the experience of the two presenters.

There will be a demonstration on how to send bulk messages to students through a text messaging web site, and how tutors would access the replies.

There will be an overview of the various ways in which an institution could go about implementing text messaging facilities for the tutors, from buying their own servers and software to using a commercial supplier (Kennedy, 2002). The pros and cons of this will be discussed.

2. Lesson plans and pedagogy

David Sugden will discuss the merits of using text messaging as a means of communicating with the students. This has increased their use of email and improved overall communication. Its use with formerly special needs students has increased their confidence in their communication skills. There is evidence from other sources that it improves student motivation and organisation (Mayer, 2002).

The downside (depending on how you look at it) of all this increased communication is an evolution of the written word to make it fit for purpose. Text messages are characteristically only 160 characters long. Spelling and grammar have had to evolve to accommodate the constraints of the medium (BBCi, 2001).

Now, that language is set to exist in its own right with the encouragement of phone operators like Orange, who have recently announced the winner of their text poetry competition (The Guardian, 2002). This is an example on how the technology can be embraced or harnessed for our own purposes.

Lilian Kennedy has worked with tutors to incorporate learning games into the scheme of work. Additionally, text messaging is used to communicate with NVQ students to increase retention and improve motivation. The results of these experiments with students will be discussed.

Examples will include the use of text messaging in education to aid revision (BBCi, 2002) and as an enticement to access further information on a website.

There will be a demonstration of how to send bulk text messages to students and what to look out for when deciding on a provider of the service. We will look at how a tutor receives replies and how these can be used to assess student learning (Kennedy, 2002).

Even when you think you are using text messaging for sound pedagogic reasons, it can backfire on you. Students in Arts and Media were reminded of a tutorial session through text messaging one week and not the next. They used this as an excuse for forgetting the second tutorial, complaining that the tutor had not sent them a text to remind them. Other pitfalls of using text messaging will be discussed to prepare those embarking on their own experiments with SMS and students (BBC, 2001b).

There will be an opportunity to brainstorm for further ways to incorporate the use of SMS into lessons, and everyone attending should come away with lots of ideas to try out.

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A context awareness architecture for facilitating mobile learning

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Abstract

The MOBIlearn architecture (EU IST-2001-37187) supports a wide range of services and applications for learners using mobile computing devices such as phones, PDAs, and laptops. The display limitations of these devices mean that it is crucial to deliver the right content at the right time. One way of doing this is to use contextual information to derive content that is relevant to what the user is doing, as well as where and how they are doing it. Here we present an architecture for a context awareness subsystem to be implemented within the MOBIlearn achitecture.

Keywords: context awareness, elearning, mobile computing, mlearning

1. Mlearning in MOBIlearn

The MOBIlearn project focuses on providing a generic, reusable architecture to support learning on mobile devices. The display capabilities of these devices are limited when compared to desktop alternatives, and so provisions must be made for tailoring content and options. Context awareness continues to be a highly desirable feature for mobile computing devices (for a recent review see Chen and Kotz, 2000), and in MOBIlearn contextual information is used to provide filtered content appropriate to users' goals, settings, and resources. For our purposes, 'content' includes not only actual learning content but also applicable services (such as collaboration tools) and options (such as interaction preferences).

1.1. Context awareness for mlearning

Context awareness in MOBIlearn is implemented as a *context awareness subsystem* (CAS) that selects content reflecting the requirements of a specific individual and then presents this content with minimal user effort.

Two potential advantages of this system over conventional approaches are:

1) The need to define search terms and perform content search is reduced
2) The system is usable whilst the person is engaged in other activity

The utility of this approach has already been demonstrated by Bristow *et al* (2002) who showed that simple sensor input indicating user status could provide effective context-dependent content management.

For example, a user walking past the library sees a link to the library homepage on a head-up display, and if they stand still they are presented with a brief version of the page itself. If they then sit down, they see the page in full.

In broad terms, the aim of the CAS is to provide a means by which users of mobile devices can maintain their attention on the world around or the task at hand, whilst providing timely and effective computer support. The CAS provides a mechanism by which relevant content can be selected, filtered, and passed to the user. Users can then either look at the content or select other content from the filtered set.

2. Architecture

The CAS comprises a central *context engine* using a set of *context features* – obtained from real-world data such as location, activity, and device capabilities – to derive a c*ontext state*. This context state is used to perform *exclusion* of any unsuitable content (e.g. high resolution web pages that cannot be displayed on a PDA) and then *ranking* of the remaining content to determine the best *n* options.

Content is to be drawn from a repository of learning objects, appropriately marked-up for content using XML or similar and an agreed mark-up standard such as the IEEE learning objects meta-data schema (IEEE Standards Department, 2002).

3. Current status and next steps

The CAS is currently implemented as a pre-prototype demonstrator with a CLIPS production system as the context engine linked to a user/debugging interface in Tcl/Tk.

The next steps for the MOBIlearn context awareness subsystem involve using sensors that can provide real-world context features on a mobile device such as a tablet PC or iPaq. We also intend to explore alternative implementation methods such as agent-based systems to engender a flexible, reusable context awareness subsystem.

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SMILE: The Creation Of Space For Interaction Through Blended Digital Technology

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Abstract

Interactive Learning Environments at Sussex University is a course in which students are given mobile devices (XDAs) with PDA functionality and full Internet access for the duration of the term. They are challenged to design and evaluate learning experiences, both running and evaluating learning sessions that involve a blend of technologies. Data on technology usage was collected via backups, e-mail and web-site logging as well as video and still photography of student-led sessions. Initial analysis indicates that large amounts of technical support, solid pedagogical underpinning and a flexible approach to both delivery context and medium are essential.

Keywords: XDA, Pedagogy, conversational framework

1. Creating Learning Environments

SMILE (Sussex Mobile Interactive Learning Environment) is an initiative at the University of Sussex to introduce mobile wireless devices (XDAs) into the curriculum. Eighteen mobile devices, with PDA functionality and full Internet access, were used as part of a re-designed course on Interactive Learning Environments. Students were allocated devices for the term and were expected to use them 'as their own'. Students were set the challenge of designing and evaluating learning experiences using a blend of technologies. Key findings from this project focus on the use a variety of technologies to create a coherent interface to social and cognitive interaction possibilities.

2 Pedagogical Framework

Initial results on the use of mobile technology, such as those reported in Mlearn 2001, 2002 and in the 2002 IEEE workshop (Milrad, Hopper and Kinshuk, 2002) have been encouraging. Researchers have suggested, for example, that mobile learning enhances autonomous and collaborative learning (Cereijo Roibás and Sánchez, 2002), and that it can be applied to a wide age range of students (Inkpen, 2000; Perlin and Fox, 1993; Sharples, Corlett and Westmancott, 2002 and Soloway, Norris, Blumenfield, Fishman, Krajcik and Marx, 2001).

However, there are still questions about the nature of the pedagogical framework that might effectively ground mobile learning experiences. At Sussex we are placing emphasis upon communication between individual learners using a blend of novel and traditional technologies through which learners and tutors can interact. We are exploring the applicability of Laurillard's conversational framework (Laurillard, 2001) as a foundation for the design of our interactive learning environment; an approach already seen as potentially useful to mobile learning technology development (Sharples, 2003). The course content material is available through lecture material delivered in both face-to-face sessions and on-line, multiple

narrative media including paper and software, and through small group collaborations with face-to-face meetings and on-line discussions. Students are encouraged to use standard desktop computing as well as the full functionality of their mobile devices. Their brief is to use the most suitable technology to both study as individuals and to collaborate in the design and evaluation of learning experiences for their peers. Our brief as tutors has been to introduce and maintain the technology infrastructure in such a way that it enables interactivity and learning without becoming the central focus of the activity

3 Evaluation

Evaluation will be through multiple data sources including video and still photography of face-to-face sessions. In addition to this, email traffic between those involved on the course has been monitored, with a view to identifying patterns in email activity arising from the use of the devices. Access to the course web-site has also been logged for each user. Of particular interest is the way in which the material on the web-site was accessed during the on-line lecture. This information is not only useful as research data but also provides empirical support for student evaluation as well as enabling a high degree of tracking of both learner performance and the learning process.

Initial analysis indicates that (i) large amounts of time and skilled effort were needed to install and maintain the mobile infrastructure, (ii) the effective collaborative use of mobile technology depends on a prior underpinning of face-to-face contact (between tutors, between students and between students and tutors) and (iii) sound pedagogy. We will describe the structure of the course, the technology, data collection and analysis methodologies and highlight the key emergent findings from the project. We will indicate the ways in which a conversational framework can be adapted to inform the design of multi-technology learning experiences.

Figure 1. XDA device used on the course

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GCSE Revision with Mobile Phones
Developing a Java-based Quiz Game

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Abstract

Ash Luecker are currently developing a revision aid for GCSE students, using the format of a multiple choice quiz game. This project tries to engage the vast number of teenage mobile phone users in the learning process by offering a fun and accessible application to download to a range of popular phones. Programmed using the J2ME (Java) platform, this tool will be available to students from April 2003. In this session we will explore both the technological and design issues involved in developing Java games for low-end mobile phones as well as examine the opportunities for learning on this platform.

Keywords: Mobile phones, Java, games, curriculum revision

1. Why mobile learning games?

The proliferation of mobile phones amongst children in their teens has risen immensely in the last few years. Furthermore, according to the International Telecommunications Union's report on mobile Internet access (Srivastava et al, 2002), teenagers appear to be the most avid users of the mobile Internet. Whilst most of the time online is spent downloading ring tones, desktop pictures and arcade games, a major broadcaster in the UK has recently used the wide availability and community-building properties of mobiles for educational purposes. As part of the revision process for exams, SMS messages were sent out which tested pupils' knowledge on key GCSE subjects. This method of revision proved to be highly successful. Following on from that particular example, the next logical step may be to combine the rise of mobile gaming with wider pedagogical principles.

2. The technological and commercial context

Games applications developed using the Java programming language have become commonplace in the mobile communications arena in 2003. More and more Java-enabled phones are being released and sold, which have varying capacity in terms of memory and display size. Nokia, the world's biggest manufacturer of mobile phones, now has about 20 different models capable of running Java applications on sale worldwide. These range from the bottom-of-the-range models explicitly aimed at the younger market (3410, 3510i) to sophisticated PDA replacements like the Nokia 7650. Other manufacturers like Siemens, Sony Ericsson and Motorola have adopted the standard and are building Java into their products. Java is an open standard and very powerful programming environment, with a wealth of experience available from its use on the Internet since the mid-1990s.

3. Basic development issues

Producing a stimulating quiz game for a small screen device like the Nokia 3410 – the most popular entry-level phone bought predominantly by teenagers – involves a whole

range of issues for the developer, the most important of which we will be addressing in this session. With a memory allocation of around 50 KB per application, graphics have to be used very sparingly and the amount of data for editorial content is limited. The monochrome screen has dimensions of 96 by 65 pixels, roughly a 10th of the available screen 'real estate' of the average PC Internet browser window. The processor speed of the 3410 phone is also negligible in modern computing terms. Although Java is a very powerful language, these limitations can hamper the development of a meaningful learning experience and need to be addressed in a creative and thoughtful way.

Ash Luecker approach this project with considerable experience in designing and developing learning games. Members of the team will be available to answer questions on technology issues, the commercial mobile gaming market and possibilities for mobile learning content.

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Learning tools for Java enabled phones. An application for Actuarial studies

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Abstract

The aim of this paper is to explore the possibilities of Java midlets (small applications that can be stored in a mobile phone) as learning tools in higher education, via an experience we are developing for the Actuarial degree of Málaga University.

Keywords: midlets, mlearning, higher education

1. Introduction

Mobile phone devices are becoming tremendously popular within the communities of university students in our country, Spain, as well as in the countries of our near environment. Although the main use of these devices is for social purposes, far less attention has been given to their use as a support for learning tools. In an previous paper, Mayorga-Toledano (2002), we study the possibilities of integrating in higher education strategies the use of interactive tests designed for WAP phones. In this paper we explore the educative use of Java midlets for two courses in the Actuarial degree of Málaga University.

2. An educative application of Java midlets in higher education

Java technologies for mobile phones are opening new opportunities for the development of educative applications in the field of *mlearning*. Java midlets are small applications that can be stored in the mobile phone, and show two important advantages with respect to WAP applications, which we explore in an earlier paper: (i) once the midlet is stored, it can be used offline, without connection costs, and (ii) the popularity of Java games makes this technology very familiar to the students. The former can alleviate the problems noticed by Cher Ping and Chwee Beng (2002) or Loh (2000) when using mobile devices for m-learning through the WAP protocol.

We are developing educative midlets for two courses in the Actuarial degree of Málaga University: Banking, Insurance and Securities Market Law (B.I.S.M.L.), and Actuarial Statistics (AcStat). These midlets are integrated into a blended learning strategy, that includes virtual (web based activities and midlets) and non virtual elements.

Figure 1. Main screen of the midlet

The midlets we are developing are deliberately simple and lightweight. They share a similar structure and interface, but their contents are specific for the two courses.

A recent study about e-learning that combines web and mobile devices, Ring (2001), states that the latter are best used to support particular aspects of learning, like alerts, remainders, multiple choices tests, or glossaries. The contents of our midlets are very similar to the ones mentioned in that study.

The midlet for the Law course includes a Glossary, a Calendar and interactive tests (see Figure 1). The main features of the tests are the following: (i) reduced number of questions in every test, (ii) questions and answers are expressed in a deliberately simple, although strictly correct, language, (iii) the answers are easily selected with the phone keys, and (iv) immediate feedback, the user knows in real time if his/her choice is correct.

Figure 2. Example of a test

The calendar module includes very useful information for the students, like the dates of exams, the Internet address of the course for additional on line resources, calendar of classes, etc., (Figure 2).

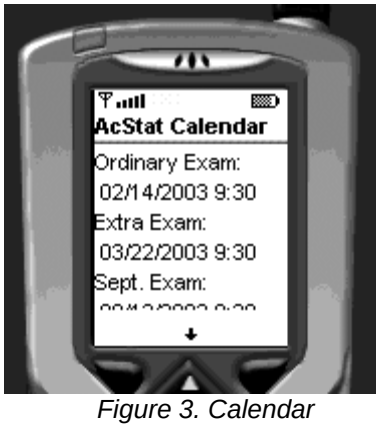

Figure 3. Calendar

The AcStat midlet has the same modules as the one of the Banking, Insurance and Securities Market Law one, but it also includes a list of the main mathematical functions used in the course, classified by lessons.

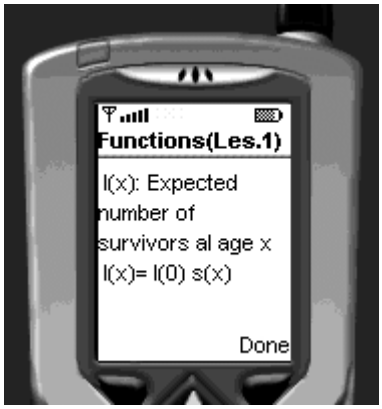

Figure 4. Example of the functions module

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Learning "2go": Making reality of the scenarios?

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Abstract

This paper discusses the role of mobile and handheld technologies in education, exploring in which arenas handhelds are being used, and how and why are they used. Does access to the technology make technology an integral part of daily life, and learning? How is it changing classroom culture? The paper draws on preliminary findings from a pilot study at a 6th grade class, a University of Michigan - Hi-CE[1] project school. This study gives indications of what can be achieved with handheld technology in education - a transition from disruptive technology to useful and enhancing educational technology. The study focuses on the school arena as it been the focus of much debate with regards to educational technology.

Keywords: Handhelds, learning culture, integral to daily learning, disruptive technology

1. Possibilities

Mobile and handheld computers offer new possibilities in education. Computer technology has been criticised for being segregated from ongoing aspects of children's lives, being relegated to the "computer rooms" in schools, and making PCs anything but personal. It has, however, been argued that flexible access to handheld technology will provide tools to help children construct knowledge throughout their daily activities, making such technology an integral part of daily learning (Soloway 2001).

2. Mobile Learning Technologies in Education

There have been many scenarios describing the use of handheld technology both in an out of the classroom. The difference between the learning that goes on in school and out has often been addressed (Lave & Wenger 1991, Resnick 1987). The National Council of Research Report *How People Learn* (Bransford et al, 2000) emphasises that bringing student and teachers in contact with the broader community can enhance their learning, while the OECD report "Learning to Change: ICT in Schools" illustrates that ICT has established a new complementarity between formal learning in school and informal learning outside. Learning has also been described as being "locked" in the schools' formal setting (Somekh 2002).

Miettinen (1999) has pointed out that school learning is characterised by memorisation and reproduction of school texts whereby teacher talk dominates, and students' activity is largely limited to answering questions formulated by the teacher. In such a learning culture, if one draws on examples of mobile telephony in classrooms, one can say that handheld devices can be regarded as an "intruder" in the learning

[1] Center for Highly Interactive Computers in Education at the University of Michigan, USA, http://www.handheld.hice-dev.org/

culture, a disturbance (Mifsud 2002), and as such, a *disruptive technology*.

3. From Scenario to Reality?

The aim of the pilot study was to find out in which arenas handhelds are used, how and why are they used? In what role can handhelds play? Inkpen (1999) points out that handheld computer technology for children is not a new idea.

The pupils in this study are twelve years old (sixth grade, 24 students, using Palm™ III, at an Intermediate School in Michigan; USA). The class is a Hi-CE project class. The teacher has been using the handhelds in teaching for three years; the pupils started using their handhelds at the beginning of the school year in September 2002. Classroom observations and interviews with pupils and teachers (informal interviews) were undertaken. The pupils were also asked to draw a concept-map[2] depicting where, what and why they used their handheld computer.

Inkpen (1999) points out that one of the main advantages of handheld devices is their ease of integration into a child's world and that the products themselves become a part of the children's culture. *All* the pupils in the study showed that they used the handheld in arenas other than school, such as home and in the car, with games hitting most scores, in situations which the pupils described as potentially "boring". Students also reported using their handheld on their way to school, both for finishing assignments and games, especially in the case where the students lived far away from the school. In this particular classroom handhelds appeared to be an integral part of the curriculum. By integral I mean used when *needed* and in *context*.

It has been suggested that access *on its own* will not fulfil the promise which many believe lies in the use of ICT in school (Bransford et al 2000). The teacher in the study pointed out that she did not fully integrate until she became more familiar with the many ways to use the Palm. "It just sort of came natural as I became more knowledgeable…" She did not always decide which technology should be used, although she did make suggestions at times. The students could decide how to solve the task at hand, using whatever they decided was most appropriate, from role-play to animation tools. The teacher also reported "letting go of some control", which indicates of a change in the classroom culture. This research indicates that handhelds can transition from disruptive to useful, enhancing technology as an integral part of school and life.

[2]Concept-mapping was used as a means of expressing ideas quickly, and to provide evidence from each of the pupils. According to the *ImpaCT2* study, concept maps "consist of putting words that represent concepts in boxes and linking these by means of words or phrases, so that the connections can be read". http://www.becta.org.uk/research/reports/docs/ImpaCT2_strand_2_report.pdf

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Exploring the potential of a game implementation for m-Portal

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Abstract

m-Portal is Ultralab's contribution to m-Learning, a 3-year pan-European project funded under the EU IST Programme. m-Learning addresses literacy and numeracy skills needs of disadvantaged young adults.

m-Portal forms the interface layer to the m-Learning system: a learner management system, a virtual tutor and skills-based learning materials. Our aim is a user-friendly portal layer that is powerful, empowering and engages the learner.

Findings from research with target audiences led us to investigate the outreach potential and possible learning gains of mobile games. There are strong indications that a role-play game implementation of m-Portal would be a valuable future development.

Keywords: mobile role-play games, learning

1 Introduction

m-Portal is Ultralab's contribution to *m-Learning*, a 3-year pan-European project funded by the European Commission under the IST Programme and led by the UK's Learning and Skills Development Agency (LSDA). *m-Learning* addresses the basic literacy and numeracy skills needs of disadvantaged young adults who may lack access to a computer – but do use a mobile phone.

m-Portal forms the interface layer to the m-Learning system with tools that allow learners to create their own microportal and pages. The system as a whole also includes a learner management system, a virtual tutor and literacy and numeracy based learning materials and themes.

A key benefit of m-learning is its potential for making learning opportunities available anywhere, anytime. Ultralab seeks to exploit this benefit via a user-friendly portal layer that is powerful, empowering and encourages active participation on the part of the learner.

2 Developers' Challenges

Challenges faced by the developers include:

- What kinds of interface and functionality can effectively engage target audiences and raise their awareness of learning needs and opportunities?
- How can *m-Portal* be a 'liberating structure' (de Bono, 1992) that can promote attitudinal change and qualities such as: adaptability, self-confidence, curiosity, creativity – qualities that may be lacking owing to exposure to curriculum approach that has become 'far too mechanistic' (Barlex, 2003).

3 Our Field Research: Games Culture

Our field research strongly indicated that a games implementation for mPortal would be worth exploring. Computer games engage users in spatial learning and cognitive processing and promote computer literacy

(McClurg & Chaille, 1987, Pillay et al, 1999), whereby decision-complexity is more important than state-space complexity as a determining factor in solving a game (Jap van den Herik *et al*, 2002) – highly relevant to mobile environments.

We set out to investigate the outreach potential of mobile games and to explore the possible learning gains. We sought from target audiences knowledge and insights concerning:

- the influence that games may have on the young adults' perceptions of a mobile device in terms of value and attractiveness;
- factors that interface between the game and the user with reference to the particular device;
- 'learnability': games are normally self-contained; do we break necessary rules by making games that link to other material?
- the signs that youngsters will spend ages learning rules of games when they don't seem to want to spend that time learning other things.

4 Interim Findings

This paper reports interim findings from the Ultralab games-oriented research; these support the authors' view that a role-play game implementation of *m-Portal* would be a valuable future development.

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Mobile Learning as a Service Offering with Near-Term Technologies

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Abstract

This work, the result of a master's project in interaction design, presents a service model and some new component concepts for lifelong mobile learning, assuming certain near-future technologies. Several prototypes of service components were developed and informally tested.

Keywords: mobile learning, service design

1. The benefits of m-learning as a service

M-learning efforts in industry and academia over the past years have progressed with a business model of pay-per-device or pay-per-lesson. Rethinking these in terms of a long-term service builds on these successes while adding additional opportunities to use multiple channels, technology market penetration, and learner prompting.

1.1. Multiple channels

Rather than trying to force one device to become the perfect learning tool, the long-term relationship implied by subscription to a service enables learners to use multiple channels, i.e. their mobile device, the web, a physical location like a classroom or office, or even the post. This enables the service designers to place components in the environment where they work best.

1.2. Technology market penetration

Early explorations in m-learning, such as those conducted in 2001 by Melissa Regan (Regan, 2001) at the Stanford Learning Lab, indicate that modern cell phone displays and networks are not engaging enough for mobile learning to be effective. Rather than bemoan the circumstance and hope for improvement, a service model actively furthers market penetration. One of the obstacles is that the perceived benefits of upgrading do not outweigh the cost. A service model provides customers with a clear value proposition, and since hardware costs can be distributed over the life of the service, perceived price decreases (Rifkin, 2001).

1.3. Learner Prompting

From research of learning and attention, we can assume that the efficacy of new devices suffers as they fade from learners' attentions. (Davachi, Maril and Wagner, 2001). We can overcome the effect of fading by incorporating learner prompting into our designs. Device-structured models do not facilitate prompting without being perceived as intrusion. Framed within a service, however, prompts are welcomed as a helpful aid to learning, and can encourage continued use of the service.

2. Design process

Three personas were developed to represent likely potential users of a service for mobile lifelong learning, based on research into current learning service demographics.

Research into learning theories, with a mild emphasis on situated learning theory (Lave, 1991), was used to develop a list of learner needs. These needs were graphed against three different learning situations: mobile, desktop, and offline. This grid provided an

opportunity map for service concepts. Where services did not already exist to fill an intersection, new components were developed. These components were illustrated using the personas and scenarios.

A map of each stakeholder's relationship to the service, also known as a *service ecology,* was developed to illustrate the value exchange of the proposed system.

An umbrella service was conceived and developed, under which clients could customize which of the components they would like to use.

Three of the components were prototyped and informally tested in an academic setting.

3. Component testing

Experience prototypes of three components for the proposed service were built to test: SMS reference, Body Learning, and Location Information.

3.1. SMS Reference

In this service, users were given a cell phone and access to a service number for two weeks. During this time, they could send SMS requests to the service number for automated dictionary, reverse-dictionary, thesaurus, and translation lookups. Responses were sent via SMS back to them. They were also given 4 opportunities to use the built-in camera to photograph something in their environment and ask free-form questions about it to a human operator, who would send their research results to the learner's cell phone via SMS or email.

3.2. Body Learning

An iPAQ PDA augmented with an accelerometer allows for the device to detect its tilt. Eventually this could be used for motion tracking for certain types of skill learning. In an early exploration of this potential was made by building a live stargazer module, which matched the tilt of the PDA against a star map, enabling direct comparison with the night sky. Users could adjust the opacity of the constellation maps to test their memory, and use the star map to browse individual features of the constellations.

3.3. Genius Loci

As location-based information begins to pile up and overlap, personalized filtering the information for topics of interest becomes paramount (Sheth, 1994). In this prototype, information based information was densely populated throughout a building. Learners built interest profiles using simple questionnaires and preference wizards, and these profiles filtered the information for them over the course of a week.

4. Testing Results

At the time of this abstract, the prototypes were in production. Qualitative results of the prototypes will be included in the presentation if accepted.

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Motivation in mobile modern foreign language learning

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Abstract

Few people want to sit down and learn a foreign language. Mobile technologies may encourage them - but how? Being able to test yourself on some irregular verbs while on a bus may help pass the time. But challenging someone else - maybe beating them and earning some virtual currency - could be fun. Especially if you could then earn even more by explaining where they went wrong. The BBC is starting to help mobile learners but - based on previous experience - the way people learn may not correspond with current expectations.

Keywords: modern languages, English, motivation

1. Motivation and the learner

Motivation is seen by teachers and students alike as an important element in the success (or otherwise) of any attempt to learn a foreign language. Indeed, according to Dörnyei (2001), it is ...*one of the key learner factors that determine the rate and success of L2 attainment*. Most studies concentrate on success rather than its opposite - demotivation - although (Johnstone, 1999, pp146-147) an analysis of what stops people from continuing with their studies may be more useful for the materials developer.

Language learning is essentially a social activity (Warschauer, 1999, pp94-97). Within a school, it takes places in locations that serve now as analogies for virtual spaces. They include learning centres, classrooms and cafes. There is also a need for spaces for the non-motivated pupil. In language learning this may, according to Albero, develop in a virtual setting into a "language space" (espace langues). Current uses of new technologies, which have seen a shift from pure CALL (Computer Assisted Language Learning) to Network Based Language Learning, already include concepts such as tandem learning (Ushioda, 2000, pp121-128), which link motivation directly with another goal, autonomy.

2. Mobile delivery and motivation

What effect will mobile delivery have? For language learners, portability and immediacy may be more useful than localisation - although teachers experimenting with an earlier generation of technology, video, showed how apparently unimportant features such as slow motion could be used to teach the continuous form of the English verb. It is now possible (Stone, Briggs and Smith, 2002, pp147-151) to take the mobile phone user on a complex journey where a series of interactive SMS exchanges may be required to achieve completion of a task or goal - which could include collaborative tasks designed to require understanding of an element of a syllabus.

There is a question of whether existing task based/process language syllabuses will be sufficient to cover knowledge/competency in what is in effect a non-structured distance education environment. The past twenty years have seen "can do" statements (such as those found in the Council of Europe's European Language Portfolio) replacing definitions of language forms: an ability to use language is - arguably - as important as an ability to analyse it. Existing tools such as Computer Mediated

Communication and message boards are, as mentioned by Lewin and Donner, situated by learners within the speech - writing continuum, with texting combining the speech-like informality of e-mail with the ability to create closed codes accessible to others in a group.

The BBC is already using SMS in conjunction with English teaching radio programmes in Francophone Africa, and other projects are planned. SMS provides in some areas of the world (Rheingold, 2002, p158) a very cost-effective means of communication. Initial results will be discussed. Research will however be needed on various aspects of mobile learning models (Norbrook, 2001), including whether self-established small group activities - using the concept of the shared mobile - or individualised / joint activities such as quizzes provide the greater motivation for learners. An important element within any mobile learning environment will be the community, and it will important to see whether trust and reputation models play a role, with credit accumulating to members who support others.

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Fragmentation in mobile learning

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Abstract

Our research interest is targeted to learning situations, which are made reachable by bringing mobility to learning. Learning with mobile devices is a highly fragmented process and this should be taken into account in designing as well as in developing evaluation methods for m-learning materials and environments.

Fragmentation is understood as experience becoming fragmented when amount of incoming information and number of communication sources are increasing. This paper addresses this issue by describing a tentative list of components of m-learning, and by emphasising the need for viewpoints of learning as a fragmented process and user experiences as an overarching elements of m-learning.

Keywords: m-learning, fragmented learning process, evaluation

1. Introduction

A learner's own experiences and observations in authentic learning contexts are central topics as mobile learning is becoming more common. As a starting point for the study we see mobile devices as pervasive medium that can help to combine work, studying and leisure in a meaningful way (Ahonen, Joyce, Leino and Turunen, 2002). Thus we consider m-learning as a life-long activity that takes place in continually changing communities, mixes with everyday life, and requires a long-range use of mobile devices. It should also be seen as a life-wide and life-deep process (Drake, 1999) where people repeatedly enhance their knowledge and skills (Sharples, 2002; Sharples, 2000).

We see that m-learning emphasises informal learning process. However learning taking place in multiple situations may cause an increasingly fragmented learning process as some preliminary research results indicate (eg Regan, 2000).

2. Components of m-learning

In order to successfully study informal learning, research should focus on actual learning projects or deliberate learning activities (Livingstone, 2000). The following model of m-learning components has been developed especially to take notice of flexible (Collis and Moonen, 2001) and informal learning practices. The model will be utilised for developing evaluation methods for m-learning materials and environments. It also gives a pedagogical approach for building m-learning learner profiles, applications and materials.

1. Continuity and adaptability between learning contexts; how to support spontaneous learning?
2. Learning as a personal process; are the m-learning products taken personally?
3. Contextuality in learning; is the context of learning better recognised in learning process?
4. Accessibility; what is the adequate skill level for m-learning?
5. Support for time and learning management; how to support learner's self-monitoring and regulatory processes?
6. Flexible interaction; how to enhance communication between peer-learners?

3. The fragmented experience of m-learning

Four m-learning experts have evaluated this model. One important notion made by the expert was that fragmentation applied especially to the component of “continuity and adaptability”. The learning process is constructed from many separated phases. If the phases are contentually too fragmented they can disturb the learning process.

The viewpoint of fragmented learning process and user experience in m-learning also encompasses fields of usability and experience design to be able to control the facts that affect to the fragmenting. The final design solutions should take notice of the critical details of the m-learning application that contributes to the overall user experience. Experience is a dynamic, complex and subjective phenomenon that depends upon multiple attributes of design that are interpreted through filters of personal, social and cultural significance (Fulton Suri 2002).

4. Future work

The components of m-learning are operationalised into on-line self-rating questionnaires including items concerning fragmentation in learning. The questionnaire is adopted for two target groups representing Finnish comprehensive school students (N=90) and adult learners (N=100) who have real m-learning experiences. Explorative factor analysis will be conducted to find possible connections between fragmentation and other measured learning attributes. At the moment the questionnaire is validated, and it will be used in fall in a pre-post test research frame. Fragmentation is evaluated also by interviewing the teachers and making observations of the performed learning tasks.

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Tate Modern Multimedia Tour Pilots 2002-2003

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Abstract

This session will report and discuss the deployment of Multimedia Tour Systems by Tate Modern in 2002 and 2003, using handheld computers (PDAs) on a wireless network in the galleries. Developed in collaboration with Antenna Audio, these projects have piloted interactive, contextual educational content and applications for visitors. The information gathered to date is the first step to providing a blue-print that will help to inform handheld technologies for museums and other institutions in the coming years.

Keywords: Wireless, PDA, Interactive Learning, Access for Deaf People

1. Tate Modern Multimedia Tours

Audio guides have been part of the interpretation and education strategy since Tate Modern opened in May 2000. Having established a reputation for delivering excellent audio tours (with award winning tours for children and for the visually impaired), Tate Modern would like to remain at the cutting edge of educational technology by helping to shape a new generation of multimedia tours.

Preliminary research into multimedia saw Tate develop a Multimedia Tour Pilot in collaboration with Antenna Audio, which was tested in the galleries from July through September 2002. Tate and Antenna Audio are now collaborating on a second phase pilot in 2003 which will expand the wireless network and applications developed in 2002 to focus on interactive educational programmes and contextual learning for younger visitors, aged 16-25, to Tate Modern's permanent collection galleries.

1.1. Multimedia Tour Pilot 2002

In July 2002, Tate Modern, London launched a unique, interactive audio-visual tour of its galleries. Using the latest developments in wireless technologies and handheld computing, this three-month pilot project was the first of its kind in any museum in the world. The tour was sponsored by Bloomberg, and developed in association with Antenna Audio. The equipment used in the pilot was loaned by Hewlett Packard.

Unlike the existing audio tours currently used in UK museums, the Multimedia Tour allowed background information about the works on display to be provided to visitors in a variety of different media on a portable screen-based device. Visitors could see video and still images that gave additional context for the works on display, and could listen to an expert talk about details of a work, while the details were simultaneously highlighted on their screen. Interactive screens encouraged visitors to respond to the art on view, for instance by answering questions or by layering a collection of sound clips to create their own soundtrack for a work.

The location-sensitive wireless network meant that visitors no longer needed to spend time searching the multimedia tour to find the relevant information for a room, because the network pinpointed their exact location in the gallery and feeds the correct information to them at the right time. Because this information came from a central server, rather than being stored in the memory of the hand-held device, practically limitless content could be provided, and could easily be kept up-to-date. A further benefit of connecting the tour to a network is that visitors could request the central server to send additional information about the art they have seen to their home email address. It also meant that Tate could broadcast messages to users during the tour, and send automated alerts when the film or other programmed events were about to start.

1.2. Multimedia Tour Pilot 2003

Tate and Antenna Audio are now building on the results of the 2002 pilot to create a second stage pilot with a view to producing a product that can be rolled out for full public use in the galleries over an extended period of time. The information gathered to date is the first step to providing a blue-print that will help to inform handheld technologies for museums and other institutions in the coming years. The development of this second stage project includes a particular focus on the interactive potential of the devices. The areas indicated below will be key areas of research:

- The facility for visitors to communicate directly with the gallery eg: posing and answering questions
- The facility for visitors to page each other in peer-to-peer communication
- The facility for visitors to access online databases while in the gallery, and to e-mail themselves further information on objects and artists on the tour in order to follow up on artists and artworks of interest through the Tate website.
- Improvement of processing speeds, tour interface, operating system stability, and location-sensitive content delivery systems.

In terms of content, the 2002 pilot tour explored a variety of contrasting approaches to delivering information about the art on display. We now want to pinpoint the most successful methods and refine them to create specifically tailored multimedia learning models for visitors.

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Figure 1 A visitor to Tate Modern learns about Duchamp's Fountain during the 2002 Multimedia Tour Pilot.

Usability and Accessibility of PDAs in Education

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Abstract

PDAs are a reasonably new and emerging technology that is rapidly evolving, though their use as an educational tool or assistive technology has only just started. The paper looks at the accessibility and usability of the actual devices (from the physical characteristics to the graphical user interface and device controls or input methods). It also suggests possible uses for them as an assistive technology.

Keywords: Accessibility, Usability, PDA, Education

1. Introduction

Those providing PDAs to students within education have a duty "to make reasonable adjustments to ensure that people who are disabled are not put at a substantial disadvantage compared to people who are not disabled in accessing further, higher and Local Education Authority-secured education." (SENDA, 2002)

Therefore consideration must be made for students who have a disability or specific learning difficulty.

This paper investigates the different issues for a whole range of disabilities and looks at different strategies, software or hardware solutions to inaccessibility problems.

2. Different Perspectives

The paper looks at the accessibility and usability of a PDA from two perspectives:

2.1. The Accessibility and Usability of the PDA Device

For example a student with a severe visual impairment may find it difficult to read the comparatively small text on a PDA display and find the information it presents inaccessible thus making the device unusable in its original form.

2.2. The Use of a PDA as an Assistive Technology

For example a student with a time management and organisational difficulty might benefit from the diary and calendar functions native to most PDAs; thereby providing functional technology assistance to someone with a disability.

3. PDA Accessibility

These two possible strands of a PDAs functionality are not mutually exclusive since it is necessary that a PDA is functionally accessible to be of use as an assistive technology.

The paper will cover:

- Changes to the user interface
- Entering text into a PDA.
- Using a PDA to support reading or referencing.
- Using a PDA to support writing.
- Using a PDA for time management and organisation.

4. Final Thoughts

The development of PDAs has been so fast since their evolution beyond PIM systems and little analysis has been made of the functionality of some PDAs for disabled people.

Though much advancement has been made on the accessibility of desktop computers with increasing amounts of assistive technology, the swift monthly development of new PDA models has meant little has been learnt from retrospective analysis.

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Evaluating a low specification wirelessly connected palm pilot as the means of supporting learning. A pilot study from the University of Bristol

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Abstract

This paper disseminates the findings of a pilot study into the use of wirelessly connected low specification palm pilots to deliver the equivalent learning materials as those provided through a virtual learning environment. The study is based on a sample of undergraduate students who are being taught Economics at the University of Bristol.

The aim of the study was to assess if the concept of was feasible, and then answer two fundamental questions; do students perceive a need for the mobile learning, and is it scaleable to a large number of students. In both cases, the jury is still deciding.

Keywords: evaluation user experience requirements

1. Background to the study

The paper disseminates the findings of a small pilot study into the use of low specification palm pilots, with wireless connectivity as a means of delivering the same functionality as a Virtual Learning Environment. The term low specification implies an entrance model device, such as a Palm Pilot M105. The rationale for using low specification devices was to reflect on concerns from other studies (Ultralab) that an increasing reliance on ICT in education is creating a widening inequality between people who can buy into the technology and therefore the educational opportunity compared to those who can not

The aims blend the technical aspects of delivering learning material to a PDA with the support issues and identifying if it contributes to the learning experience. In particular, how effective is mobile learning from the perspective of the student? and how scalable is it to a large number of students? This embraces the views forwarded by Kristiansen (2001) who suggests the challenge of further developing mobile learning has more to do with educational design and organisation than with the technology. The terms of reference of the study do not explicitly require the evaluation of a pedagogical model for mobile learning.

The pilot study is based on a group of 13 undergraduate students studying Introductory Microeconomics (subsid) at the University of Bristol. The course is supported by the inclusion of learning materials in Blackboard's Virtual Learning Environment. These learning materials were converted into an accessible format for the wirelessly connected palm pilots. The case study lasted 6 months, and involved various tasks that the students were required to complete. The project was part funded by the Learning Technology Support Service at the University of Bristol and by TechLearn, under the auspices of the widening access with wireless technologies call.

2. The methodology

The methodology that will be discussed is divided into 2 distinct areas;

- Mapping the features of the VLE course to those needed to be accessed via the PDA. The lecturers current use will be cross referenced with the literature (Mason (1998), O'Leary (2001)) to ensure that the common VLE features are being used. In addition, reference will be made to the design aspects that need to be considered when developing usable web pages that can be accessed via a PDA (Kacin 1999, Neilson 2000).

- A description of the tasks that the student's undertook during the study.

3. The findings

The paper will argue from a technical perspective that the low specification technology can adequately deliver the functions and features of a virtual learning environment. In particular, content delivery, course announcements, email and discussion boards.

However, with respect to students perceptions of the role mobile learning has to play in their education, and the management issues in successfully scaling the deployment to a large group is less clear. For instance, students questioned what the technology added compared to what they could already access, and they suggested often toted anywhere / anytime paradigm of mobile learning was not forthcoming due to technological constraints. However, further scrutiny of the student characteristics and the intentions of the lecturer suggests that mobile learning does have a role to play in face to face taught courses as some students are adopting a more sophisticated strategy to blend their use of different devices to meet their needs.

The discussion will also use the findings of the management log to suggest that the potential benefits of mobile learning are unlikely to be realized if the support mechanisms are not adequately provided. The findings suggest that a significant resource is required to support relatively few students using low specification hardware, with few obvious economies of scale.

Before concluding the paper will draw out some policy implications for successfully embedding the technology into the learning experience, and raises need for further areas of study.

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Evaluation of a Mobile Learning Organiser and Concept Mapping Tools

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Abstract

We describe a Mobile Learning Organiser that has been trialled with university students. The aim was to investigate whether an integrated set of learning tools would be useful, which tools would be adopted, and the contexts in which the tools would be used. The results show no single favoured application. The most frequent activities were reading email, note taking, managing deadlines and appointments, and listening to music. The main reported limitation, apart from battery life, weight, and processor speed, was the loss of wireless LAN connectivity, and thus usefulness, when outside the university department.

A comparative evaluation was also carried out between one of the learning organiser tools - a tree structured concept map - and a more traditional style free-format concept map. The results suggest that each concept mapping tool may be suited to different tasks and type of user.

Keywords: learning organiser, iPAQ, wireless LAN, learning tools, concept maps

1. Equipment and software

Mobile office organisers are becoming indispensable tools for many professionals. Learners at university, college or school have as broad a range of demands for self-organisation as professionals, but their requirements are somewhat different: to attend classes, meet course deadlines, read and understand teaching material, revise for exams, and manage individual and group projects. This paper describes a project to evaluate software for a Personal Learning Organiser (see Holme & Sharples, 2002).

Eighteen students taking an MSc in Human Centred Systems at the University of Birmingham were loaned an iPAQ handheld computer with a wireless LAN sleeve and docking cradle. The sleeve provides high speed access to web pages, course material and email within the university department. The docking cradle enables those with computers at home to synchronise their calendar, notes and documents, and to transfer software.

Students were given three types of software:

(1) An integrated suite of learning tools developed at the University of Birmingham, comprising: a Time Manager with a timetable showing teaching periods for the day and course deadlines; a Course Manager with course material in Microsoft Reader format; a Communication Centre for email, text messages and contacts; Map-it!, a concept mapping tool to create a visual map of notes and documents. Students could download material for teaching modules, including PowerPoint slides and supplementary texts, through the wireless LAN connection.
(2) The standard set of PocketPC applications, including email, Internet Explorer, Windows Media Player, and pocket versions of Word and Excel.
(3) Software that the students downloaded. It was made clear that they could use the device for their own personal use and entertainment.

2. Evaluation: Learning Organiser

Students completed detailed questionnaires about their iPAQ use after 4 and 16 weeks. After 4 weeks, 64% (n=17) were using the iPAQ at least once a day. This fell to 42% (n=14) after 16 weeks (possibly due to course requirements at the time). There was no single favoured application. The most frequent activities were email, note taking, managing appointments and deadlines, and listening to music.

The most popular tools are shown below, with the first figure being the percentage of students reporting 'useful' or 'very useful' after 4 weeks, and the second, the percentage after 16 weeks. email (76%, 79%); timetable and deadlines (59%, 64%); web browser (65%, 64%); instant messaging (59%, 50%); course materials (59%, 43%); supplementary materials (53%, 43%); concept mapper (35%, 14%). Logbooks showed locations of use to differ quite widely across users (Bull, 2003). The popularity of email, messaging and timetable (despite these also being available on desktop machines) suggests the importance of mobile organisation and communication tools to enable students to manage their learning. The main reported limitation, apart from battery life, weight, and processor speed, was the loss of connectivity, and thus usefulness, outside the department.

3. Evaluation: concept map tools

Due to the low use of the concept map tool, a comparative evaluation was also carried out of Map-it! and another concept mapping tool: Concise Concept Mapper (CCM) also developed at the University of Birmingham (see Figure 1).

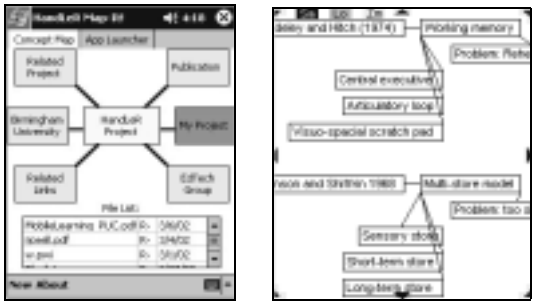

Figure 1: Screenshots of HandLeR Map-It! And Concise Concept Mapper

A concept map is a tool for recording and organising information through visual semantic association. The exercise of structuring ideas to create a concept map can encourage reflection and understanding. While both mapping tools described here are optimised for pen-based interactions on a small screen, they have significantly different operation.

HandLeR Map-It! (Chan and Sharples, 2002) uses a logical tree structure whereby one node is shown as central with linked surrounding nodes. Navigation is by clicking on one of the outer nodes which brings it to the centre, displaying the topics related to it. Clicking on the centre node displays any document associated with the node. The user adds a new node by selecting a document from the file list, which attaches it to the central node.

CCM uses a free-form concept map based on user-positioned nodes and links (Rudman et al., 2002). Interaction is by pen gestures, e.g. dragging a box moves it to follow the pen. If the pen reaches the edge of the screen, it scrolls the map in the direction of the arrow. A zoom facility displays a compressed version of the entire map, giving an overview of its structure. To add a new node at an unoccupied place, the user taps at that point, opening an input area for the node's text. This node may be attached to the map by dragging it over another node.

The results suggest that each tool may perform best in different situations. CCM performs better for note taking and organising information with no obvious structure; it is also more suited to experienced users. On the other hand, Map-It! is better at presenting highly structured information and organising documents by semantic relations; it is also more suitable for novice or occasional users.

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Early footsteps and next steps: 'm-learning' with disengaged young people

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Abstract

In phase 1 of the m-learning project we built sample learning materials to run on a wide variety of mobile devices. Some were based on existing PC-based materials, and others developed especially for the mobile platforms. We trialled these with 4 groups of young adults who had dropped out of mainstream education. These materials will be demonstrated, eg video clips made by some learners who decided to 'improve' the learning materials by filming their own versions! We will also discuss our selection of technologies, as well give general feedback from the trials.

We are currently developing a new generation of materials and templates to help us maximise the many different ways that mobile devices can talk to each other, with a special emphasis on the technologies most likely to be mainstream within the year. These will be introduced and discussed.

Keywords: mobile learning, technology, feedback, iPAQ, SMS, MMS, VoiceXML, learning materials, mobile phones, collaboration

1. The project

M-learning is a three-year pan-European collaborative research and development programme supported by the European Union. The consortium is a partnership of organisations (LSDA, CTAD and Ultralab from the UK, Lecando from Sweden and CRMPA from Italy) combining skills in pedagogy and technology.

The project is developing prototype products and innovative approaches to delivering learning experiences through the medium of handheld devices e.g. mobile phones and palmtop or pocket computers. The prototype products and services developed are being designed to assist in the development and achievement of lifelong learning objectives. The primary target audience is young adults who are not currently engaged in education or training, including those who are unemployed or homeless, and have literacy or numeracy development needs.

2. Early steps

We are half way through the project. In the first (completed) phase we developed prototype learning materials for SMS, iPAQ, HTML (miniBrowsers) and VoiceXML, which we trialled successfully with four groups of disadvantaged learners across the UK.

3. Platforms

Mobile phones were selected as one platform as they are the communication tool of choice for the target group of learners and a relatively inexpensive hardware option.

Personal Digital Assistants (PDAs) were the second platform since they provided greater computing power to support multimedia applications in a small device, and it was anticipated that the technologies of PDAs and mobile phones would soon converge, as indeed happened during the course of the project. Specifically we used the iPAC, but most content was developed to run on a browser within the iPAC so that they would be platform independent.

Fig1. IPAQ showing m-learning material

4. Content

A range of numeracy and literacy materials was created. Learning outcomes were mapped to the new adult literacy and numeracy standards for England and Wales (entry level 3 and level 1) to ensure that learning activities were both relevant and trackable from a content point of view.

For mobile phones, Voice XML was used to deliver interactive stories or quizzes and a simple database system was used to receive registrations and send instructions and SMS reminders to learners.

iPAQs were used to deliver browser-based materials (HTML and multimedia, such as Flash movies), as well as PocketPC-specific applications. The materials included soap storylines, animations, quizzes and interactive information.

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Fig2. IPAQ materials: Urban Soap

4.1. Additional content

Additional content focussed on developing specific skills (series of iPAQ games), or offering some unmanaged scope for constructive work (iPAQ tools for drawing, writing, listening, creating music, reference).

The learners were also given access to a video camera and in one trial took part in a 'commissioning' exercise where they committed to make some film for the project.

5. Main findings from phase trials

M-learning is seen as a viable means of delivering learning materials. Learners have been enthusiastic and motivated to maintain their participation throughout the trial period and have felt empowered to offer both favourable and critical comments on their learning experience.

6. Next steps

In the second phase of the m-learning project, we need to roll out the learning experience to a far larger number of students, so we have focused much of our development energies towards technologies that they already have – primarily phones.

7. New content

Some of the most powerful lessons learned from our trials are feeding directly into our current designs and content plans. These include:

- Collaboration
- Gifting
- User control
- Quick reward

8. Technologies

We have also reviewed the technologies we are developing content for, and are now using:

SMS – text messages
MMS – multimedia messages, including students using camera phones
Voice XML – dialogs over the phone
WAP, MiniBrowser – a collections of technologies letting you browse websites from small screen derives

None of these technologies are particularly rich by themselves, but combined together in the right way, can provide an engaging and beneficial experience for even the most resistant learner.

Fig3. Visualisation of VoiceXML dialog

Designing Scalable, Effective M-Learning for Multiple Technologies

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Abstract

Mobile learning requires a combination of factors in order to be successful. These include an awareness of the constraints that network technologies impose; form factor constraints of mobile devices; and the efficacy of the pedagogical material in use. This paper attempts to reconcile these issues by first presenting a summary of work undertaken to date by the authors, drawing from both reviews of the literature and their own research findings. A framework will then be presented which considers how technical constraints (i.e. network quality of service, and device dependency) may be reconciled with delivering learning objects without losing pedagogical meaning.

Keywords: blended learning, learning objects, mobile learning, ubiquitous computing

1. Introduction and structure

Mobile learning requires a combination of factors in order to be successful. These include:

- an awareness of the constraints that the network technologies impose
- the form factor constraints of the mobile devices in question
- the efficacy of the pedagogical material in question when used in situ.

At the time of writing, there are a plethora of network technologies which have the potential to deliver content which could be used to support learners. However, these all have differing constraints, both in terms of technical and pedagogical issues. In parallel to this, it is essential to consider the influences on provision of educational content, i.e. the growing consensual move towards the development and provision of reusable learning objects.

This paper attempts to reconcile these two issues by presenting a summary of work undertaken to date by the authors, drawing from both reviews of the literature and their own research findings (some of these previously unpublished). Original research to be published in this paper includes findings from interviews with 3G trial users (Stone *et al*, 2003), and student-centred research examining perceptions of how m-learning could be of optimal use to them. This is set against a backdrop of the evolution of mobile network infrastructures, and what they can offer in terms of bandwidth, applications, and services.

2. Scope of paper

The scope of this paper ranges from 2G technologies which learners already use in conjunction with traditional e-learning solutions available to them (Stone *et al*, 2002) to 4G networks, which have the potential to facilitate ubiquitous mobile learning (Prasad & Munoz, 2003 and Wang 2001). However, without learning objects which have the potential to be as flexible as the infrastructures available to the learners, the expected outcomes will inevitably

be sub-optimal. The framework described below will attempt to address this issue.

3. A framework for designing scalable, effective M-Learning for multiple technologies

In order to reconcile the variety of issues mentioned in the previous sections, we shall present a framework which can be used to inform both providers of educational content, and suppliers and users of mobile networks and devices, ways in which the efficacy of their m-learning strategies can be deployed and evaluated.

This will consider how technical constraints (i.e. network quality of service, and device dependency) need to be reconciled with delivering learning objects without losing pedagogical meaning (e.g. Cowen, 2002). Emerging standards such as CC/PP and UAProf (Gimson, 2002) are envisaged as being used to express these respective considerations, and are expected to underpin ubiquitous computing applications as could be achieved through 4G networks and services.

This framework will then be illustrated through an example scenario which considers the above points, with recommendations and considerations at each stage. We intend to demonstrate that regardless of the technology being considered (from simple SMS and touch-tone interactivity in 2G technology, to more complex scenarios involving variable quality of service in both 3G and 4G environments, e.g. Ma *et al* 2000, and Cowen 2002), it should be possible to deliver successful m-learning solutions based on a foundation which is both **stable** (in terms of providing consistent learning outcomes) and **supple** (where variable content delivery in terms of network quality of service, device constraints, and flexibility of original content is involved, the effects on pedagogy can be known and addressed in advance).

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A Task-centred Approach to Evaluating a Mobile Learning Environment for Pedagogical Soundness

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Abstract

This focus of this paper is how to evaluate the pedagogical soundness of a mobile learning environment in which many users (both teachers and learners) may not have previously encountered mobile technology, so may be uncertain as to how best to deploy it to achieve their goals. Drawing on concepts from Activity Theory and the socio-cognitive engineering method described by Sharples, (2000) an approach is described which enables an enriched view of users' current and future activities, which in turn will allow us to understand the range of actions and opportunities for mobile learners, and seek ways of extending this range to support what learners want to do – even if they themselves do not yet know what that is.

Keywords: learning, socio-cognitive engineering; activity theory; pedagogy; evaluation; mobile environments;

1. Introduction

A major goal of the worldwide European-led research and development project MOBIlearn is:

'…the creation of a virtual network for the diffusion of knowledge and learning via a mobile environment where, through common themes, it is possible to demonstrate the convergence and merging of learning supported by new technology, knowledge management, and new forms of mobile communication' (MOBIlearn Annex 1, p 7).

The project aims to evaluate the pedagogic effectiveness of the learning environment thus developed to ensure that it is sound. Although there are tried and tested methods for pedagogic evaluation of specific applications of technology for learning (eg see Draper et al, 1997; Scanlon et al, 2000), there are no existing comprehensive frameworks for broader formative evaluation in the mobile environment, largely due to 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 artifacts as well as 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. They may simply then avoid using the technology 'in anger' once the evaluation study is complete.

Therefore, to make progress in achieving our goals, we must develop a thorough understanding of:

- the learning opportunities presented by the new mobile technology
- its (potential) impact on the way people perform learning tasks
- its (potential) impact on human social processes and interactions
- how these in turn are changed or modified by the technology

In the rest of this paper we briefly indicate how it is possible to develop this understanding driven by task-centred user requirements rather than technological advances, so describing an approach which underpins our evaluation strategy for MOBIlearn.

2. Understanding activities

Addressing this issue, we have adopted the socio-cognitive engineering method for system design (Sharples 2000; Sharples et al, 2001)

which describes a two-stage process: first, that of **activity analysis** which sets constraints on the system design and analyses how people work and interact with their current tools and technologies; and, second, a stage of **design of new technology** integrated into the user's/learner's environment and activity structures. One such technique for engaging in activity analysis is the Future Technology Workshop (Vavoula et al, 2002). In these workshops, participants are encouraged to consider the range of, and benefits of, their existing activities before being supported in thinking about how those activities could be more effective when supported by new technologies and services. This allows participants to approach the concept of a new activity structure in a way which has their goals at the forefront of the discussion, rather than have their aims and objectives subsumed beneath the glamour and glitz of new technology for its own sake. In addition to this method, an activity theoretic view (eg see Mwanza, 2001) informs our analysis of the environment in which the activities are taking place, other potential collaborators in the activity, and the ways in which organisational requirements can impinge on those activities.

Through this enriched view of users and their current and future activities, in which learning is viewed as a distributed activity, we can better understand the range of actions and opportunities which are on offer to mobile learners, and seek ways of extending this range to support what learners want to do – even if they themselves do not yet know what that is. This broadening of the scope of the 'learning system' enables a much deeper understanding of users' needs, and the constraints which govern their behaviour.

From the evaluator's point of view, then, the task is to evaluate the effectiveness with which learners are able to achieve their goals, and complete learning activities, irrespective of the specific devices which might have been used in doing so. Indeed, the same or similar activities could be instantiated in a variety of different ways depending on availability of technical support (e.g. access to wireless LAN) and user preferences. In so doing, we will necessarily be evaluating the validity of the tasks themselves as vehicles for learning.

3. Conclusion

The evaluation framework for the MOBIlearn project is driven both top-down and bottom-up. The theoretical perspectives of Activity Theory and constructivism, here represented by the socio-cognitive method, allow us to analyse learners in their appropriate contexts and to understand the nature of their learning tasks, and how they go about them. The Future Technology Workshops provide us with much useful data on the views of potential mobile learners and what they see as crucial elements in their learning activities. At the same time, usability studies are, of course, essential. As the MOBIlearn system is being developed, standard usability testing is being performed on component software and devices, in parallel with higher-level evaluations of pedagogic benefit. A key issue for the project in the future will be to ensure that the two levels can meet intelligently in the middle with a mutually informing discourse. We believe that the task-centred approach will facilitate this marriage.

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MLearning – Making Reality from Hype

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Abstract

As a learning organisation Complete Learning has recognised the need to develop and deliver learning content across a mobile platform. We must ensure that we are able to offer our clients a total learning solution that offers support irrespective of time or location.

As a result of such demands we have developed a series of training modules for Cisco Systems, fondly known as 'Knowledge Nuggets'.

The success of the Knowledge Nuggets has enabled us to dedicate a resource team to furthering mobile services for a much wider audience.

The emergence and adoption of 2.5G and 3G technologies will enable further benefits to mLearning.

Keywords: Knowledge Nuggets, Learning Support Tool, Blended Solutions, Engaging and Innovative

1. Making Reality from Hype

PDA's and mobiles are more than just useful gadgets to store personal information on, or play the occasional games of solitaire.

Used wisely the mobile device can act as a supportive learning tool that offers gems of knowledge at the point of need or equips individuals with information to ensure that they gain competitive advantage.

Learning material that is accessed across a mobile platform is an ideal way to complement instructor led and eLearning programmes. Far from replacing the classroom environment, mLearning provides investment protection by providing the means to obtain information which otherwise would be lost from memory. Instant access to learning content irrespective of location is the key to providing a complete learning solution.

2. The Mobile Challenge

Our clients have become increasingly demanding and as a learning provider we must ensure that we offer them a total proven solution. We have as a direct result of these demands developed a way to deliver learning content across a mobile platform (ref Figure 1 – Screenshot of a Mobile Device).

Figure 1. Screen of mobile device

3. Knowledge Nuggets

Cisco Systems are one of the market leaders in the establishment and continuing growth of the Internet and they're not the easiest people to impress; therefore it was with a mixture of excitement and trepidation that we, Complete Learning launched 'Knowledge Nuggets', a

mobile support tool that provides training modules with vital information regardless of location.

The content display is clear and you can select audio depending on your needs. The supportive text allows you to map your training to suit your needs and timescales. We have so far developed seven modules for Cisco, each release supported by real enthusiasm – one manager commented ‘this content rocks!’

The success of the Knowledge Nuggets has enabled us to dedicate a resource team to furthering mobile services for a much wider audience. As a result we are actively developing our mobile strategy to support educational services by providing learning content across mobile platforms.

4. Our Vision

We recognise the need to develop learning content to assist in a variety of subject areas in a way that it’s easily accessed; it’s engaging and enables retention. More and more people are reliant on mobile technology, and we at Complete Learning are working to use this platform to increase knowledge.

We are enthusiastically creating a diverse range of learning products that work towards a total solution to complement eLearning and classroom-based training.

Mobile learning is not exclusive to businesses or professionals; therefore the continuing development of content such as GCSE support modules and professional development modules will support an increasing audience with what they want to learn and importantly when they want to learn it.

The emergence and adoption of GPRS (2.5G) and UMTS (3G) technologies will enable further benefits to mLearning. Download times will be reduced and the user experience will be advanced through more enriched content.

Complete Learning is ideally placed to continue to provide mLearning the content for which mobile technology has been long awaiting.

m-learning – Evaluating the Effectiveness and the Cost

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Abstract

*The EU **m-learning** Project managed by LSDA is developing a mobile system for adult basic skills in which learners access content and discussion transparently across a range of mobile and computing devices. For any commercial exploitation, it is necessary to explore and assess the factors that determine the various developmental efforts and their respective educational benefits. This paper suggests a way to integrate and apply work on multimedia educational software cost-estimation, cost models of networked learning, the Laurillard conversational framework and blended learning development tools. These factors must underpin any objective economic evaluation of **m-learning** and establish the foundations for understanding the basis of commercial exploitation.*

Keywords: cost-benefit, software cost-estimation, conversational framework, media-mix

1. Introduction

Mobile learning is currently at a stage of small-scale projects working to establish aspects of technical feasibility in specific educational settings. (The EU **m-learning** Project[1] co-ordinated by LSDA is an exception to this generalisation.)

If these projects are successful in both the educational and technical sense, and act as the focus for a consensus of what constitutes mobile learning, then the next phase must be large-scale social use and commercial exploitation. This will only take place on a sustainable basis if there is an understanding of the relations between the costs of mobile learning, in all their different forms, and the educational, and perhaps social, benefits. Hence, commercial exploitation is a question of educational cost-benefit analysis and in particular that part of educational cost-benefit analysis that deals with large-scale or industrialised educational systems explored for example by Rumble (1997) and Peters (1998). However, mobile learning is a technical system with significant computing components and so much can learned by looking at the literature of software engineering, especially software cost-estimation and project management, summarised in Pressman (2000) and Sommerville (1992).

2. Software Cost Estimation

For commercial and industrial software developers, there has always been a considerable economic advantage in being able to predict and control the effort and thus the cost of software development. This opening section looks at methods for predicting the effort and hence cost of developing programs.

[1] EC Directorate-General Information Society IST 2000-25270

3. Educational Effort Estimation

This section looks at an application of software cost estimation techniques to educational software and identifies those underlying characteristics of multimedia educational packages that drive educational software development costs upwards or downwards. This is the work of Dr. Ian Marshall and his collaborators at the University of Abertay (1995a, 1995b). We will see that these characteristics are fundamental to different conceptions of teaching and learning, and are shared by many components of **m-learning** systems.

4. Analysing m-learning – the Conversational Framework

The previous section identified potential "cost-drivers" for the didactic components of **m-learning** systems. It was, however, an incomplete account of **m-learning** economics because it failed to address other components of such systems. It also failed to address the educational effectiveness of the various components. This section will look at a more general framework developed by Laurillard (1993) that allows us categorise and understand the activities within **m-learning**.

5. Using the Conversational Framework - Media Advisor and CRAM

The previous section provided a theoretical model for discussing the costs and choices involved in developing an **m-learning** system. This section looks at two current attempts to combine Laurillard's conversational framework with data relating to a range of developmental activities. They provide examples of how an economic analysis of **m-learning** might proceed. This is a significant step towards a transparent procedure for optimising the elements used within a teaching system and a considerable improvement on the pragmatic "media-mix" solutions of Reisner and Gagne (1983).

6. Human Factors

This section looks briefly at some factors that complicate this apparently rational and systematic analysis of the economics of **m-learning**, namely the preferences, attitudes and behaviour of teachers and learners, and how they are currently manifest in e-learning.

7. Conclusion

This paper has attempted to develop a rational and systematic framework for assessing the effectiveness, efficiency and economics of **m-learning**. Existing work already shows how to increase the efficiency and effectiveness of any commercial exploitation. Increased exploitation will improve on this.

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A Critical Approach to an Adaptive User Interface Design

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Abstract

In our study we present a critical approach to usability issues and usability evaluation particularly involving adaptive user interface design for mobile learning environments. We describe some design challenges for adaptive user interfaces and key usability issues in the MOBIlearn project. In addition, we compare these challenges with three different learning approaches.

Our hypotheses are that the learning approach used in most usability studies is not clearly defined, and, influences of different learning approaches are not considered enough in usability evaluation. Our aim is to develop usability of such mobile systems that are based on more than one learning approach.

Keywords: adaptive user interface, usability, learning approaches

1. Adaptive user interfaces

Studies of web-based educational systems and mobile learning environments have recently started to focus on systems that are called adaptive. Adaptive systems can be seen as an alternative to the "one-size-fits-for-all" approach (Brusilowsky, Stock and Strapparava, 1999). An adaptive user interface can be defined as "*a software artifact that improves its ability to interact with a user by constructing a user model based on partial experience with that user*" (Langley, 1999). The term adaptation refers to a system's capability to dynamically change its behaviour in order to keep the quality of service above a certain level. In many cases adaptation is seen as a part of context-aware systems. The system that adapts itself according to the user refers to adaptivity. Furthermore, if the users have to change the system behaviour it is referring to adaptability.

Adaptive user interfaces can be focused, eg to a task of information or content-based filtering, task of recommendation, task of social or collaborative filtering, and task of optimising (Langley, 1999).

2. Adaptive user interfaces, usability and different learning approaches

We see adaptive user interface design as a vital part of usability design of an application or a service. We argue that the learning approaches, which are based on the usability design including adaptive user interface design and adaptive system design should be defined more clearly.

We examine three learning approaches in our study: formal learning, problem-based learning and workplace learning. Our aim is to study design challenges of adaptive user interfaces and some key usability issues in mobile learning environments. Our study is based on the MOBIlearn project, which is the research and development project in EU IST Programme. Furthermore, in traditional usability testing the long-term usage is underestimated.

In some recent studies argue that current adaptive (hypermedia) systems are based on "*a*

stereotypical user model with limited levels of user differentiation" and some additional research is suggested to be done in the evaluation of the educational effectiveness of system adaptation (Triantafillou et al, 2002).

Also the psychological effects of an interface adaptation on user performance have been studied earlier. Two competing possible effects of using adaptive user interfaces can be found: social facilitation and "chocking". The former refers to consequences, which occur because the user performance is monitored by the interface. The latter, "chocking", refers to consequences caused by the interface, which adapts to user's performance (Jettmar and Nass, 2002).

In our study we examine examples of existing adaptive user interfaces for mobile learners and some key usability issues. Our aim is to develop usability of adaptive user interfaces in mobile learning systems that are based on more than one learning approach. We will conclude with some guidelines for adaptive user interface design. Furthermore, we will study some design challenges of mobile learning architecture and related adaptivity themes.

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Wireless All the Way: User's Feedback on Education through Online PDAs

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Abstract

Technological advances in mobile computing devices and wireless internet promise to revolutionise the delivery of educational materials. We report on the process of developing a series of geoinformatics course modules which ultimately will be distributed in a wireless learning environment. In the early stages of the project, students were involved to discuss their current use of mobile technologies (mobile phones, laptops,…) and reflect on the potential of GPRS/GPS-enabled pocket PC's both for private use and study/fieldwork. The educational demands placed on the delivery of time/place independent course materials and the specific issues with regards to the use of mobile devices in fieldwork are the focus of this presentation.

Keywords: wireless fieldwork, wireless course design and delivery, user feedback, pda's

1. Wireless Education for Geo-informatics

In recent years, ICT has been adopted by many academic disciplines as a solution to increasing demands from students for individualised learning paths and learning styles. The fields of Geography and Geoinformatics, with their emphasis on fieldwork and multidisciplinary teamwork, pose a unique challenge for conventional ICT infrastructure in educational institutions. However, recent technological advances in mobile computing devices and broadband wireless internet promise to revolutionise the delivery of (individualised) ICT services in this field. This leads to a need to analyse the consequenses of these developments for the design, organisation and presentation of educational materials.

2. The GIPSY project

GIPSY (***G****eo-Information for* ***I****ntegrating* ***P****ersonal learning environments by web and mobile ICT* ***SY****stems*) is a two year running collaborative project between three Dutch universities, each with well-established Geography departments. The institutions are jointly developing two multidisciplinary modules on geo-information.
The design of course materials in this project is based on the didactical principles that:

1. they should fit in with the growing demand of students to be able to work through individual learning paths (time and location independent);

2. students in this field should be able to study and work in multidisciplinary teams

2.1. Developing a wireless hardware/ software architecture

The need for ICT to support these requirements is evident. Both modules will be developed within a web-based environment, with data transmission being supported by

broadband internet between the three institutions. The more innovative aspect of the web-based support is based on current developments in mobile communication (GSM, GPRS, UTMS). The project will investigate how educational materials can be distributed in small entities ("byte chunks) by mobile technology and full online devices such as pocket PC's or personal digital assistants (PDA's). Another area of investigation is how wireless technologies can be used to assist students carrying out fieldwork in remote areas (and support the delivery of location-based services) and what type of mobile devices are most useful in this kind of environment. We are currently designing and developing a wireless fieldwork architecture, interface and functionality and carrying out a comparison of PDA GIS software packages. These will undergo extensive testing in the summer of 2003.

2.2 User's feedback on wireless education and fieldwerk

As more and more universities are gaining some experience with the use of wireless technologies, they also need to identify the requirements these place on the design of educational materials, the type of educational activities which may be supported and the way mobile devices may be used in combination with more established technologies such as mobile phones, laptops and desktop PC's for the purpose of study and fieldwork.

The educational sub-project in GIPSY has therefore in the first phase of the project decided to engage youngsters between 16-22 years (who are mobile technology enabled and potential future participants of mobile learning) to take part in a series of student panels to discuss possible applications of wireless devices in education. Both high school students and university students with a background in geography and/or affinity with fieldwork were asked to take part (about 40 in total). During the panel sessions, participants are interviewed about their current use of mobile phones, palmtops, PC's and laptops, both for private and educational purposes. They are asked to try out the state-of the-art 'XDA' (the first combined pocket PC and GPRS device on the consumer market with a colour screen) and asked to reflect on the functionalities and user-friendliness of full online devices in the context of their school/study work and/or fieldwork. They also are asked to evaluate customized educational software applications such as assessment software and geographic mapping software (ArcPad) on the XDA.

The insight we are gaining in the project on the thoughts and ideas of students themselves on the future deployment of such devices, provides a useful context when starting out with the design of educational materials. The didactical constraints and opportunities which are placed on the design of such materials can be a good starting point for other universities when venturing into this area themselves.

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Mobile Cinematic Presentations in a Museum Guide

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Abstract

In this paper we introduce the idea of enhancing the audio presentation of a multimedia museum guide by using the PDA screen to travel throughout a fresco and identify the various details in it. During the presentation, a sequence of pictures is synchronized with the audio commentary and the transitions among the pictures are planned according to cinematic techniques. Preliminary studies and pilot tests show encouraging results and interesting effects.

Keywords: Multimedia Museum Guides, Cinematography

1. Introduction

Many research projects are exploring the new possibilities offered by Personal Digital Assistants (PDAs) in a museum setting (see for example, Grinter et al, 2002 and Cheverst 2000). Usually, these multimedia guides use static images, while others employ pre-recorded short video clips about museum exhibits. In a previous work (Not et al, 1998), we explored different techniques to automatically build multimedia, location-aware presentations in a museum setting. The advent of more powerful devices has allowed researchers to experiment with new forms of multimedia, in particular time-based media such as animations.

In this paper we introduce the idea of enhancing the audio presentation (dynamically assembled pre-recorded or synthesized speech) of a complex fresco by using the PDA screen to travel throughout the fresco itself and identify details. Our hypothesis is that the use of this type of animation to present the description of a painting allows the visitor to better identify the details introduced by the audio counterpart of the presentation. In this manner, both the efficiency and the satisfaction dimensions of the system usability are increased (Nielsen, 1994) while also providing an enhanced learning experience for the visitor. At present, we have completed a first prototype for the famous XV century fresco "The Cycle of the Months" at Torre Aquila in Trento, Italy. It illustrates the activities of aristocrats and peasants throughout the year and covers all four walls of a tower. It introduces a number of characters as well as many different activities from falconry to wine harvesting. A web-based demo of the prototype is available at the following URL address: http://peach.itc.it/preview.html.

2. Cinematic Presentations

The language of cinematography (Metz, 1974), including shot segmentation, camera movements and transition effects, is employed in order to plan the animation and to synchronize the visual and the verbal parts of the presentation.

Figure 1. Screen of mobile device

In building the animations, a set of strategies similar to those used in documentaries were thus employed. Two broad classes of strategies have been identified. The first class encompasses constraints, imposed by the grammar of cinematography, while the second deals with conventions normally used in guiding

camera movements in the production of documentaries. For instance, a strategy in the first class would discourage a zoom-in immediately followed by a zoom-out, while a different strategy in the second class would recommend the use of sequential scene cuts, rather than a fade-out effect, to visually enumerate different characters in a scene. It is worth noting that in the latter strategy it is often necessary to make reference to the discourse structure of the audio part of the presentation, such as enumeration of properties, background knowledge, and elaboration of related information. In order to formally use discourse structure, we employ the Rhetorical Structure Theory (Mann and Thompson, 1987).

3. Mobile Presentations

The guide is implemented on a PDA, which by means of infrared sensors is capable of identifying its position within the frescoed Tower of the castle. Interaction with the system is both proposed by the system itself and accepted by the user, thus sharing the responsibility of information access. When the system detects that the visitor is in front of one of the four walls, a picture of that wall is displayed on the PDA and, after a few seconds, if the user has not changed her position the panel she is facing is highlighted (see figure 2). At this point, the visitor can click on the panel and receive a multimedia presentation of the panel she has chosen. This modality has been chosen in order to allow the visitor to retain control of an inherently proactive guide.

Figure 2. Mixed-responsibility in fresco selection

4. Evaluation

Preliminary studies and pilot tests show encouraging results and interesting effects.

All users became acquainted with the system very quickly. Most of them used the PDA as a "3D mouse", pointing directly to the infrared emitters to speed up the localization. In the future, we will propose a new interface where the user can be explicitly involved in the process of localization.

Most of the users complained before actually using the system that a video sequence on a PDA would distract their attention from the real artwork. After a short interaction with the system, however, they appreciated the possibility of quickly localizing small details on the fresco. This demonstrates that use of cinematic techniques in a multimedia guide can be effective, particularly when explaining a complex painting.

A formal study will start next May in Torre Aquila that will involve approximately 80 subjects. The purpose of the study is that of investigating the correlation, if present, between rhetorical devices and the visual attention of the guide user. We will study how the application of the rhetorical transitions described above affect user attention by observing the patterns of eye movements to and from the fresco and the guide.

5. Acknowledgment

This work has been supported by the PEACH and TICCA projects funded by the Autonomous Province of Trento.

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ISBN 1 85338 855 6

m-Learning and MOBIlearn
are projects supported by
the European Commission
Directorate-General Information Society
IST-2000-25270 (m-learning)
IST-2001-37187 (MOBIlearn)

Information Society Technologies