# MLearn 2002
# European Workshop on Mobile and Contextual Learning

20th and 21st June

University of Birmingham
UK

## Workshop Proceedings

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*Dear Colleagues,*

Welcome to MLearn 2002, the first European Workshop on Mobile and Contextual Learning. Technology-based mobile learning is still in its infancy, despite a gestation of over 30 years dating back to the influential Xerox Dynabook project in the early 1970s. The equipment is now available to enable learning on the move, in the form of powerful handheld computers and high speed wide area communications. Equally important, there is a recognition of the importance of learning outside the classroom and an educational imperative to support workplace training and lifelong learning. We have the opportunity to empower children and adults to manage, share and enjoy their own learning in many contexts, throughout their lifetimes.

The workshop is for researchers and practitioners in industry and education with an interest in developing new approaches to mobile and contextual learning. This includes the design of new technology and software for mobile learning, as well as research and development in technology-supported informal and lifelong learning. A central aim of the workshop is to broaden the horizons of mobile learning, to explore possibilities for experiential learning, personal learning projects, on the job learning, and just-in-time learning. It will also provide a showcase for new learning technologies and solutions, including wearable learning devices, learning toys, learning organisers, and multimedia content delivery to handheld devices.

When we set out to organise the Workshop we were aware of a few pioneer research projects on mobile learning and some initial trials by e-learning companies to deliver training material to PDAs. The response to the call for submissions has shown the range of current research and development, with topics ranging from the design of digital toys to support social interaction, to mobile devices for breast care.

The Workshop promises to be a stimulating opportunity to share and discuss new directions in mobile learning. We hope it will be the first of many such events.

Mike Sharples
*Workshop Chair*

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## Technical Demonstrations

# A Creative Learning Environment (CLE) for Anywhere Anytime Learning (AAL)

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## Abstract

*The Birmingham Grid for Learning BGfL) will become a creative learning environment (CLE) – one that facilitates ownership for the learner in a way that can be controlled by them and influenced by the teacher. It will provide a gateway to different resources, tools and learning environments, both synchronous and asynchronous, and a range of communication systems for interaction with peers, teachers and learners, with each system appropriate to the requirements and desires of the user. The CLE will provide a flexible and appropriate environment for learning anytime and anywhere and as such will enable interaction with the range of interfaces of access devices, without hindering end user interaction or functionality.*

## 1. The BGfL and AAL

The BGfL (www.bgfl.org) was conceived as a teaching and learning site for the Birmingham learning community. At the point of conception the map of the BGfL and the theoretical framework supporting it was linked to that of a library structure. The resources were to be used in classroom settings where the teaching and learning took place. The resource development made use of models for learning on an ad hoc basis, the need was for content to fill the library shelves. Resources to support teaching and learning were added to each key stage area according to the subject areas defined by the National Curriculum.

The development of the anytime, anywhere learning (AAL) concept paralleled that of the BGfL. The Birmingham model for AAL is now firmly focused on providing access to the learners own CLE using whatever (connected) device they may happen to be using at the point of required use.

The BGfL therefore faces the renewed challenge of revisiting its original aim of being a teaching and learning site and all that that entails and accommodating this aim within the concept of AAL, new portable technologies and other access devices.

## 2. Learning

### 2.1 A Model for Learning - Constructivism

The behaviourist model, which provided the framework for the ILS systems, is now recognised as being unsustainable. It depended on the development of a credible model for learning and teaching that has not happened. Instead the constructivist model based on the work of Piaget[1] has proved to be the most accepted and durable model for teaching and learning. In this model constructivism sees learning as a personal idiosyncratic experience, characterised by individuals developing knowledge and understanding it through the forming and reforming of concepts. The focus of constructivism is on learner control, with learners making decisions that match their own cognitive states and needs. Squires[2] concluded that a constructivist approach to learning would lead to an e-learning site that would:

- Provide opportunities for the learner to explore the behaviour of systems, environments or artefacts.
- Allow the learner to express personal ideas and opinions.
- Allow the learner to explore ideas and try different solutions to problems.
- Give a sense of ownership.
- Present the learners with complex environments and tasks.
- Support the learners in coping with the complexity.

### 2.2 The Learning Situation

An important consideration in creating any learning environment is the context. We might gain some tools that will help us learn but if those tools are not used the learning becomes meaningless. It is also important that the tools are used in an appropriate context that relate to the learners personal experience. Brown, Collins and Dugid [3] and later Stefen [4] recognise the argument that learning is not independent of the learning situation and introduces the idea of situated cognition. Squires[2] calls this Contextual Authenticity. He said that a belief in this idea leads to a learning environment that should:

- Relate to the learners personal experience of the real world.
- Augment learning rather than attempt to supplant it.
- Be collaborative.
- Involve a change in the role of the teacher from a director to a manager or facilitator of learning.

Linked to this there is considerable evidence emerging that indicates that using ICT in the home is a more valuable experience than its use in schools. Downes and Reddacliff [5] and Facer et al [6] both come to the conclusion that computer interaction at home was more likely to lead to learning. This clearly has implications for AAL, and the virtual environments that support it.

## 3. The BGfL as a Creative Learning Environment (CLE)

It is intended that the changes in the BGfL will be directed by the need to create a teaching and learning environment suitable for an AAL programme and informed by a constructivist model for learning that takes account of the context in which learning takes place.

The focus for this change will be the establishment of a front-end interface that will allow users to create their own teaching and learning environments with as little remediation as possible. This 'My Learning Area' will also accommodate the AAL concept because teachers and learners will have the capability of creating environments that match the access technology.

Figure 1. Me and Learning – My Learning Area

<table>
<tr><td colspan="2">My latest news (what has just been given to me to work with)</td><td colspan="2">Me sharing my view and perhaps influencing others (voting)</td><td colspan="2">Me deciding what resources I need to do my work (my links)</td><td colspan="2">My work (my files, my notebook)</td></tr>
<tr><td>My learning environments (synchronous/ asynchronous, the whiteboard my mates with our shared slate!)</td><td colspan="2">Me using the resources my teacher has given me (files and weblinks that my teacher has given me)</td><td colspan="2">ME</td><td colspan="2">Me talking to my teacher about my work (chat, discussion, email, video conferencing)</td><td>Me talking to my mates about my work and other things (chat, discussion, email, video conferencing)</td></tr>
<tr><td colspan="2">What I will do and when (calendar)</td><td colspan="2">My learning plan ( targets and goals, assessments)</td><td colspan="2">My mates who are working with me at the moment (who is online, who is in my class)</td><td colspan="2">The work my teacher has given me (assignments)</td></tr>
</table>

The 'My Learning Area' will allow for incorporated subversion and be an environment for the continued development of a constructivist pedagogy that would have been initiated by the activities. It is in this area that we will get true online collaborative learning and a context that supports it. The 'My Learning Area' will draw support material from the existing BGfL which will be redefined as a support and news area

Resources and other activities will be developed to established models for teaching and learning and a careful consideration of the situational context in which they are used. These should provide for, wherever possible:

- The exploration of the behaviour of systems, environments and artefacts.
- The expression of personal ideas and opinions.
- Problem solving.
- A sense of ownership.
- Complex environments and tasks.
- Support for coping with complexity.
- Relate to personal learning experience of the real world.
- Augmentation of learning.
- Collaborative learning.
- Changes in the role of the teacher from a director to a manager or facilitator of learning.
- Engagement when used with a range of access devices.

**References**


[1]Piaget, J. (1952). The origins of intelligence in children. New York: International Press.

[2]Squires, D. (1999). Educational Software for Constructivist Learning Environments: Subversive Use and Volatile Design. Educational Technology p 48-55

[3}Brown, J.,Collins, A. & Dugud, P.(1996) Situated Cognition and the Culture of Learning online at **http://www.ilt.Columbia.edu/ilt/papers/JohnBrown.html** (accessed 17/04/02)

[4]Steffen, K (1997) Of landscapes, anchors and tools: On learning with multimedia computer programs. Journal of Information Technology for Teacher Education. Vol 6 No1 p 9-23 also online at **http://www. triangle.co.uk/jit/jit-06-1.htm#ks** (accessed 14/03/02)

[5]Downes, T., Reddacliff, C. (1996). Young Children Talking about Computers in their Homes, Faculty of Education, University of Western Sydney, **http://www.bssc.edu.au/community/events/info96/Compaq/ToniDownes/bendigo.doc** (accessed 16/03/02)

[6]Facer, K., Furlong, J., Furlong, R., Sutherland, R. (2001). Constructing the Child Computer User: from public policy to private practices. British Journal of sociology of Education. Vol. 22 p 91-108.

# Tangible Technologies for Collaborative Storytelling

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## Abstract

*This paper describes a preliminary evaluation of the use of a combination of digital and physical technologies to support collaborative storytelling in small groups of 7 year-old children. PDAs, RFID tags and barcodes were used to enable children to work in distributed collaborative activities with KidPad, a shared storytelling application. The technologies were designed to allow integration of physical (e.g., paper based drawings) and digital artefacts (e.g., tagged sounds associated with physical drawings). The results of this initial evaluation suggest some promising directions for the design of wireless mobile learning technologies to support collaborative learning.*

*Keywords: Tangible technologies, CSCL, storytelling, collaborative learning, mobile learning*

## 1. Introduction

Storytelling in the UK primary school classroom is typically a combination of whole class, small group, paired and individual activities, often within a single lesson. This places some considerable organisational demands on teachers to manage smooth transitions between types of teaching. Desktop learning technologies have in the past been designed for individual use. Even if, in practice, pairs or small groups share a single desktop system or the technology enables use by many children over networked systems, the box on the desk basically provides a limited set of physical activities. If technologies are to be used in support of storytelling in the classroom they will need to be designed with these different activities in mind and, ideally, be flexibly adaptable by teachers to the actual context of use, with all its physical and organisational constraints. With the advent of (relatively) cheap wireless and mobile technologies (e.g., PDAs), there are now much greater possibilities for designing computer based learning activities that support and augment a variety of physical activity spaces [1].

This paper describes a preliminary usability study of a configuration of sensors (e.g., pressure pads), wireless devices (PDAs, RFID tags), displays and scanners connected to a laptop running the KidPad storytelling software application. The research was carried out as part of the KidStory project, the aim of which was to develop collaborative storytelling technologies for young children [2].

## 2. The KidPad shared storytelling environment

KidPad is a shared 21/2D drawing tool that incorporates links and a zooming interface [3], enabling children to add narrative structure to their stories by dynamically moving between different parts of a drawing. In the early stages of the KidStory project, KidPad was adapted using the approach of Single Display Groupware (SDG), where several children interact with a single display using multiple input devices, for example, two or more independent mice [4]. The goal was to design software that encouraged collaboration, via a technique called 'tool mixing'. When two (or more) children use 'mixable' tools together, the tools give enhanced functionality (see Figure 1) [2].

Early experimental evaluations of the shared software were encouraging – shared KidPad improved the quality of children's stories compared with a single-mouse version [5]. The software was also taken up in a UK school and used independently by some of the teachers as part of mainstream teaching.

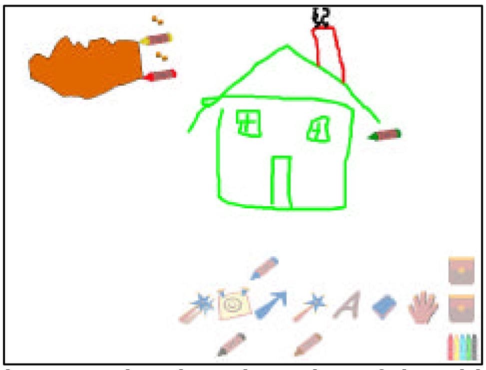

**Figure 1. The shared version of the KidPad interface with mixed crayons being used. Note that inactive tools are faded. There are three active crayons, and two are currently being used to create a "mixed" area.**

Despite its successful adoption by the school, early experiences raised a number of issues that needed to be addressed in the further development and educational use of this technology. Two main ones were that, first, children found it difficult to use some of the features of KidPad – especially zooming and navigation (see Figure 2), probably due to the need to use mice to manipulate the on-screen tools. Second, the desktop version of KidPad was not easy to integrate with whole class storytelling activities that may involve large groups of children and incorporate physical artifacts made by the children in traditional materials (e.g., drawings and models).

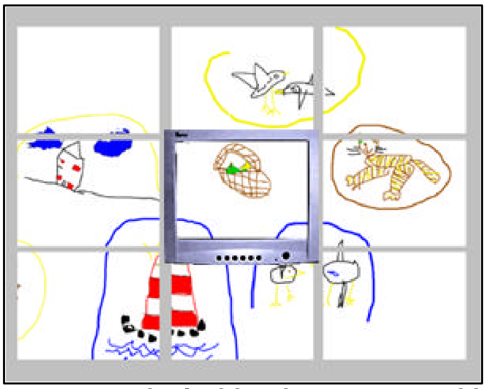

**Figure 2. . A typical KidPad story created by a class of 7-year-olds. Only one part of the story is visible. By zooming in/out or navigating left/right or up/down it is possible to view the other parts of the story or access blank space to create more content.**

In extending KidPad to meet these requirements, we adopted an approach that is *physical* and *tangible*. By physical we mean that it is movement-based. By tangible we mean that it involves graspable and touchable objects [6]. Physical and tangible interaction is important in this context because children's collaborative activities in both play and school involve physical interactions with spaces, objects and each other. Support for larger groups also implies moving beyond conventional sized screens and desktop devices. Finally, story retelling involves some element of theatre or performance – this requires expressive ways of rendering interaction *visible* to an audience.

## 3. Designing for 'tangible storytelling'

### 3.1. Creating story elements

The tangible version of KidPad enabled children to incorporate their physical drawings of story elements (props, scenes) via the use of barcodes. Pictures drawn by the children were assigned barcodes and scanned in order to upload them onto the screen. The system was then set up so that if an object had already been uploaded then scanning that object again with the barcode reader would move the user directly towards the given object, similar to following zooming-links with the hand (browse) tool in the conventional KidPad interface.

As well as being able to interface with physical barcoded drawings, children were able to draw and input pictures via PDAs using a simple graphics application. There was one PDA for each different coloured crayon in the equivalent KidPad application (see Figure 3). The pictures were transferred into KidPad via infrared. A webcam also allowed the children to incorporate photographs into their stories.

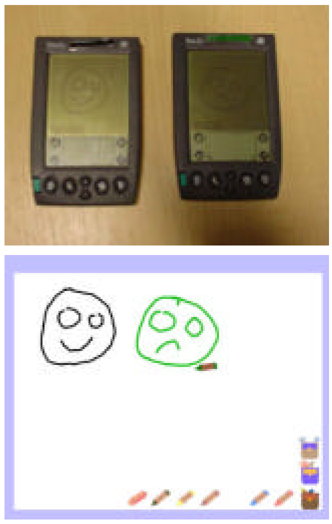

**Figure 3. Using PDAs to input pictures.**

In addition to creating images children could record sounds as part of their stories. An RFID tag reader was placed on a small table in front of the screen with a microphone placed next to it. A tag was covered in paper with a microphone image on it. To record a sound children placed the tag onto the tag reader and spoke into the microphone. The computer recorded sound from the point when the tag was placed onto the reader until it was removed. Once the tag had been removed a bar code was printed out on a small label printer that was placed by the tag reader. This barcode, when scanned with a barcode reader placed nearby, would replay the sound. The barcode could be placed on anything, such as the children's physical drawings, and incorporating sounds into the story. Figure 4 shows the steps involved in using tags and barcodes to record and replay sounds.

**Figure 4. Using RFID tags to record sound and associate them with barcodes which can be placed on top of pictures. The scanned pictures can then be used to retell a story (with sounds) via barcode readers.**

### 3.2. Navigating for storytelling

The tangible version of KidPad involved replacing mice for navigation with a 'magic carpet' which comprised twelve pressure sensors placed under a carpet in front of a large back projection screen (see Figure 5). Standing on any of the three sensors at the front of the carpet (facing the projection screen) would cause the viewpoint to zoom in to the drawing. Standing on those at the back would zoom out and on those at the sides would pan the viewpoint left and right. Multiple sensors could be triggered at a time by several children. In this case the sensor inputs were summed to determine the resulting action. Triggering two or more front sensors would move forwards faster. Triggering one front and one side resulted in a diagonal movement (a combination of zoom and pan). Triggering one front and one back resulted in no movement. In this way, the idea of 'encouraging collaboration' was extended to the tangibles setup. In addition, barcodes were used to allow movement up and down the screen. Two barcodes were stuck onto arrows and placed on the screen below the projection. Two handheld barcode readers were provided to allow up to two children to move the screen together.

**Figure 5. A group of children interacting with the tangible setup. One girl stands on the magic carpet to navigate through the story while another girl is scanning in her physical drawing. The boy is using a PDA to draw his content. The tag reader and barcode scanner are located in the front and to the right of the back projection screen, which shows the story the children are creating in KidPad.**

Children could also navigate directly to one part of the picture using 'links'. An RFID tag was covered with a picture of a KidPad tool, used to link two parts of the story space. When this tag was placed on the RFID tag reader in front of the screen a link was printed. This showed the picture currently on the screen with a barcode by the side. If, after moving to another part of the story, this barcode was shown to the barcode reader, the screen would return to the viewpoint shown on the printout.

The children could use these different technologies at the same time. Icons were displayed on the screen for all the components that were being used at any time.

## 4. Preliminary evaluation study

Early evaluations of the use of elements of the tangible setup took place in a local primary school. These initially involved the magic carpet and barcodes, together with a gesture based navigation system not described here. Initial observations from these experiences are described elsewhere [6]. As a follow up more detailed evaluation a group of four 7 year old children from the school took part in storytelling sessions in a lab-based setup after school, comprising three sessions of about one hour each over a two week period. Each session was video recorded for later analysis.

The arrangement of the session was similar each time. Ten minutes was spent reminding the children how the technologies worked (this session was about 25minutes on the first visit). Then 40 minutes was spent in story creation. Then children spent approximately 10 minutes retelling their story. The task the children were asked to carry out each time was to create a story working together. This story was a continuation of a familiar tale in which they were asked to take one of the characters and create a story around what would happen to them next. At the beginning of each session a new character was chosen and a new story created.

In brief, the main findings arising from the study were as follows. The physical arrangement of the magic carpet for navigating and the use of the barcodes and scanner encouraged children to work collaboratively to input and place their story elements on the large screen. The children also collaborated effectively with the tags, tag reader and barcodes for creating sounds and adding them to physical and digital versions of their story. The large screen as well as the physical arrangement of the sensors and input devices made everyone's actions visible to the group in ways that are difficult to achieve with desktop software, even if it is shared. The physical nature of the setup affected the pace of interaction, making it possible to coordinate activities and to join in or interrupt one another's actions in productive ways. Finally, the use of the PDAs for input enabled the children to switch smoothly between individual, paired and whole group activity.

As the pace of interaction was relatively slow and visible, children were seen to observe other's actions and react to them. The physical distribution of the set-up made it more difficult for a child to work alone in terms of physical effort and time taken to complete a task. As a result, children were often observed to collaborate without verbal communication indicating that the design of the technology encouraged collaborative behaviour. Figure 6 shows an example of this.

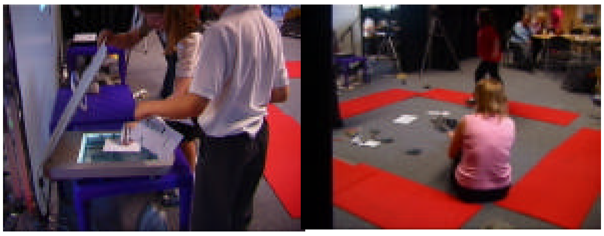

**Figure 6. W. goes to the scanner to input a picture, J. helps him. E. moves to the RHS of the carpet and starts moving it without talking to the others, E had realised that J + W were going to put another scanned picture in and there was no space, she anticipated the problem and went to the carpet herself to move it. J reveals that she is aware of this action by saying, "well done L". She then directs as the others help on the carpet moving the screen until there is enough space.**

## 5. Conclusions and future work

There has been a good deal of interest recently in exploring the use of handheld wireless devices for learning. Much of these early explorations have focused on delivering web-based content to PDAs or the use of handhelds as data 'probes'. However, as Roschelle and Pea [1] have suggested, such devices have much more potential than this, including supporting peer-peer interactions (as opposed to the traditional client-server model) and augmenting physical spaces. The study we have described here provides further support for this claim. The integration of relatively cheap, simple wireless devices together with physical artifacts and spaces (including displays) creates interesting opportunities for seamlessly distributing learning activities between digital and physical worlds.

We have recently built upon our experience with the collaborative storytelling environment to create two further collaborative applications using wireless and mobile technologies. One is an indoor collaborative adventure game called "The Hunting of the Snark" (http://www.equator.ac.uk/projects/snark). The other more recent application is an outdoor collaborative field trip called "Ambient Wood". Both of these projects are supported under the EPSRC's Equator interdisiciplinary research centre.

## 6. Acknowledgements

This work was carried out as part of the KidStory project funded under the EU ESPRIT $i^3$ Experimental Schools Environments initiative (P29310). The authors gratefully acknowledge the contribution of Camilla Abnett, Victor Bayon and Sue Cobb, Albany Infant and Nursery School, Nottingham, and the rest of the KidStory project team.

## 7. References

[1] J. Roschelle and R. Pea, "A walk on the WILD side: How wireless handhelds may change CSCL", *Proc. CSCL 2002* (pp. 51-60), LEA.
[2] S. Benford, B. Bederson et al., "Designing storytelling technologies to encourage collaboration between young children", *Proc. CHI'00* (pp. 556-563), ACM.
[3] A. Druin, J. Stewart et al., "KidPad: A design collaboration between children, technologists and educators", *Proc. CHI'97* (pp. 463-470), ACM.
[4] J. Stewart, B. Bederson, and A. Druin, "Single Display Groupware: A model for co-present collaboration", *Proc. CHI'99* (pp. 286-293), ACM.
[5] C. Abnett, D. Stanton et al., "The effect of multiple input devices on collaboration and gender issues", *Proc. Euro-CSCL 2001* (pp. 29-36), University of Maastricht, NL.
[6] D. Stanton, V. Bayon et al., "Classroom collaboration in the design of tangible interfaces for storytelling", *Proc. CHI'01* (pp. 482-489), ACM.

# The Young Ones: The implications of Media Convergence for Mobile Learning with Infants

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***Abstract*** *Using digital 'smart' toys can help children become more effective users of digital technology. They could make fun and play central to learning in the classroom of the future. They may also provide a way of engaging learners with what technology can do for them without wedding their perceptions of what technology is to the desktop computer metaphor. Through the implementation of a portable or networked learner model, this mobile technology may also allow us to bridge the gap between informal and formal learning contexts.*

## 1. Introduction

There is significant political pressure for increased use of Information and Communication Technologies (ICT) within the infant and pre-school classroom, and beyond, through both wired and wireless technologies. At the same time there has been a call to decrease the use of computers within education [1]. One can speculate about the reasons for this apparent lack of belief in the worth of the technology. For example, too much focus on the technology rather than on what it can do within an educational context perhaps. We need to bear these warnings in mind as we widen the range of technology we introduce to increasingly younger users. "In an age of media convergence, it is important to consider the entirety of children's experiences of their media environment rather than discrete elements of it." [2]. This short paper discusses our work with digital toy technology in children's home and school learning contexts. We describe the work being conducted as part of the CACHET research project funded under the ESRC/EPSRC PACCIT programme. Through considerations of our emerging findings we suggest that young learners are already sophisticated users of technology and are in a position to benefit from the development of educational experiences that merge interactions between different artefacts.

## 2. CACHET: Computers and Children's Electronic Toys

CACHET is a research project that aims to construct an explanatory framework for the interaction and mediation engendered by digital toys. These toys are varied but are all artefacts with which children can interact and obtain a response; some can also be linked to associated PC software. Moreover, the toys provide a new form of interface: one that is not televisual or text-based and does not rely on a desktop metaphor. Instead, they exhibit a range of manipulative and haptic interface modalities. They are qualitatively different from animated pedagogical agents because they are not screen-based, virtual objects but mobile artifacts that can be squeezed and cuddled. There are an increasing number of educationally marketed digital toys. These prompt a number of questions about educational value, for example:

1. Can young children make the connection between two different interfaces and co-ordinate the experience they receive through their convergence?
2. Where is the interface for communication and collaboration when children interact with the toy and with the computer software?
3. To what extent do children understand the toy interface: do they interact with the toy's repertoire, or simply use it as a teddy bear that makes noises?

These questions are of interest to mobile learning researchers if we are going to fulfil the potential offered by media convergence across formal and informal learning contexts. Within the CACHET project we are engaging with learners aged from 3.5- to 6-years and exploring the way they use digital toys and PC software across a range of contexts: the school classroom; out of school clubs, and the home. In this paper we use examples from the school-based studies to illustrate how this work is helping us to explore interactions that co-ordinate multiple interfaces. Clearly, when data gathered in the school is combined with data from home and club, we will be able to consider the potential for working across contexts as well as across artefacts.

# 3. What do Children do with Digital Toys in the Classroom?

In an empirical study with nursery and reception-class children during Autumn 2001 and Spring 2002, we used soft toys[1] based on the American book and cartoon characters Arthur and DW, which feature squeezable sensors in their ears, hand and toes that enable them to respond to children. They invite young learners to join in a large repertoire of number and word games, and wireless technology also enables them to guide children's progress with compatible software. The toys can be shared with other children, teachers and parents.

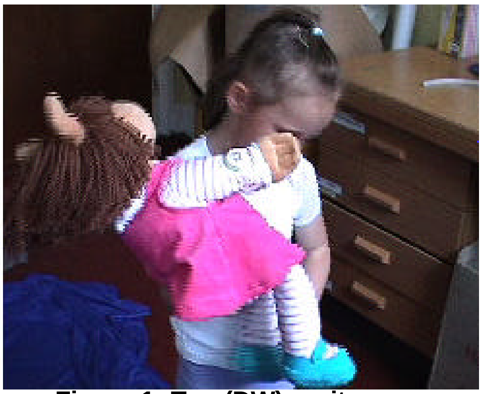

**Figure 1: Toy (DW) on its own**

A total of 36 children have taken part in our school-based study completed in February 2002. The study consisted of videotaped sessions of children (both as individuals and in pairs) using the toy on its own (see Figure 1 above), followed by a session in which the children used the software (see Figure 2 below). In addition to securing parental consent, data was collected from parents about digital toy and computer use in the home. Also, data was collected from teachers about the play behaviour and classroom computer habits of individual children, and each child completed a standardised test of verbal and non-verbal ability.

[1] Microsoft Actimates.

**Figure 2: Toy (Arthur) and Computer**

Videotapes from the software sessions are currently being transcribed. Tables 1, 2 and 3 show extracts from the transcriptions of sessions during which nursery and reception-class age children interacted with the toy and software. Dialogue and behaviour are transcribed in the following categories: researcher comments (R); action (e.g., pointing, looking at researcher, activating toy); comments and dialogue between children and experimenter; comments from the toy (Arthur/DW); and dialogue from on-screen characters. Even at this early stage of our research, findings are emerging that suggest digital toy technology could have a role to play in young learners' educational interactions. We now illustrate these findings with the short transcript excerpts below:

In Table 1, two nursery-age boys (4 an 3;3) are busy with the painting activities provided by the toy and compatible software. Normally during this activity, the toy offers praise and encouragement, which is either spontaneous or prompted by the child squeezing one of the toy's sensors. In this dyad, as in all other male dyads we have observed so far, the more able child (child 1 in this case) dominates control of the mouse. At T=18.15 in this excerpt, child 2 squeezes Arthur's left ear (sq l e) to elicit a verbal reaction. Perhaps encouraged by the resulting flattery from the toy, child 2 first imitates the flattery and then attempts to gain control of the mouse from child 1. After being rebuffed, child 2 then concentrates on imitating the toy. What makes child 2's enjoyment of this imitation remarkable is that his performance on the tests of verbal and non-verbal ability was extremely poor, and imitations like these were the only understandable words uttered during the entire session.

| T | R | Action | Child 1 | Child 2 | Arthur | On-Screen |
|---|---|---|---|---|---|---|
| 18.15 | | C2 sq l e* | | | | Eraser |
| 18.16 | | | | | *You're doing great! | |
| 18.19 | | C2 looks at R | | Doing it great! | | |
| 18.20 | | C2 sq l e* | | | *You're an artist! | |
| 18.24 | | | | | That looks great! | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 18.31 | | C2 tries to control mouse | | Give it to | | |
| 18.32 | | | Wait let me do it | | That looks great | That's great |
| 18.42 | | | | | Neat | |
| 18.44 | | | | | Good job! | |
| 18.46 | | | | | That looks cool! | |
| 18.49 | | | | | You're doing great! | |
| 18.52 | | C2 looks briefly at Arthur and touches l arm | | (mumble) | That looks great! | |
| 18.55 | | | | Doing it like, that's *great*! | | |
| 18.59 | | C2 attention back to screen | | (mumble) | That looks cool! | |
| 19.02 | | | | That – looks – cool (laughs) | | |
| 19.04 | | | | | Good job | |
| 19.05 | | | | Good job (mimicking A) | | |

**Table 1: Software session with nursery-age boy-dyad and toy**

In Table 2 below, the flattery offered by the toy is not so well received. This is an excerpt from a session involving older, reception-class boys (4;4 and 4;11) who scored highly on the verbal and non-verbal tests. Child 1's frustration at not being in control of the on-screen action emerges as irritation at the irrelevance of the toy's flattery. Eventually during this session, both boys began to verbally abuse the toy and subjected it to some rather rough and inappropriate treatment.

| T | R | Action | Child 1 | Child 2 | Arthur | On-Screen |
|---|---|---|---|---|---|---|
| 4.04 | | 2 in control of mouse | | | You're doing great! | |
| 4.08 | | C1 turns to R | He keeps on talking | | | |
| 4.10 | | | | | You're doing great! | |
| 4.12 | | C1 points to on-screen printer icon | (mumble) Press that printer | | | |
| 4.15 | | | | No | | |
| 4.18 | | | Just chuck it | | | |
| 4.21 | | | Push…just …(mumble) throw it that hard | | | |
| 4.48 | | | | | That looks cool. You're an artist* | |
| 4.51 | | C1 looks at Arthur | *We're not! Just stop talking for a bit | | | |
| 4.57 | | | | | That looks cool | |

**Table 2: Software session with reception-age boy-dyad and toy**

The results from our teacher assessments confirm the traditional view: girls spend less time using the class PC, and less time trying to work out how things work. However, initial inspection of the video data suggests that girls may engage with the toy in a qualitatively different way to the boys. The girls showed the toy more affection, and responded more appropriately to the toys help prompts. Table 3 contains an abridged extract from a session in which a reception-class girl (5;0) worked alone at the painting activity. In this case the toy chosen was DW, the female version of the Arthur Actimate (in fact, his sister). In this extract, the girl spontaneously offers her opinion of the Actimates, which she refers to as 'puppets'.

| T | R | Action | Child | DW |
|---|---|---|---|---|
| 46.53 | | C selects new backdrop, looks at R | Is DW good? | |
| 47.03 | Well - she's sitting there, isn't she | | | Neat |
| | | | I think she is good because she's, she's sitting there doing all the work with me | Good job<br>Neat<br>Neat<br>You're an artist<br>That looks cool |
| *** | *** | *** | *** | *** |
| 49.39 | | | I like these puppets | Woah, that looks great |
| | | C turns to R | | Good job |
| | | C turns attention back to screen | Do you know why I like these puppets? 'Cause they speak – On their own | |
| | And they can tell you what to do, can't they? | C nods | | You're an artist |
| | | | And they can move | That looks terrific |
| | | | You don't have to put, wh…when/ | |
| 50.06 | And you don't have to what, C? | | | You're an artist |
| | | | And you don't have to make them move their arms, with your hands – they can just move on their own | You're doing great |

**Table 3: Software session with individual girl and toy**

We now return to the questions raised in section 2 above:

1. *Can young children make the connection between two different interfaces and can they co-*

*ordinate the experience they receive through their convergence.*

There is substantial evidence to suggest that children as young as 4 years are not fazed when faced with feedback and interaction possibilities from different artefacts. For example, in table 2 the boys might not have liked Arthur's commentary, but they had no problems in relating the output coming from the toy with their interactions through the screen.

2. *Where is the interface for communication and collaboration when children interact with the toy and the computer software?*

Here we consider this question in terms of the communication and collaboration that can occur between children when sharing these resources. The technology can allow peers simultaneous access to interactions with the content and activities in a way that the standard desktop does not. In Table 1 for example, we see one child manipulating the Arthur toy whilst both children interact with the software. In contrast, children operating the PC by themselves are often so completely absorbed in the software that they pay little or no attention to the toy.

3. *To what extent do children understand the toy interface: do they interact with toy's repertoire, or simply use it as a teddy bear that makes noises?*

The children in the study were able to understand the mechanics of the toy interface and all could engage at an operational level of interactivity. For example, the child in Table 2 – despite achieving only a very low score on the test of verbal and non-verbal ability, had no problem in grasping the nature of the toy's interface and relating it to the on-screen activity. However, both with the toy on its own and in its combination with the PC software not all children engaged in activities at the conceptual level. Unlike adults [3], they are not 'taken in' by the constantly positive and flattering feedback. Even if they take notice of the help prompts, they do not all interpret them correctly. In particular when using the PC software they do not always have sufficient mastery of the traditional mouse/keyboard interface to implement the advice they are offered

# 4. Conclusions

Young children are sophisticated users of technology who can co-ordinate the integration of multiple interfaces and multiple artefacts. The use of non-screen based tactile, mobile devices can engender social interactions and collaboration between peers. It may also be instrumental in redressing the current gender imbalance in the educational use of computers. All this is important for those of us interested in the expansion of mobile learning and its integration into different learning contexts. Toys may provide a way of engaging learners with what technology can do for them without wedding their perceptions of what technology is to the desktop computer metaphor or indeed to any artefact in particular. They may also help us to bridge the gap between informal and formal learning contexts.

# 5. References


[1] Cordes, C. and E. Miller, eds. *Fool's Gold: A Critical Look at Computers in Childhood*. 2000, U.S. Alliance for childhood

[2] Stephen, C. and L. Plowman, *ICT In Pre-School: A Benign Addition? A review of the literature on ICT use in pre-school settings*. 2001, Institute of Education University of Stirling.

[3] Fogg, B.J. and C. Nass, *Silicon sycophants: The effects of computers that flatter. International journal of human-computer studies 46(5):551-61*. International journal of human-computer studies, 1997. **46**(4): p. 551-561.

# ITZ GD 2 TXT – How To Use SMS Effectively In M-Learning


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## Abstract

*This paper reports the results of an experiment undertaken to test the effectiveness of a two-way SMS campaign for a UK youth brand. The experiment was undertaken by a group interested in m-learning which is about to embark on interactive some interactive SMS projects to support students. It is proposed that these results and their findings can inform more effective m-learning design, for interactive SMS and more sophisticated applications.*


## 1. Introduction

The Learning Technology Research Group (LTRG) at Kingston University has interests in the effective use of multiple media in teaching and learning, [1] its evaluation from a user-centred perspective [2,3] and is also actively engaged in the effective use of mobile telephony as a medium to support this [e.g. 4,5]. At the time of writing, we are developing a number of m-learning applications including ones to support students from Further Education (FE) to postgraduate levels, and students in their placement year. In late 2001, an experiment was undertaken to test the effectiveness of different styles of two-way SMS campaign for a youth brand in the UK.

The purpose of the experiment was fourfold:

- To evaluate the effectiveness of SMS as a data collection mechanism for the youth brand
- To compare different data collection processes
- To produce guidelines for future SMS activities
- To compare email, SMS and the web as ways of announcing SMS campaigns

## 2. Outline of the experiment

A sample group of 1000 mobile users were invited to take part in a prize draw: they had to send their name, university, house number and postal code by SMS. This sample group was divided into 4 subgroups to test the effectiveness of different types and lengths of SMS interaction. For the purposes of clarity in the remainder of this paper, the groups are referred to as follows:

Group 1:
*Announce campaign via email, request all info at once*
Group 2:
*Announce campaign by SMS, request all info at once*
Group 3:
*Announce campaign by SMS, 2-step process*
Group 4:
*Announce campaign by SMS, 3-step process*
Group 5:
*Campaign announced on website, 2-step process*
*(This was an additional group, which comprised of those who followed a link to the campaign on the web site)*

The experiment was designed to address a number of research questions:

1. How well and how quickly do the selected audiences respond to the SMS campaign?
2. Does increasing the number of steps in the process improve the quality of the data?
3. Does increasing the number of steps in the process reduce the number of responses?

4. How does the method of announcement affect the participation, quality of the data and the speed of response?

We believe these questions are equally valid in the context of developing better quality mobile teaching and learning support, as they are in determining effective marketing practice for a youth brand. However, the implications for these two areas are quite different. In this paper, we are concerned with the latter - how the research can help us develop better m-learning applications.

## 5. Results and comments

The results from the study are presented here, with comments on the findings. As explained above, this data has implications for both the company which was working with us (and others interested in using SMS as a youth marketing tool), and for those interested in using SMS and mobile telephony as an effective tool in education (sometimes referred to as "m-learning").

### 5.1. Total replies received and comments

| | Group1 | Group 2 | Group 3 | Group 4 | Group 5 |
|---|---|---|---|---|---|
| Replies | 4 | 43 | 42 | 62 | 81 |
| % response | 1.6% | 17.2% | 16.8% | 24.8% | N/A |

**Table 1: number of replies and % response**

This measured the total number of responses irrespective of whether they were correct or not. Group 5 is excluded, as this group did not receive an invitation to participate. The relative failure of the email group is the most striking feature of these results, particularly compared to the results obtained by an announcement by SMS. These response rates are unlikely to be sustained in the commercial marketing sector, as SMS marketing becomes more common over time.

However, this data is very useful to indicate the willingness of students to respond to an SMS request for interactivity, in order to have a service (unsolicited – but offered with consent) provided, in this case, entry into a prize draw. We feel that where a university offered timely, relevant support services that would facilitate student life vis-à-vis their dealings with the university and library, these results are encouraging to support such developments.

Group 2 might have been expected to produce fewer responses than 3&4 because of the complexity of the response that was required. Group 3&4 were asked for the same initial response, so these might have been expected to produce more similar response rates. Group 2 has been excluded from the results except for the total number of correct responses.

### 5.2. Correct responses and comments

| | Group1 | Group 2 | Group 3 | Group 4 | Group 5 |
|---|---|---|---|---|---|
| All correct | 4 | 38 | 27 | 48 | 63 |
| % response | 1.6% | 15.2% | 10.8% | 19.2% | N/A |
| % correct from all response | 100% | 88.4% | 64.3% | 77.4% | 77.8% |

**Table 2: breakdown of correct responses given**

A correct response was identified if the information supplied was complete, even if it had been supplied in the wrong order or with incorrect punctuation. It might require human intervention to clean and extract the relevant information. Keywords were not required for a response to be correct.

It was noted that most people supplied the correct information, although often in the wrong format with additional punctuation and occasionally comments. These responses would sometimes be hard to read automatically, particularly where there is potential ambiguity. The high percentage of correct responses from Group 2 is unexpected, given that all four pieces of information had to be supplied at the same time.

### 5.3. Keyword responses and comments

| | Group 2 | Group 3 | Group 4 | Group 5 |
|---|---|---|---|---|
| Keyword | 40 | 41 | 58 | 81 |

| | | | | |
|---|---|---|---|---|
| used | | | | |
| % responses using keyword | 93% | 97.6% | 93.5% | 100% |

**Table 3: comparison of keyword usage**

Keywords are vital if SMS campaigns are to be run simultaneously using the same server/number to make sure that the incoming message is processed in the right way. Most people correctly included the required keyword and all those who could see the instructions as they replied (responding to offer from the web site) used the keywords.

### 5.3. Correct punctuation and comments

| | Group 2 | Group 3 | Group 4 | Group 5 |
|---|---|---|---|---|
| Keyword used | 19 | 12 | 20 | 35 |
| % responses punctuated | 44.2% | 28.6% | 32.3% | 43.2% |

**Table 4: breakdown of correct punctuation usage**

Messages were correctly punctuated when a comma separated each item. Every outgoing message included an example of the punctuation required. Correct punctuation is required, in order to make machine processing of the data straightforward.

Relatively few of respondents in all groups copied the required punctuation. We found it extremely surprising that the group 2 (the one perceived to have the "hardest" task) produced the highest quality responses. It was also noted that many responses inserted an extra comma after the keyword; these were not included in the totals above.

### 5.4. Correct punctuation and comments

| | Group 2 | Group 3 | Group 4 | Group 5 |
|---|---|---|---|---|
| Mean<br>Median | 320<br>33 | 123<br>26 | 486<br>32 | 5403<br>5687 |
| Min | 6 | 10 | 7 | 18 |
| Max | 3228 | 1584 | 7268 | 11398 |

**Table 5: Speed of response (minutes)**

SMS and emails were sent out simultaneously to the target groups and the first response time was measured. It is useful to note that the mean time before the initial response is less useful than the median (the time by which half the respondents had responded). This is because we anticipate applications using interactive SMS in m-learning will be those which are quite time-sensitive; e.g. short revision tests, placement support applications, and other scenarios where the exchange of information within a narrow time-scale is essential.

Consequently, the median is a more indicative measure of how to estimate expected response times where interactivity is required, allowing "outliers" to be discounted that would greatly increase the mean statistic. Such anomalies may be due to illness, lost phones, or lack of interest in completing the exercise. However, we believe it is reasonable to assume that students using such technology to support their own learning would be more motivated (particularly with an opt-in service model), and so feel justified in using the median as opposed to the mean in this analysis.

The SMS groups (2,3,4) reached 50% response within about 30 minutes with early responses within 10 minutes of the initial outgoing message. It is instructive, in the light of the above discussion on the efficacy of the use of median versus mean as the most useful statistic for considering an "average", to consider the distribution of actual response times over the exercise.

### 5.4. Distribution of response times

As can be inferred from Figure 1, SMS produces dramatically faster results than the web. This has major implications for ensuring timely reactions from participants. Many of the applications we are in the process of developing are of a time-sensitive nature. These results only strengthen our claims that SMS is a medium that can support such demands, due to the nature of its usage patterns by students.

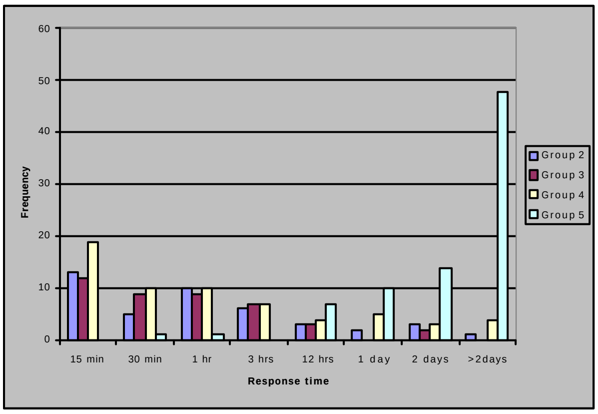


**Figure 1: distribution of response times**

## 6. Other comments and observations

A few respondents clearly believe that their messages are being read by a person because they include chatty comments and punctuation (e.g. "thanks!", "thanx", "who is this?").

Multi-part dialogues do not appear to reduce respondents' willingness to participate. Furthermore, mobile users are prepared to co-operate with fairly complex interactions and to supply accurate information. This is particularly useful given the constraints of the current technology in use by the student population (i.e. SMS).

Whilst the take-up of improved standards, technologies and protocols (i.e. EMS and MMS) will mean vast improvements in terms of potential user-friendly interfaces, it is encouraging to note that in spite of the constraints, effective applications may be developed using current technologies. As this generation of users moves on from education to work, there is a great potential to provide them with resources with future generations of mobile devices, knowing that they have grown up comfortable with a notion of m-learning already.

Careful consideration needs to be given to the human tone of the messages, as users appear to associate messaging with personal contact. If it is not made clear what the functionality of an application is, and the extent to which "errors" are dealt with in a user-friendly manner, the "over-interaction" with such a system may result in negative user experiences.

There are many issues that require investigation in order to successfully develop and implement effective mobile learning applications. We believe that our research will help inform the effective development of interactive SMS-based applications, and provide a positive and novel contribution to educational technology and pedagogy.

We find these results an indication that SMS is a medium preferred by students in certain scenarios where a certain type of response is required. This could therefore be interpreted as supporting evidence for its efficacy as a complementary media, being used in a novel combination but as a 'hybrid strategy', developed from old ones used as separate technologies [4].

## 7. Acknowledgements


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## 8. References


[1] Alsop, G. and Tompsett, C.P. "Interface Design In Learning Management Systems". Contact g.alsop@kingston.ac.uk for a username and password access to http://infosys.king.ac.uk/LTRG/. [Presented at ALT-C 2001 Edinburgh].

[2] Alsop, G. and Tompsett C. P., "A Grounded Theory Investigation of Students' Perceptions of Learning Management Systems", *Proceedings of the 9th Improving Student Learning symposium, 2001*, Oxford Centre for Staff and Learning Development, Oxford (in print), 2002.

[3] Stone, A., Alsop, G., Tompsett, C., "Grounded Theory as a Means of User-Centred Design and Evaluation of Mobile Learning Systems", *Proceedings of 2002 International Workshop on Wireless and Mobile Technologies in Education, IEEE*, Växjö, Sweden, 2002 (forthcoming).

[4] Stone, A., Alsop, G., Briggs, J.,.Tompsett, C., 'M-learning as a means of supporting learners: tomorrow's

technologies are already here, how can we most effectively use them in the e-learning age?", *Proceedings of the Third International Conference on Networked Learning 2002,* , Sheffield, UK, 2002, pp. 558-563.

[5] Stone, A., "Mobile Telephony and Learning: Nuisance or Potential Enhancement?", *Proceedings of 2002 International Symposium on Technology and Society (ISTAS'02) Social Implications of Information and Communication Technology, IEEE,* Raleigh, NC, 2002 (forthcoming).

# An Evaluation of the Implementation of a Short Message System (SMS) to Support Undergraduate Student Learning


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## Abstract

*An evaluation of a short message system (SMS) was undertaken with 67 undergraduate psychology students. Information was collected on student's perceptions of effectiveness of the system to guide, prompt and support their learning. The findings were overwhelmingly positive, with students perceiving the system to be 'immediate, convenient and personal'. One hundred percent of participants requested that such a system be used to support their future study. Suggestions are made for development of such systems and future research.*


## 1. Introduction

Post Dearing (1997) universities have been required to recognise that there is a changing student population. A change that has been further influenced by the Widening Participation (2002) agenda within universities. The payment of fees has also influenced the behaviour and attitudes of the student cohort toward study. A growing number of students have important commitments outside university. Many students have to work to support themselves financially. There is also an increase in the number of students with child care responsibilities. No longer can students be perceived as 'campus based', and there is an increasing 'distance' between student and university. One way in which universities can recognise these changes is by enhancing communication systems. Universities can potentially learn how to improve communication from examples within industry. Chiem (2000) reported that industry was changing how communication occurred with customers. SMS texting was cited as one way in which customer loyalty and sales could be enhanced. While universities may not be seeking to enhance sales, customer loyalty is a central concern when it is expressed in terms of student retention and satisfaction. Effective communication is an essential part of education and flexible communication is one way of enhancing effectiveness

The independent learner is the goal of higher education. However, the development of a student from a taught approach to a more independent learner can be difficult, especially at the transition point, where a student can potentially feel isolated. Therefore it is important that there are effective systems of communication between student and university.

This paper addresses the role that SMS can play in bridging the communication gap as students become independent learners and increasingly more 'distant' from the university .

One of the key problems that has been identified about establishing independent learners is the feeling of isolation, in that students do not feel part of a learning community which can offer support and cohesion at times of doubt. An SMS system to keep in contact with students could potentially play a key role in maintaining a supportive community. The use of technology to support communication between actor and agent is not new. Paging has been used with the medical fraternity to engage with patients and support their medication regime. Erickson et al (1998) reported how paging improved compliance with medication. This enhancement was achieved mainly by sending the patients prompts to take medication. Crucially this study also noted the cost effectiveness of the system, both financially and in the quality of life the patients. Similar conclusions were reached by Hanada et al (2000), and Facchinetti et al (1998) with patients reporting greater levels of satisfaction with the quality of care and enhanced compliance when paged with instructions. Paging has also been used with groups who have specific memory problems, Wilson et al (2001) reported notable improvements in memory when patients were prompted with reminders during the day. This indicates the possibility to enhance engagement with tasks via a prompting system. Prompting that can occur remotely and be received in the lived environment.

Medical paging systems have had a positive effect on patients care and satisfaction. There are example of where SMS systems have been used more spontaneously and collectively. Coronel

(2001) reported how the use of SMS messaging within the Philippines hastened the downfall of President Estrada in 2001. The emphasised some of the key strengths of SMS messaging, in that it is quick, efficient and reliable. It is a technology that has become embedded into world culture and is readily used. SMS systems can be used to access banking details (Helme, 1999) and for voting in the UK local elections in Spring 2002. However, a potential negative perspective is the 'big brother' monitoring nature of such systems, which students potentially could view as oppressive and run counter to independent learning. Therefore care must be taken not to send an excessive and unnecessary amount of prompts or information. On the whole the above examples indicate however that SMS is a known and understood technology, which would suffer from little technopobia or distrust (if used appropriately) that can completely undermine some new technologies.

From the above it can be concluded that SMS can be used to interact with people and influence their actions and understandings of situations. SMS is a stable technology that is known and utilised in an ever-increasing range of environments, indicating that technological implementation should not prove problematic. This evaluation will investigate students' perception of a SMS messaging service within their study.

## 2. Method

### 2.1 Participants

Participants were 67 1st year undergraduate psychology students. These students represent approximately 78% of the entire 1st year cohort and were predominately female aged 18 - 20 years. The entire year group were briefed as to the nature of the project and given the option to participate in the study. Volunteers were asked to provide their mobile number (and network), student identity number, name (optional) and support group number (the entire undergraduate is divided into 6 support groups). The latter would allow text messages to be sent to individual support groups.

### 2.2 TEXT System and Messages

Messages were texted to student mobiles from a PC using the C-Soft Mobile Messenger system. The system was chosen for its ease of use and its ability to allow communications to be sent to specific groups within the cohort.

Over the course of the evaluation a total of 8 messages were texted to the students. The messages covered a number categories, for example, reminders of assessment submission dates and examination dates, postponed teaching sessions and general seminar/lecture session information.

### 2.3 Evaluation Questionnaire

The duration of the evaluation was approximately 4 months. At the end of the formal teaching period a SMS project evaluation questionnaire was distributed to participants. Initial questions investigated the participants overall evaluation of the messaging system, including its strengths and weaknesses and which categories of message they found most/least useful. Participants were asked to rate their preference for this system in comparison to other sources of information delivery i.e. e-mail and notice boards. Participants were also asked a number of questions relating to how the system could be improved and extended. Responses to questions were either *tick box* or short written answers.

## 3. Results and Initial Discussion

95.4 percent of the participants rated the SMS system as positive or very positive addition to the methods of information delivery. Reasons offered to support this included that the system was convenient (54 respondents), immediate (47 respondents) and personal (16 respondents). There were only 10 respondents who highlighted negative issues, these mainly referred to the limited amount of information in each message. These findings clearly indicate that the students overwhelmingly perceived the system as a positive addition to aid their study.

The messages sent were categorised into; course information (e.g. exam dates), emergency (e.g. lecture X is postponed) and prompt information (e.g. please collect feedback)., The results showed that course information was rated as the most useful category of message, with emergency and prompt information rated approximately equally and second most useful. These findings were supported and elucidated when the inverse question was asked requesting student to identify the two least helpful categories of message. Only a minority of students chose either course or emergency messages with a much higher number selecting prompt messages as one of their choices. It can be concluded therefore that students perceive course details and emergency changes as the most useful and therefore ideal categories of message to be sent via an SMS system

Students were given the opportunity to indicate if they would have like other information to have been sent via text, 75.8% indicated not. Of the 24.2% who would have liked other information their comments centred on information being available for other courses outside their psychology course (student take an option subject not run within the psychology dept).

Only 19% of the participants reported experiencing 'problems' with the system. These were mainly related to change of mobile telephone number and the procedure for informing the text system administrator of this change. At the time of conducting the project no formal system for supplying change of number information was in operation. It should be recognised that within such a system there is a reasonably rapid turnover of mobile handsets. Therefore in the administration of such a system an efficient and simple method for submitting, receiving and updating the participant information on the database must be in place.

A number of questions investigated participants' preference for the three main methods for providing written information i.e. notice board, e-mail conferences and text. There was a clear preference for text messaging over the other two methods. Sixty-one percent preferred text over e-mail and 91.5% preferred text over notice boards. The notice board was the least popular method of providing information with 96.6% preferring e-mail over notice board. These results demonstrate a clear preference for electronic information sources. This is probably associated with the immediacy and convenience of access of this information. Moreover, text messaging was by far the most popular way of providing information. Again this probably reflects the immediacy and convenience (not location bound) of text. Very little effort and organisation is required to collect texted information and messages are delivered with a clear prompt to action. E-mail messages require access to a PC (specific location) and organisation to check messages with little prompting.

The participants although clearly confident with using the text system, largely favoured (79%) having another back-up means of providing the same information. E-mail was the most popular support system. The advantages of the e-mail system as support is that it is bi-directional and students can ask further questions for clarity and comment upon the material provided.

An indication of the text systems success is that 100% of participants wished for the system to be continued when they enter the second year of study.

## 4. Conclusions

This initial evaluation of SMS usage in H.E. has been overwhelmingly positive, in terms of ease of implementation, utilisation and students perception. Further close study needs to be undertaken to investigate its direct influence on effective study and integration with other communication systems. However, even in this basic format students want it to form part of their future H.E. learning experience.

The system evaluated was a transmission system from staff to students, the evaluation indicated a demand for a two-way communication procedure to be put in place, both staff-student and student-student. This would enhance the sense of learning community between students as they would 'own' and directly engage with the communication system (Coronel, 2000). Such a system would also facilitate them taking on more responsibility for their learning, so enhancing their independence, a key goal of Dearing (1997). However, students would require a mobile phone to benefit from the system and the additional financial burden this would place on students would have to be considered fully (although many students do own a mobile phone). This financial burden would be key if such systems were presented as ways of addressing the Widening Participation Agenda (2002). The flexibility of text messaging enhances students' time management possibilities and ensures as little time is wasted with unnecessary journeys if classes are postponed. This is ideal when attempting to support students who may have work or care responsibilities outside their full time study. However, the cost burden should be monitored to ensure the positive supportive system does not exclude the target students financially.

SMS appears to have a positive contribution to make to universities' on going developments to meet the demands of a more diverse student base and become more flexible. This initial evaluation has indicated that even in its most simplistic form SMS has sound pedagogic contributions to make to the support and development of students learning.

## 5. References


Auditor General (2002) Widening Participation In higher Education in England and Wales. London: The Stationery Office

Chiem, P.X. (2000). Live help is on the way (customer relationships online). BtoB, 85, 20, 25-6.

Coronel, S.S. (2001). The media, the market and democracy: the case of the Philippines. Javnost, VIII, 2, 109-124.

Dearing, R. (1997). Higher Education for the 21st Century. DfEE Report. HMSO.

Erickson, S.R. et al. (1998). Use of paging system to improve medication self-management in patients with asthma. Journal of American Pharmaceutical Association, 36, 6, 767, 769.

Facchinettic, N.J. (1998). Using paging technology for reminding patients. HMO practice, 12, 1, 39-40.

Hanada, E. et al (2000). Advantages of low output mobile communication systems in hospitals. Journal of medical systems, 24, 2, 53-59.

Helme, S. (1999). Branching out (mobile banking). Banking Technology, 16, 9, 40-42.

Wilson, B.A. et al. (2001). Reducing everyday memory and planning problems by means of a paging system: A randomised control crossover study. Journal of neurology, neurosurgery and psychiatry, 70, 4, 477-482.

# Mobile technologies for informal learning – reflections on past research

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## Abstract

*The focus of this paper is adult informal learning. The viewpoint presented here draws upon earlier research [1] that explored design issues involved in creating media rich learning materials using an interactive drama metaphor. A literature review of learning, media and cultural theories was undertaken to underpin this research. This paper focuses on the learning theory element and updates it to consider its relevance to mobile computing and communications technologies.*

*Keywords: adult informal learning, learning theory*

## 1. Introduction

The use of computing technology for learning has been tried in various ways over several decades. Unfortunately, the promise of research has not always been realised in practice. The introduction of mobile, hand-held and other forms of ubiquitous computing now offers similar promises and raises similar questions.

These personal technologies need to be integrated within an interdisciplinary framework of theory and practice. Such a framework needs to support the learning needs and wants of people, and link into the qualities of the technology and media resources that are employed. This creates a three-way relationship between learners, educators and content developers.

The relationship between these three groups has been explored in research [1] that describes the design processes and concepts involved in creating multimedia learning environments (MLEs) for informal learning purposes. The research took an interdisciplinary perspective to investigate the learning that interactive drama might engender in the representation of significant life experiences. In this case relating to the personal aspects of pregnancy. This work offers some useful insights for future research into m-learning.

## 2. Theories to support informal learning

One of the motivations for looking at informal learning was the realisation that people are being asked to take more responsibility for the important decisions and choices that they make in everyday life. Health is one such domain. There are many others related to personal lives, relationships, employment and education. It very quickly became clear that such learning involves not only the development of personal knowledge but also a great deal of learning related to individual identity, values, relationships and emotions.

Some of the theoretical perspectives that can inform our thinking on informal learning include John Dewey's [2] views on the nature of experiential education. He describes learning as being far more than an individual internal process. Learning takes place under a continual flow that involves interacting and sharing spaces with others. These spaces may be physical, imagined or artificially built and are driven by the dispositions and abilities of learners. Vygotsky [3] also recognises the complex processes of development and learning through language and social interaction. Bandura's social learning theory [4] presents learning in terms of observation of other people's activities and the outcomes that result. His theory emphasises the self-regulatory processes that enable people to build up complex patterns of social behaviour.

Lave & Wenger [5] give an explanation of situated learning in terms of the interactions and complex cultural interrelationships that occur between people, communities of practice and the tools or artefacts in which learning activities are embedded. From this viewpoint, the use of technology has a huge cultural and historical significance within a learning community.

These writers recognise, from their own perspectives, how language, social interaction and cultural artefacts all present hugely important areas in the learning process. When combined, they parallel Visser's [6] view of people's learning as being multidimensional at all levels of social involvement and as an ecological phenomenon.

Other areas of learning are also of relevance to the use of mobile technologies in informal learning. They are likely to grow in significance as the capabilities of mobile technologies develop and interconnect with other forms of media and social interaction. Examples include somatic or embodied learning, narrative learning [7] and the role of emotions [1].

## 3. Changing perceptions of media

Research into the learning of individuals and groups suggests that people will draw upon information and opinion from a variety of sources and experiences. So for example, adolescents learning about various aspects of growing up will draw upon knowledge of friends and family, broadcast media, magazines and the Internet as well as more formal places for advice and education [8,9]. Research into the learning needs of new parents [1] suggested that the interpersonal and emotional nature of such learning often involves difficult and emotive choices. The formation of knowledge, beliefs, values and decisions can come from sources as diverse as medical practitioners, family, urban myth and soap opera.

Mobile technologies have leverage on the social lives of many people. Palen et al [10] have found that new mature users of mobile technologies can show a degree of reticence towards their purchases, but that they soon shed their reservations. Holmes and Russell [11] have studied the use of mobile and computing technologies by adolescents. They suggest that society is moving to a second age of interactivity, where an interactive communicative form of dissemination is taking over from the broadcast mode. They argue that there is likely to be a weakening in the power of traditional institutions. Networked-based environments engage people with new sets of cultural relationships. This, they say, radically shifts the role and potency of traditionally authoritative sources of knowledge such as publishers, broadcasters and classroom educators. It also "recalibrates personal relationships" and notions of personal identity.

## 4. Conclusions

There is much to discover about the adoption of mobile technologies for learning. Learning is a socially situated process that is centred on the relationships a person or group of people have with their cultures and environments. People are not automatically swayed by gadgetry. A new technology must offer new abilities, and fit with culture and context, to be successful with any group of learners.

The research described [1] found that in order to make the most of learning technologies, there is a need to understand the social lives and learning wants of the people who use it, their perceptions of self, roles they adopt, media literacies and emotional responses.

It is also important to realise that technologies will not automatically resolve the need for wider learning experiences. This in combination with research into the situated and ecological nature of learning can provide one route towards investigating the impact that mobile technologies will have on our informal learning processes.

Mobile devices can offer immediacy of access, freedom of location, personalised attributes and communication features, as well as an increasing variety of media features. However their size does place limits on their capabilities in comparison with other media and computing technologies. It is their ability to work as 'personal devices' in context with other experiences, situations and media that give them their potential.

## 5. References


[1] T.J. Rogers, *Design models for multimedia learning environments based on interactive drama*, PhD Thesis, University of Plymouth, 2000.

[2] J. Dewey, *Experience and Education*, Macmillan, New York, 1938.

[3] L.S. Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*, Harvard University Press, Cambridge, MA, 1978.

[4] A. Bandura, *Social Learning Theory*, Prentice-Hall, Englewood Cliffs NJ, 1977

[5] J. Lave and E. Wenger, *Situated learning: legitimate peripheral participation*, Cambridge University Press, Cambridge, 1991.

[6] J. Visser and Y.L. Visser, "Undefining learning: Implications for Instructional Designers and Educational Technologists", *Educational Technology*, 2002, Vol. 42, No. 2, March-April, pp15-20.

[7] M.C. Clark, "Off the Beaten Path: Some Creative Approaches to Adult Learning", *New Directions for Adult and Continuing Education*, 2001, No. 89, spring, pp 83-91.

[8] R. Hammersley, J. Ditton and D. Main "Drug Use and Sources of Drug Information in a 16-year-old School Sample". *Drugs: education, prevention and policy*. 1997, Vol. 4, No. 3, pp231-241.

[9] M.S. Larson, "Sex Roles and Soap Operas: What Adolescents Learn About Single Motherhood", *Sex Roles*, 1996, Vol. 35, No. 1/2, pp97-110.

[10] L. Palen, M. Salzman and E Youngs, "Discovery and Integration of Mobile Communications in Everyday Life", *Personal and Ubiquitous Computing*, 2001, Vol. 5, pp109-122.

[11] D. Holmes & G. Russell, "Adolescent CIT Use: paradigm shifts for educational and cultural practices?", *British journal of Sociology of Education*, 1999, Vol. 20, No. 1, pp69-78.

# Location Activated Nomadic Discovery (LAND): A Mobile, Location-Sensitive Visitor Information and Navigation Service for Cumbria

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## Abstract

*The LAND project aims to significantly enhance the accessibility of tourist information by offering a mobile system that delivers media rich information tailored to the user according to context. By relating user profile and current location to content, LAND empowers visitors to discover the wealth of 'hidden' environmental and cultural knowledge embedded in the region. This paper identifies the key elements in the LAND project.*

*Keywords: location-based services, PDA, GPS, interoperability, wireless network*

## 1. Introduction

Reports from tourism professionals indicate that many visitors are conservative in their exploration of the target region. This is attributed to the visitor's lack of knowledge of the area and compounded by their unfamiliarity with the means to acquire that knowledge.

Cumbria attracts over 12 million visitors per year and is heavily used by walkers, a large percentage of whom already carry with them mobile phones or personal digital assistants (PDAs) and two-dimensional maps on paper.

The LAND prototype will deliver media rich content on a GPS-enabled PDA defined by both the geographical co-ordinates and the personal profile of the user.

## 2. The Project

LAND is a database driven application hosted on a server and accessed on a mobile, networked device. Static data, such as mapping data, will be stored on the PDA whereas dynamic data such as destination management information will be delivered on the fly using a wireless service. The end-system will be context-sensitive, i.e. it will have knowledge of the user and of their environment including, most importantly, their physical location by means of GPS. This information will be used to tailor the system's behaviour in order to provide users with an intelligent visitor guide.

The interface will present 3D mapping data on screen around which the user will navigate, orienting themselves by means of GPS.

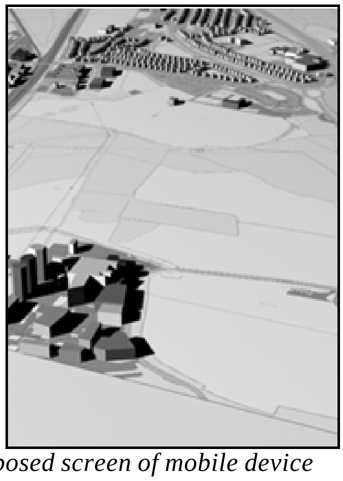

*Figure 1. Proposed screen of mobile device*

## 3. Current Provision

The LAND project focuses upon the provision of location-based information. Specifically information tied to geographic co-ordinates and the information required to successfully navigate between these co-ordinates.

There are a variety of resources available to the tourist for both route finding and location specific information. Prior to visiting an area, visitors often research the area in guidebooks. However this form of information provision can only represent historical and other static data and risks becoming merely a snapshot of the life of the area during one fixed point in time.

The staff within Tourist Information Centres maintain a wealth of local knowledge but are clearly fixed to a physical location requiring the visitor to plan their route around specific geographic locations.

Visitors commonly use maps to both reach the area to be visited and to further explore once they arrive. This relies upon an ability to read maps, a skill that is neither innate nor straightforward. The translation of two-dimensional map data into a three-dimensional form is a critical cognitive demand in successful map reading [1] however well established gender differences point out that spatial awareness skills are not distributed evenly throughout society.

## 4. Enhancing Current Provision

Clearly then there is a considerable amount of valuable data held by public information agencies that is currently not offered in the form most suited to the needs of visitors. Cumbria Tourist Board is currently developing a large database for the region; this will include a destination management system and contextual information about the area.

Visitors with access to handheld devices will be able to link through a wireless network to this knowledge base. Live access to dynamic data such as this will give the visitor access to up to the minute information; new events, changes in venue etc will all be immediately available to the visitor avoiding the provision of redundant information. In addition information available to the user will be filtered according to the user's personal profile ensuring the relevance of the data delivered. This intelligence will enable the device to direct the user to locations, events etc that they may not have considered but nevertheless matches their profile.

The visitor data must be up to date to ensure the success of LAND. The commercial exploitation phase of the development will explore a number of options for making regular updates of the mapping data and location based information available.

To encourage exploration visitors must first be reassured that they can successfully make their way around an area with confidence. The LAND system aims to provide this reassurance by translating existing mapping file formats into a navigable 3D form. Research indicates that users can more readily familiarise themselves with a real world environment after exploring virtual environments than after looking at two-dimensional maps [2].

LAND reduces the focus upon spatial awareness skills simplifying traditional navigation techniques and freeing visitors from the requirement for map reading skills.

## 5. Interface Development

The LAND interface is one of a three-dimensional navigable environment augmented with two-dimensional information. This interface and the technology that drives the virtual environment (VE), draw heavily upon the development of computer games. Here complex information is often presented in a VE with status information overlaid. Game designers have long known that "certain things that are incredibly abstract and confusing in two dimensions can seem intuitive in three" [3].

The user has the option of accessing differing levels of view. Each step forward brings the user closer into the world. Simple toggling between these levels coupled with a representation of the user's current location determined by the GPS position of the device, ensure that the relative positions of personal location and area of interest is always clear.

Information tied to the geographical co-ordinates present in the area visible on screen are displayed and updated as the user explores both the VE and the physical environment.

## 6. 3D Engine Development

The software solution for the LAND project incorporates two-dimensional OS data which is in common file formats such as DXF (data exchange file) and GML (geographic mark-up language). This data is translated into a three dimensional form using the 3D engine developed for the project.

The Land-Form PROFILE data is a common DXF format and is used to interpret the height data for the 3D graphic engine.

MasterMap, a 2D vector based GML format, provides the crucial information that will interpret the TOIDS or topographic identifiers into a three-dimensional form and database structure. It is this data which be used as the location identifier for the eventual database.

Although current PDA technology is still fairly graphically limited due to the lack of hardware acceleration and maths co-processors, 30,000 polygons at wireframe have been achieved within the windows CE environment. The engine is optimised through the use of assembler language rasterizing algorithms that will be linked to the 3D engine at runtime.

## 7. References


[1] Seiler, R. (1996). Cognitive processes in orienteering: A review. *Scientific Journal of Orienteering, 12,* 50-65.

[2] Witmer, B. G., et al. (1996). *Virtual spaces and real world places: Transfer of route knowledge*. International Journal of Human-Computer Studies, 45, 413-428.

[3] Herz, J.Z. (1997) "Joystick Nation" pp 220 Abacus

[4] European Information Technology Observatory 2002

[5] Cheverst et al. Developing a Context-Aware Electronic Tourist Guide: Some Issues and Experiences http://www.guide.lancs.ac.uk

# Requirements for the Design of Lifelong Learning Organisers

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## Abstract

*We propose a set of general requirements for the design of Lifelong Learning Organisers (LLOs), based on our studies of personal learning practices. The studies showed [1] that learning activity is mobile between locations, time slots, and topic areas. Moreover, learning follows a hierarchical organization at three operational levels: learning activities are discrete acts, which are grouped to form learning episodes, which in turn are grouped to form learning projects. Objects are used in the process of carrying out learning activities, episodes and projects, which the learner organises based on a personal organisation system. On the way, the learner constructs personal, meaningful knowledge. We describe KLeOS, an example of a system to organise such knowledge over long periods of time.*

## 1. Introduction

In seeking to design a system that supports a person's everyday learning over a lifetime, a descriptive Framework of Lifelong Learning (FoLL) was produced. The framework originated in a theory-informed phenomenological study of learning [1]. This study required 12 learners to keep diaries of their daily learning over 4 days and at the end to participate in a structured interview, which explored issues arising from the diary entries.

The FoLL led further to the definition of a set of general requirements for technology to support the organisation of lifelong learning. The requirements pointed to the need for tools that provide facilities for management of learning, of learning materials and resources, and of the learnt knowledge. Furthermore, mobility and flexibility with respect to time, place and topic were identified as important attributes of an enduring learning organisation system. Based on these requirements a prototype system, KLeOS (Knowledge and Learning Organisation System), was designed.

Section 2 of this paper presents the background to the requirements, based on the FoLL, which is fully described in [1]. Section 3 outlines the recommended general requirements for Lifelong Learning Organisers (LLOs), and section 4 briefly presents KLeOS (for a more detailed description see [2]).

## 2. Background

The phenomenological study of learning indicated three ways in which learning can be considered "mobile". Learning is mobile in terms of space, i.e. it happens at the workplace, at home, and at places of leisure. It is mobile between different areas of life, i.e. it may relate to work demands, self- improvement, or leisure. It is mobile with respect to time, i.e. it happens at different times during the day, on working days or on weekends.

The study also analysed the activities that people reported to carry out during learning. The participants were asked to report their learning experiences, without being given a strict definition of a learning experience. In some cases, a diary entry reported the performance of a single activity (e.g. reading a book). In other cases, however, a diary entry involved the performance of a number of different activities (e.g. reading, searching the internet, and taking notes).

The fact that people reported these as a single learning experience rather than as distinct experiences demonstrates that people differentiate between learning *episodes* and *activities:* distinct learning acts are grouped together by thematic, temporal and/or spatial proximity to form learning episodes. In some cases, people described episodes as forming part of a greater learning *project*. To group episodes into projects, people use purposes and outcomes: episodes that contribute to the achievement of a particular aim are likely to be grouped together under a single project. A number of learning projects may be pursued during the same period. Learning episodes may contribute towards more than one learning project.

While carrying out the learning activities, episodes and projects, people engage with various types of learning object. These can be *containers* (objects containing other objects), *conduits* (objects that allow the access of resources or that enable/assist the activity), *resources* (objects that contain the actual information to be learned), *stimulators* (objects that trigger reflections, thought processes, or discussions that lead to learning), *tools* (objects used to carry out an activity), and *pointers* (objects that point to other objects).

People reported several different ways of organising their learning objects: in chronological order of use, theme, by context of use.

Through the process of carrying out learning activities, experiencing learning episodes, and managing learning projects, people construct personal, meaningful knowledge by associating the new things they learn with the things they already knew. In many cases people make and keep a record of the things they learn in the form of notes. The notes may be taken during or after a learning episode, using a variety of recording devices (notebooks, logbooks, diaries), and the content ranges from personal thoughts to general information, comments, suggestions, summaries, etc. The structuring of notes varies as well, from no structure to date tagging, to reference information followed by detailed notes. In many cases, however, it is important that the person can trace back the origin of a piece of knowledge, for example for validation purposes.

## 3. Requirements for Lifelong Learning Organisers

Lifelong Learning Organisers (LLOs) is a proposed class of systems that assist the learner in organising learning: organise the carrying out of activities, events, and projects; organise the knowledge they learn; and organise the resources they use. It should be possible to do this for different topics, in different locations and times, in a way that assists the learner to integrate his or her learning experiences and construct personal, meaningful knowledge over a lifetime.

With respect to designing for the mobility of LLOs, we propose the following requirements:

1. A LLO should be easily transferable between places: it should be either implemented on a device that is easy to carry and use around, or it should be designed so as to run on a single computer system and be accessed remotely, via any system.
2. LLOs should be available and functional anytime, during any day of the week.
3. LLOs should provide a smooth transition between learning topic areas and support the user to construct meaningful, integrated knowledge.

With respect to designing for the functionality of LLOs, we propose that:

1. LLOs should assist the learner to organise his or her learning activities into events, and the events into projects (synthesise serendipitous learning). Conversely, LLOs should assist the learner to plan learning events for a project, and learning activities for an event (plan deliberate learning). Finally, LLOs should assist the learner to plan learning activities for an event that will be then linked to a project (manage semi-structured learning).
2. LLOs should assist the learner to organise his or her knowledge based on thematic or other associations.
3. LLOs should assist the learner to organise learning resources (i.e. objects that contain or embed information) based on context of use or thematic associations.
4. LLOs should assist the learner to make and maintain associations between learning events, resources, and the learnt knowledge, and use these associations as a means for the later retrieval of knowledge, for the reviewing of learning materials, and for the reviewing of past successful practices.

## 4. KLeOS: A Knowledge and Learning Organisation System

Personal organisers offer many of the attributes outlined above. For example, Microsoft Outlook allows the recording of events and their categorisation, and is mobile between different platforms. However, it does not provide for the organisation of the actual knowledge learnt, or of the learning materials that were used. The eduPAD [3] also incorporates basic functions of a personal organiser, but it is designed for use in schools and, although it provides for the management of learning resources, it does not provide for linking between resources and the organiser. The Electronic Learning Diary presented in [4] allows the user to organise their notes relating to specific learning events, but it is meant for use in a specific context (medical students) and it does not support reference to the actual learning materials, only to the learner's reflective notes. The WhizFolders Organiser [5] is another system for organising notes and personal information. However, it does not provide for the management of learning projects, and the organisation is based on a folder structure.

The prototype for KLeOS reflects the hierarchical organization of the learning practice described above and it demonstrates functionality in three different levels, allowing the user to (a) manage their learning projects; (b) monitor the learning episodes they complete and associate them with projects where applicable; and (c) perform learning activities whilst within an episode. Furthermore, activities and events are directly linked to the learning resources used.

The prototype also features a knowledge map, organised as a concept map or 'mind map' [6], which reflects the knowledge that the user has acquired over time. The knowledge map is not disconnected from the organiser. Rather, the two components are bridged together so that the user can update the knowledge map whenever a new piece of knowledge is acquired during learning, or alternatively the user can start from a map entry and trace back the learning episodes that led to this knowledge.

In effect, this combination allows for monitoring both semantic and episodic memories. Episodic memory is involved in the recording and subsequent retrieval of memories of personal happenings and doings, whereas semantic memory relates to knowledge of the world that is independent of a person's identity and past [7]. Episodic memory records have been used in the past for information retrieval [8, 9]. The working hypothesis for KLeOS is that an interlinked record of semantic and episodic learning memories will be a better aid for knowledge retrieval than a semantic-only or episodic-only record.

The interface is based on the timelines metaphor [10, 11]. Timelines are graphical representations (lines) that depict a period of time during which a specific event was occurring. For KLeOS, learning projects are represented by such lines. The user can zoom in and out in time to gain daily, weekly, monthly, yearly, and decade views. Episodes that are associated with a project appear as marks on the project line at the corresponding point in time. This presupposes that learning episodes exhibit time continuity, which is in accordance with learners' perceptions [1]. Episodic memories are organised chronologically [7]. Thus, it is reasonable to assume that a representation of learning events, which fall in the category of episodic memories, based on timelines, will be meaningful to the user.

When zooming into a learning episode, the screen changes to display contextual information about the episode at the bottom, relevant learning activity timelines in the middle, and the learning object used for a (selected) activity at the top.

The system provides two ways for retrieving electronic learning objects and/or the knowledge learnt through them: (a) by exploring project lines to locate relevant learning episodes and activities (i.e. based on the user's episodic memory), and (b) by navigating through a web of relevant concepts (i.e. based on the user's semantic memory). The knowledge map nodes are tagged with contextual information, so that the user can easily 'jump' to the relevant learning event if necessary.

KLeOS is now being implemented as a Java application. The system's architecture and functionality allow for the mobility of learning to be accommodated. The information about learning projects, episodes and activities is stored in a database. The Java application runs on any platform and is optimised for PC and notebook monitors. The Java platform is now available for the Compaq iPaq® and thus a version of the interface for small devices could be implemented in the future. The database could be held on the user's main PC or notebook locally and accessed from any other client device remotely. With the rapid improvements of telecommunications networks, this configuration will provide the flexibility needed to learn anywhere, anytime.

KLeOS's intrinsic functionality allows the user to transfer easily from one learning project to another, by navigating time and clicking on the appropriate project lines and episode marks, or by navigating the knowledge map.

## 5. Conclusions

Based on a Framework of Lifelong Learning, we propose requirements for the design of Lifelong Learning Organisers. The requirements relate to assisting the organisation of learning activities, events, and projects, the organisation of learning resources, and the organisation of knowledge. They also relate to supporting the thematically, temporally, and spatially mobile nature of learning. KLeOS, a prototype Knowledge and Learning Organisation System, was designed based on these requirements. A system evaluation will need to be performed once the system is fully implemented, in order to decide both the usefulness of the concept and the system's usability.

## 6. References

[1] Vavoula, G.N., and Sharples, M. From Phenomenological Studies to Requirements Analysis: A Framework for the Design of a Lifelong Learning Support System. Submitted to International Journal of Computer Applications Technology special issue on "Designing Technology Supported Learning".

[2] Vavoula, G.N., and Sharples, M. KLeOS: a personal, mobile, Knowledge and Learning Organisation System. Submitted for presentation at the Workshop on Wireless and Mobile Technologies in Education (WMTE), to be held in Vaxjo, Sweden, August 29-30, 2002.

[3] Lourdusamy, A., Chun Hu, and Wong, P. Perceived Benefits of eduPAD in Enhancing Learning. Paper presented at the International Educational Research Conference, Fremantle, Western Australia, 2-6 Dec 2001. Accessed on 27/05/02 at http://www.aare.edu.au/01pap/atp01299.htm

[4] McGlade, K., Toal, C., Kernohan, W.G. An electronic learning diary. Active Learning 4, 42-45, 1996.

[5] WhizFolders Organizer 4.2. Accessed on 27/05/02 at http://kanadepro.com/ whizfolders/

[6] Buzan, T. The Mindmap Book. BBC Books, UK, 1995.

[7] Tulving, E. Elements of Episodic Memory. Oxford University Press, Oxford UK, 1983.

[8] Lamming, M.G., and Newman, W.M. Activity-based Information Retrieval: Technology in Support of Personal Memory. Technical Report EPC-1991-103, Rank Xerox Research Centre, Cambridge Laboratory, 1992.

[9] Bovey, J.D. Event-based personal retrieval. Journal of Information Science, 22(5), 357-366, 1996.

[10] Plaisant, C., and Shneiderman, B. An Information Architecture to Support the Visualization of Personal Histories. Information Processing and Management, 34(5), 581-597, 1998.

[11] Plaisant, C., Rose, A., Rubloff, G., Salter, R., and Shneiderman, B. The Design of History Mechanisms and their Use in Collaborative Educational Simulations. HCIL Technical Report No. 99-11, 1999.

# Authentic Contextual Lifelong Learning Design

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## Abstract

*This paper is concerned with leaning design considerations of authentic learning environments that will provide students with the skills to be lifelong learners. Authenticity includes realistic settings and complex open-ended tasks carried out in a meaningful manner within a genuine community of practice. Higher education institutions can be involved with authentic contextual learning environments in a number of ways including interacting with the external workplace wherein applied learning and lifelong learning have to take place. Design considerations for learning lifelong skills in all authentic contextual situations include: access to expert practitioners; mechanisms for student support; the ability to practice with peers and teachers; and the opportunity to reflect and develop transferable skills in a changing employment world.*

*Keywords: authentic, contextual, lifelong learning, work-place learning, learning design*

## 1. Introduction

Learning in higher education institutions is often remote from the location and setting wherein what has been learned will actually be put into practice. Learning environments that attempt to bridge this gap may be quite varied and may utilise advanced technology to 'place' the student in realistic settings that require various actions. The design of these learning activities should include the ability to interact with experts in the field who are engaged in authentic practice. Outcomes of this contextual learning should also incorporate reflective cognitive processes as part of skill acquisition if they are to equip the students with the range of skills to become lifelong learners.

## 2. Authentic learning

Authentic learning involves action; it's about the student performing engaging tasks that are contextually meaningful [1] [2]. It involves both product and processes. The task is part of the process that includes reflection and metacognition – knowing what and how one is learning while doing the task. That process is essential to being a successful lifelong learner.

Authentic learning has a number of attributes:

- the learner is performing tasks in a realistic setting e.g., learning a procedure is carried out by doing the procedure; studying period literature is done in character and context
- the learning tasks are complex and represent what it's like to do the work for real – there is no spoon-feeding; tasks are not simple or remote from context to enable a single approach or answer [3].
- the tasks have community value i.e., they are meaningful to a community of practitioners [4]
- the tasks are meaningful to the learner
- the tasks are relevant to the desired learning outcomes
- the learner engages with the tasks

## 3. What does authentic learning mean in higher education?

Because there is simply too much to learn in any discipline, and because knowledge has a 'shelf-life' in any case, higher education should be more concerned with assisting a student to develop the skills needed for lifelong learning. The skills are multi-fold and include:

- the ability to continue learning in response to changing employer requirements
- skills that are relevant to knowledge and practice in a specific discipline or profession
- community skills, i.e., generic skills to enable functioning within a community of practice
- skills to enable continued personal growth in a discipline or profession
- skills to enable changing of discipline or profession as circumstances change, i.e., adaptability

Often, competence is measured by what the student produces (e.g., an essay, an exam paper, a presentation, a thesis) whereas lifelong skills are concerned with what processes the student is able to apply to be a lifelong learner [5]. These learning processes are not usually measured and in fact are often simply not recognised as being an essential part of learning.

Those lifelong learning skills naturally apply to conditions outside the higher education institution. The issue therefore is concerned with how higher education institutions can truly prepare their transient students for lifelong learning if the students are remote in space and time from where they need to employ their skills? The solution lies in the student learning being authentic, for in being authentic the processes required for lifelong learning are practiced.

To enable student participation in an authentic contextual learning environment, there are essentially four approaches:

1. the outside world comes into the higher education institute
2. the higher education institute goes into the outside world
3. the outside world adopts teaching and accreditation practices and standards
4. the higher education institute provides internal environments and learning opportunities that strongly resemble and mimic practices and processes in the external world

### 3.1. The outside world comes in

In practice, the outside world rarely, if ever, comes into the higher education institute to provide an authentic learning environment. To physically enable such situations, practicing external communities would have to be brought into higher education institutions; yet to offer authentic value they would necessarily have to retain their functional integrity by remaining separate. In physical terms this paradox might be impossible to resolve but it is possible to imagine a technological solution whereby external communities of practice 'visit' educational institutions to enable student participation.

### 3.2. The higher education institute goes out

In the second approach, the higher education institute often goes into the outside world in that students are often placed in realistic environments, such as hospital internships, farm work, engineering placements, and naval placements. In these cases the authentic environment is not provided by the higher education institute but by the prospective employers, and for the locations mentioned, is truly contextual. The role of the institution in this case is to assist the student with the reflective learning process skills.

Also, in the second approach, technology can enable a 'virtual' presence in the real workplace; for example, a student may use some communication system (purposefully technically undefined here) to interact with remote expert practitioners. This technology would enable the learner to see, hear, ask questions, discuss, offer suggestions, make decisions, and answer questions concerned with for example an actual surgical procedure or naval exercise. In fact, through such a communication system, the entire 'classroom' could interact with practicing experts and partake in activities in the remote and authentic location. As technology advances, it will become easier to 'place' students into the outside world to become an active participant in authentic activities. (In fact, this same technology would result in a blurring of the distinction between these first two approaches.)

This model is an extension of the cognitive apprenticeship model [6] whereby students interact with the expert then practice until they become experts themselves. An advantage of such a 'placement' is that the student can be in two worlds (the higher education institution and the workplace) at the same time and benefit from the expertise available in both. In the institution there would be critical analysis with peers and teachers of the workplace experiences in an immediate timeframe.

The importance of dialogue in learning has been stressed [7], and in this kind of dual setting there would be critical and analytical dialogue in the institution and dialogue with the expert in the workplace – although these activities are not exclusive to either domain. In the real world, work is often collaborative in nature and authentic tasks should include collaborative activities wherever possible. If well designed, this can enhance the learning experience and the social negotiation that promotes higher order thinking [8].

### 3.3. Work-based learning

The third approach, where the outside world adopts teaching and accreditation standards and practices (while not actually conferring accreditation), is often called 'Work-based Learning' [9]. In this situation, students carry out their approved formal learning in their place of work under local supervision. This situation is obviously authentic and contextual, yet as noted [10] it may throw into sharp contrast such binaries as: organisational learning and university learning; organisational discourses and academic discourses; and disciplinary knowledge and workplace knowledge. These binaries may not be so contrasting if communication methods and technologies enabled each environment (the academy and workplace) to be more synchronous in space and time, and if teaching methods that enable authentic learning to take place are valued and practiced in both camps.

### 3.4. Simulations of practice

Where scenarios are required in the institution that strongly resemble and mimic practices and processes required in the external world (the fourth approach), these can be provided in two not exclusive ways: by simulation (e.g., turning a ship) and by situations where the lifelong learning skills are practiced (e.g., developing a prototype by collaborative teamwork; role-playing historical political decisions, both of which are actually also simulations).

The value of the learning experience is enhanced if the participants reflect on their personal learning processes, wherever and however the authentic learning takes place. For example, following (and during) a dialogue with a practicing expert where the intention is to actively discern and describe the processes the expert uses during an authentic problem solving task, the learners should be reflecting on their own problem solving techniques in relation to the particular context.

## 4. Learning design for authentic contextual lifelong learning

Where students are serving external internships or placements of various kinds (real or virtual) or situated in work-based locations, the design considerations of the learning experience includes ensuring that the student is engaged with genuine open-ended complex tasks and not given simplified and closed tasks that are removed from real practice. The tasks should be just the same (wherever practicable) as carried out by people in the community of practitioners. Where the higher education institution is providing the authentic contextual experience away from the real practice (by simulation of various kinds), design considerations include situations that are credible, challenging and engaging. Also, bearing in mind that one of the primary aims of higher education institutions is to assist students to acquire lifelong learning skills that are processes, the following design summary can be made.

- Learning in authentic situations (real, virtual, simulated, on campus, remote) requires communication devices to provide learner support
- Authentic situations should include access (perhaps technologically mediated) to expert practitioners who learners can question and with whom they can engage in dialogue
- Irrespective of location, authentic situations should enable the learners to analyse, interpret and practice in conjunction with peers and teachers
- An identification of personal learning processes in the authentic context should be incorporated to facilitate transfer of these skills to new situations

By including these process features into the design of authentic learning environments, and giving them genuine value, learners will be equipping themselves with the full range of lifelong learning skills. To truly provide commonplace authentic learning environments that are not confined by institutional and workplace boundaries, considerable advances need to be made in communication technologies in particular.

## 5. References


[1] J. Herrington, and A. Herrington, "Authentic Assessment and Multimedia: how university students respond to a model of authentic assessment", *Higher Education Research and Development,* 1998, 17, 305–322.

[2] J. Herrington, and R. Oliver, "An instructional design framework for authentic learning environments", *Educational Technology Research and Development*, 2000, 48:3, 23–48.

[3] Grabinger, R.S. and J.C. Dunlap, "Rich environments for active learning: a definition", In *The Changing Face of Learning Technology* (eds D. Squires, G. Conole, G. Jacobs), pp 8–38. University of Wales Press, Cardiff, 2000

[4] Wenger, E. (2001) Supporting communities of practice; a survey of community-oriented technologies http://www.ewenger.com/tech/index.htm

[5] C. Medel-Añonuevo, T. Ohsako, and W. Mauch, "Revisiting Lifelong Learning for the 21st Century", UNESCO Institute for Education, Hamburg, Germany, 2001.

[6] B.L. Brandt, J.A. Farmer, and A. Buckmaster, "Cognitive apprenticeship approach to helping adults learn", In *Applying cognitive learning theory to adult learning* (ed. D. D. Flannery), pp 69–78. New directions for adult and continuing education, Jossey-Bass, San Francisco, 1993.

[7] Laurillard, D. *Rethinking University Teaching: A Framework for the Effective Use of Learning Technologies*, RoutledgeFalmer, 2001.

[8] J. Herrington, and R. Oliver, "Using situated learning and multimedia to investigate higher-order thinking", *Journal of Educational Multimedia and Hypermedia,* 1999, 8:4. 401–421.

[9] Boud, D., N. Solomon, and C. Symes, "New practices for new times", In: *Work-based Learning: A New Higher Education?* (eds D.Boud and N. Solomon), pp 3–17. SHRE and Open University Press, 2001.

[10]Boud, D., and N. Solomon, "Future directions for work-based learning: reconfiguring higher education", In: *Work-based Learning: A New Higher Education?* (eds D.Boud and N. Solomon), pp 215–227. SHRE and Open University Press, 2001.

# Mobile devices for breast cancer care
# A Personalised Education Information Profiling System (PEIPS)

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## Abstract

*This paper explores how mobile devices may support the educational information needs of breast cancer patients and how they may help to overcome the difficulties they currently encounter in accessing information. We look at how the provision of an information infrastructure may serve to help to connect breast cancer patients to each other, the Primary Care Group and rich interactive multimedia educational content and resources.*

*Keywords: PDA, interoperability, Bluetooth, Wireless LAN*

## 1. Introduction

"Since patient-specific options and risk-benefit scenarios are numerous, the need for guided education of patients with cancer is greater than ever" [1].

The intention of this project is to build a Personal Digital Assistant (PDA) prototype to provide breast cancer patients with personalised information that may empower them to make individually informed choices about their future treatments.

## 2. The Project

The project aims to provide an affordable, easy to manage and modern medium to deliver high quality educational information that will aid communication and support and connect the patients and professionals involved. Via the Internet and hospital Intranet, the patient can access text, images and audio-visual material. The patient will be provided with a PDA that they may keep for the duration of their hospital care. As the patient moves through their course of treatment the PDA uses intelligent software to reflect information appropriate to their individual needs.

User content can be accessed by asking specific questions, the answers to which are created by content specialists as part of specific subject knowledge bases. The patient is able to make personal notes that are linked to a diary application providing key points for discussion at hospital meetings. In addition, patients can make initial contact, patient to patient, via an SMS service, accessing a network that can provide valuable insight from first hand shared experiences.

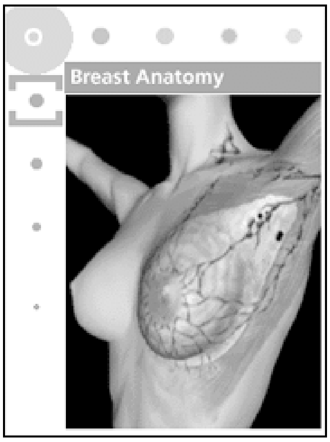


*Figure 1. Prototype screen for PDA*

## 3. Current educational resources

The time constraints placed on the health care professionals can leave patients with unanswered questions [2]. Support centres offer educational facilities but are often met with negative attitudes due to a lack of information [3].

In the US the healthy and newly diagnosed count for 65% of online consumers [4] with women and the over 50's being the heaviest health related information seekers [5]. Internet users have difficulty assessing if information is accurate, up to date and authoritative and 75% of people in the US still cite their doctor as their favourite source of information [6]. Many users have to filter through generalised or irrelevant information [7]. As family and friends scour the Internet [8] there is a danger that the patient may receive inappropriate information indicating a less positive prognosis. Personalisation services are available but confidentiality and privacy of personal information are cause for concern [9].

"The Digital Divide is also an online health divide. The same populations that have higher incidences of disease – minority ethnic groups, poor people and older Americans – also are less likely to use the Internet" [10].

## 4. Enhancing current educational provision

Responding to current difficulties, the PDA offers the Primary Care Group a resource covering subjects of predominant concern [11] removing the confusion general, non-specific information creates. Patients can be assured of the highest quality information produced by content specialist which may lessen the need to look to less reliable educational sources. Creating a shared set of resources may aid communication and understanding between the patient and the Primary Care Group.

Using intelligent software, the PDA provides personalised information that the patient has control over by means of secured password permission. Any details entered into the PDA will remain private to them.

The mobility of devices allows patients to access to information at any time, in any location and throughout their course of treatment. The PDA can quickly and efficiently educate family and friends providing an informed support network as well as providing access to disadvantaged groups.

To aid retention and recall [12], the PDA will enable patients to make recordings at important times and this may also benefit those with hearing difficulties. The device has the potential to provide audio content to help those with low literacy levels or visual impairment. With an integrated Notebook and Diary the patient can annotate content for future discussion receiving timely reminders from the device's Dairy.

The key role of the SMS service is for patients to easily and efficiently make contact with other patients to share valuable first hand experience.

## 5. User interface design

A patients' course of treatment progresses in stages that may last for up to 12 months. It seems appropriate, therefore, to develop an interface that moves through time, placing the patient as a central pivot to the content. The use of such a navigational device provides flexibility and enables content to be added or subtracted in response to the individual.

Patients require differing quantities and types of information and the timeline caters for this by initially providing top-level, general content. Using the built in PDA navigation button, the user can move left and right through time in relation to their current treatment. The patient has the choice to move through progressively more in-depth information by navigating down from the top level of content, effectively going deeper and deeper.

## 6. Interoperability and infrastructure

Interoperability of devices means that multimedia content can be dynamically delivered to any device in or out of the hospital environment. The database structure is flexible and has the ability to hold multimedia content that can respond to personalisation. This flexibility has great potential within the health care services to cover many related health subjects that have the potential for access via interactive TV, mobile phones and future mobile devices.

Memory restrictions of current PDA's dictate how much information can be stored on each device at any one time. This works to the to the strengths of PEIPS, as information is tailored to the individual, each patient requiring only what is appropriate to their needs and current treatment. Information can be downloaded to the PDA via Wireless LAN, Bluetooth or PDA cradle connectivity.

As the project progresses, the use of flash cards may help to overcome memory restrictions. They can be easily added to the device to provide extra memory and used to create 'health topic' modules accessible by numerous different devices.

## 7. References


[1] Stewart J A, M.D., Hawkins R.P, Ph.D, Gustafson D. H, Ph.D. Internet technology-based patient education: The Chess program *E-Health Care and Oncology*, USA 2001, pp

[2] Luker K.A., K. Beaver, S. J. Leinster, R. G. Owens, L. F. Degner & Sloan J.A. Information needs of women newly diagnosed with breast cancer. *Journal of Advanced Nursing*, UK 1995, 22, , pp 134-141.

[3] Luker K.A., K. Beaver., S.J. Leinster, R.G. Owens, Information needs and sources of information for women with breast cancer: a follow up study. *Journal of Advanced Nursing*, UK, 1996, 23, pp 487-495.

[4] Cain .M. M, J. Sarasohn-Kahn, J. C. Wayne, Health e-People: The on-line consumer experience. *California HealthCare Foundation report.* USA, August 2000.

[5] Block, M, Health information on the net, *Lewis and Clark Library System*, USA, 25/04/2002.

[6] - op sit [5]

[7] - op sit [2]

[8] - op sit [1]

[9] MacDonald, K, J. Case and J. Metzger. E-encounters, ihealth reports*: California Health Care Foundation*, USA, 2001.

[10] - op sit [5]

[11] - op sit [3]

[12] Learning from Bristol: the report of the public inquiry into children's heart surgery at the Bristol Royal Infirmary 1984-1995. *Bristol Royal Infirmary Inquiry*, UK, July 2001.

# Cognitive, Ergonomic and Affective Aspects of PDA Use for Learning

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### *Abstract*

*A study of learners' use of PDAs for reading and note-taking on an online course, together with findings from staff development workshops, have shown that there are numerous issues underlying effective, efficient, and satisfying use of this new technology. The paper reports on the issues by examining cognitive, ergonomic and affective aspects of learners' experience.*

## 1. Research Background

During 2001, a study was conducted to evaluate the use of PDA devices by students on a Masters level course [1]. This paper gives a focused account of selected aspects of the findings, namely the cognitive, ergonomic, and affective aspects of PDA use, as they emerged in online conference discussions. This is supplemented by data collected during workshops in which other participants used the same PDA in a different learning context.

The research reported here relates to the usability of a PDA and texts delivered on that device. Usability is typically defined as being the effectiveness, efficiency and satisfaction with which specified users can achieve identified goals in particular environments [2]. Another way of expressing this is to say that what is at stake are the cognitive, ergonomic and affective factors that impact on student learning. There is current interest in student use of e-books and handheld readers [e.g., 3] and research into user interaction with new reading appliances [e.g., 4]. This project taps into both strands: general usability issues and the specifics of technology-supported reading.

## 2. Participants, aims and methods

The study centred on students taking the postgraduate course 'Applications of Information Technology in Open and Distance Education.' This Open University course is primarily delivered online, making use of web resources and First Class conferencing. In the final block of the course (August-September), however, students use print-based reading materials. The idea was to give students the option of reading some course materials on a PDA. Students could choose to read on a PDA or only the print version, or both.

Students on the course are typically studying part-time and are involved in other professional activities. They are mostly in their 40s and come from a variety of cultural backgrounds, as the course is delivered globally. All 65 students enrolled in the course were supplied with Palm m105 PDAs in July 2001. Most were new to PDAs, although there were some students who had used palmtop computers in the past and some who owned a PDA or similar device.

The study aimed to assess the benefits and constraints introduced by PDAs, and to examine how this new tool impacts upon students' reading strategies. In learning contexts, readers often like to make notes (e.g. by underlining words, writing in the margins, etc.) or on a separate piece of paper, therefore annotating and note-taking were included in the investigation. WordSmith, a document editor and viewer, was used to present course materials on the PDA. The document viewer mode enables users to read and search the text in several ways.

Evaluation data was collected through questionnaires, interviews, and conference messages. Twenty-seven students contributed to the conference discussion on PDAs. The discussions were not mediated or directed. The qualitative data from conference messages brings to light a number of interesting issues which are presented in the next section.

## 3. Issues in conference messages

A conference was opened up to students in the run-up to the distribution of PDAs. It became a focal point for 'early adopters', i.e. those students who were already users of handheld computers, or who were immediately interested in the technology. A number of issues emerged spontaneously in this conference.

Cognitive challenges:

- what one notices in print can differ to what one notices on a screen

- using a PDA means re-visiting information that is already known about other devices, e.g. battery life or memory on one's PC, laptop, other handhelds
- conceptions of paper-based study tools may need to be re-visited, e.g. is a PDA like a paper organiser?
- PDAs can open up new information gathering strategies, e.g. via a news clipping agent

Ergonomic preferences:

- predictive text (automatic word completion); concern whether this is available on PDAs
- preference for a good quality colour screen, as used on another handheld
- backlight feature useful for reading under bedclothes
- desired compatibility with other devices, e.g. one's mobile phone

Affective issues:

- an emotional attachment to one's gadget or tool; impossible to lend it to someone else
- some learners naturally look for fun, e.g. games
- overwriting diary or personal information by mistake
- concern about possible health hazards of PDAs, by analogy with mobile phones

Once the PDAs were distributed, the conference was accessed by a wider circle of students. There was a tendency towards technical queries and mutual support. In addition, the following issues emerged:

Ergonomic issues:

- reading 'the minute text on the little screen'
- when font is enlarged, the text is difficult to scan
- eye ache and visual disturbance; choosing to print the instruction manual, designed to be read on screen
- preference for beaming information to the PDA
- preference for portable keyboard
- dislike of clicking noise when selecting a function
- problems caused by cleaning the PDA screen while the device is switched on

Affective aspects:

- reluctance to switch over from own handheld
- some affection towards the Palm m105: 'this little chap', 'enjoying the little beasty'
- aspiring to join the 'illustrious group' of those who were already PDA users

## 4. Observations of users in workshops

Data was also collected during two staff development workshops, during which 20 participants used Palm m105s, the same as the Masters students. The workshops aimed to give an understanding of PDAs through hands-on experience. Participants completed reading and note-taking tasks individually. Discussion of experiences and opinions took place in small groups. Group facilitators observed participants and took notes.

Several *cognitive issues* were identified. For example, skim-reading seemed to be slower than skim-reading print materials. Participants found that if they changed font size in the middle of reading, they lost their place in the text. There was a feeling that it would be difficult to absorb complex concepts. Readers wanted to be able to mark the text, to underline, highlight, circle words. Taking electronic notes was difficult, as this disrupted reading. *Ergonomic issues* included screen contrast, room lighting, needing to re-calibrate the screen, and accuracy with the onscreen keyboard. Some people found it hard to grip the very thin stylus, or tended to lean heavily on the PDA, inadvertently pressing buttons at the bottom of the device.

## 5. Summary

Cognitive issues revolved around effects on the reading process, new skills and strategies, the design of texts, and how the PDA was conceptualised. Ergonomic issues concerned features such as screen sensitivity and quality, constraints of text input, lighting, and physical impact on the user. The conference messages drew out affective aspects which were not so evident in workshops.

## References

[1]J. Waycott and A. Kukulska-Hulme. An Evaluation of the Use of Personal Digital Assistants for Reading Course Materials on H802. Institute of Educational Technology, The Open University, CITE Report 9, December 2001.

[2]ISO 9241-11 International Standard - Ergonomic Requirements for office work with VDTs. Part 11: Guidance for specifying and measuring usability. Geneva, Switzerland: ISO, 1998

[3]Young J.R. A university that reveres tradition experiments with e-books. The Chronicle of Higher Education Information Technology 2001: Available from htttp://chronicle.com/free/v47/i36/36a03901.htm

[4]Adler A. Gujar A. Harrison BL. O'Hara K. Sellen A. A diary study of work-related reading: Design implications for digital reading devices. In: Proceedings of CHI 98, ACM Press, Los Angeles, 1998, 241-248.

# Using PDAs as Learning and Workplace Tools: An Activity Theory Perspective


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### *Abstract*

*This paper reports two studies that evaluated the use of PDAs as learning and workplace tools. The findings are discussed with reference to activity theory to explain how new tools are integrated into existing activities.*


## 1. Introduction

This research explores the impact that personal digital assistants (PDAs) have upon workplace and learning activities, using activity theory as a framework for understanding how tools mediate activity. Activity theory emphasises the socio-cultural context in which activity takes place, and also provides tools for understanding the impact of new technologies at the operational level of activity [1, 2]. Leont'ev [3] divided activity into hierarchical layers, consisting of actions and operations. Operations are routinized processes that are carried out to perform the action, while actions are conscious processes with specific goals that help to meet the overall objective of the activity. The introduction of a new mediating tool - such as a new technology – would change the conditions of the activity, leading to a reorganization or actions and operations. Processes that were formerly operations, when a more familiar tool was used, would become individual actions and over time, as familiarity with the new tool increases, these actions may become operationalized [2]. The research described in this paper aims to examine the impact of PDAs on learning and workplace activities at both the operation/action level, and in terms of the wider social context of the activity.

## 2. The research

Two evaluation studies were carried out. The first examined the use of PDAs by staff in the Institute of Educational Technology at the Open University. Eleven staff members were supplied with one of three PDAs: a Palm Vx, a Handspring Visor Deluxe, or a Hewlett Packard Jornada. Staff used the PDAs as general workplace tools, primarily for supporting time and information management. Interviews, exploring how the PDA had changed work activities, were conducted approximately five months after the study began.

In the second study, Masters students on an Open University course were supplied with Palm m105 PDAs, which were used to access and read course materials. Students' perceptions of this experience were evaluated using questionnaires and interviews. More information about this study can be found in [4] and [5].

Both studies showed that participants varied greatly in the extent to which they adopted and used the new tool. Using activity theory to make sense of this data, it became clear that there is a two-way process by which a new tool is integrated into an activity. The existing activity system influences how the new tool is adopted and used. Meanwhile, the new tool - the PDA - changes the activity it is used to support. The following sections summarise these findings.

## 3. How the PDA changed activity

Most participants in the workplace study used the PDA to support diary management. The PDA enabled users to keep an electronic diary that could be synchronised with the desktop computer and could be accessed while the user was away from the office. In addition, having a diary in electronic format enabled users to share their work schedule information with colleagues, which modified the division of labour of the activity system. However, limitations of the PDA made it difficult for some participants to fully integrate the new tool into the activity. In particular, awkward data input methods meant that, for some participants, previously operationalised processes - such as entering an appointment in the diary - became actions that required individual attention. Each action was more time-consuming and required greater effort than it would have done had it been operationalised.

For students on the masters course the portability of the PDA made it easier for students to fit their reading around other activities, such as work and family commitments. The PDA was an *"unobtrusive and neat device that could always be to hand"* and could be used to read course materials while students were engaged in other activities. However, the small screen size of the PDA made it difficult for students to skim-read the text and meant they had to adopt a more concentrated, line-by-line reading strategy. It was also difficult to pick up on visual clues, such as headings, and some familiar contextual clues, such as page numbers, were not available on the PDA. Therefore, students had to learn to use new contextual clues to aid the process of navigation, and this caused some disruption to the reading activity. Students also experienced difficulties when taking notes about the course materials on the PDA. As in the workplace study, the PDA introduced new methods for note-taking and as these were not yet operationalized, they were difficult and time-consuming to use. Typing on a full-size keyboard or writing on paper was deemed to be much faster and superior.

## 4. Factors contributing to adoption and use of the PDA

The interview data from both studies was analysed to determine the reasons why the adoption and use of the PDA varied across participants. In both studies, similar issues were identified. Participants had different preferences for features of the device (e.g., screen size, display colour, portability), and these were weighed against the actual device characteristics. If the user's personal preferences were in conflict with the device characteristics, adoption of the new tool was minimal. Another important factor was past experience, particularly in relation to data input methods. Those who were touch-typists compared handwriting on the PDA unfavourably with typing on a full-size keyboard, whereas those who did not consider themselves touch-typists were less concerned about this. It was also important for the new tool to be easily integrated with existing tools. The PDA did not replace the tools participants already used. Instead, it was used in conjunction with existing tools, and - for those who used the PDA extensively - it modified the way those tools were used. Unsurprisingly, it was also important for participants to have time available to learn to use the PDA. This was seen as an inevitable 'cost' or 'investment' of adopting a new tool.

## 5. Summary

The findings from both studies suggest that the integration of a new tool into existing activities is a two-way process. The new tool (the PDA) introduces new possibilities and constraints to the activity. These change the conditions of the activity, introducing new ways of doing things and modifying the relationship between actions and operations. Typically, former operations become actions as the user adjusts to the new tool.

There are also socio-cultural factors that affect the success with which the new tool is integrated into an activity. These include the user's personal preferences for device characteristics, past experience and the prioritisation of time to learn to use the new tool. The relationship between the new tool and existing tools is also important, particularly in the case of PDAs which are seen as extensions - rather than replacements - of existing tools. If the PDA complements rather than conflicts with existing tools, it is more likely to be successfully adopted.

## Acknowledgements

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## References

[1]Y. Engestrom, "Activity theory as a framework for analyzing and redesigning work," *Ergonomics*, vol. 43, pp. 960-974, 2000.

[2]K. Kuutti, "Activity theory as a potential framework for human-computer interaction research," in *Context and Consciousness: Activity Theory and Human-Computer Interaction*, B. A. Nardi, Ed. Cambridge, MA & London: The MIT Press, 1996.

[3]A. N. Leont'ev, "The problem of activity in psychology," in *The Concept of Activity in Soviet Psychology*, J. V. Wertsch, Ed. Armonk, NY: M.E. Sharpe, Inc., 1979, pp. 37-71.

[4]J. Waycott and A. Kukulska-Hulme, "An Evaluation of the Use of Personal Digital Assistants for Reading Course Materials on H802: Final Report," The Institute of Educational Technology, The Open University, Milton Keynes, CITE Report Series 9, December 2001.

[5]J. Waycott, "Reading with new tools: an evaluation of personal digital assistants as tools for reading course materials," *ALT-J*, vol. 10, In Press.

# Organizing Mobile Teaching

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## Abstract

*Mobile students and lecturers can access multimedia documents from linked rooms. We propose a speaking agent (Spear) to provide organizational assistance for nomadic teaching. The agent is present in each room with its own view of the data describing lectures. Spear's software architecture utilizes an ad hoc network infrastructure based on Java's JINI services. We illustrate its implementation in our Virtual Computer Lab.*

*Keywords: linked rooms, speaking agent, JINI*

## 1. Introductions

Mobile information technologies allow for new didactic approaches to teaching. For example, laptop universities have been proposed and implemented for self-driven learning. Students are enabled to be mobile and rapidly gain access to electronic study material outside the lecture hall through wireless technology [1]. Often this is used to work on student projects independently of the lecturer but together with like-minded colleagues who join physically at some place outside a lecture hall, for example in the cafeteria or elsewhere on the campus. Learning is self-driven and no intervention by lecturers necessary.

Such an approach to teaching allowing retrieval of relevant topics by students is also common in the area of distance education [2]. Students read text, browse presentations, and interact with tutorial software. Only occasionally they receive individual feedback from a teacher or mentor.

However, transfer of this approach to degree programs requiring presence of students is only developing. Computers allow browsing in digital libraries and allow students to apply their knowledge to software applications. Nevertheless, surfing the web while being present in a lecture, is not easily seen as an acceptable behaviour.

Teaching with computers supports turning a passive listener into an active member of class who works without the need for conversation with the teacher. Nearly every student starts some activity with a computer if requested to do so during a lecture. Unlike tasks solved by groups of students every student may solve individually a common task. A drawback is the teacher's lack of flexible control of large crowds of active computer users and very often traditional social control is preferred to software packages for supervision. We investigate such usage patterns as experienced by students and lecturers in the Virtual Computer Lab at Harz University (*Virtuelles Informatik Labor*, VIL [3]).

## 2. Nomadic teaching

Mobility of lecturers requires more assistance by media technology then wireless laptops or handheld devices. VIL provides

- distribution of presentation material and the speaker's image and voice
- conferencing between student and lecturer, and
- controlling student PCs by the lecturer.

If the PC allows continuous learning around a learning topic because it is online and used on a personal and mobile basis we propose in the following an agent-based approach for linked rooms to take into account mobility of both lecturers and students.

If students are active themselves physical presence of the lecturer can be less frequently required as long as his voice, maybe image and slides are available. Thereby the location of the lecturer is no longer important. He or she can teach virtually from any room where presence is considered more necessary as long as the presence can be established quickly after identification of such a need within the same room or a different room. Several students can experience direct feedback or, in other words, the lecturer becomes a private teacher, if he moves from room to room in a nomadic manner and visits a student.

Figure 1 describes the schematic layout of linked rooms in our Virtual Computer Lab, each with electronic blackboard, video and audio capturing devices and presentation of blackbboard and slides via data projector.

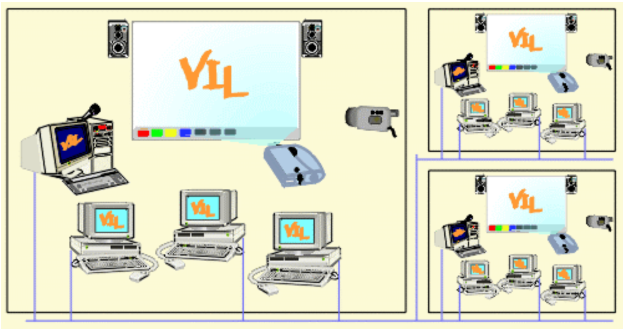

*Figure 1 Virtual Computer Lab*

Since winter term 2000/2001 lectures take place in the virtual computer lab. A survey acknowledged acceptance by students. Students confirmed that the lecturer's image is not as important as high fidelity for audio transmission. Lecturer's feedback was on

- the quality of the electronic whiteboard,
- the need for synchronisation of audio and image transmission, and
- the need for rapid and simple set-up of Virtual Computer Lab in various configurations depending on the size of the student group.

Practically, space for a few people and up to 120 people in four rooms each with 30 seats can be configured.

Daily usage has revealed another effect: There is a take-over of work from previous lectures into the following one. Schedules, change of the lecturer and lecture room in general would prevent students from doing so, but mobile equipment counteracts these organizational features.

We have developed therefor a technical infrastucture to intergrate all rooms and devices, primarily a network for several types of devices. This includes common PCs and embedded devices of any type like PDAs or wearables. The heterogenuous system is based upon a platform independet of the programming language available for the common types of devices in the todays IT world.

As discussed before, the physical location of teachers and students must not be of interest to a nomadic teaching system. This leads torwards the next requirement: the system must be self-organizing. In this context self-organizing means that the components of a distributed system like a mobile teaching environment connect itself to a functional unit completly transparent to the user and independent of the physical location. This has to be considered in the design because this is a rare feature of distributed systems.

Another problem is distribution of software. This must be organized from a central point, the best solution is an automatic process of software distribution and versioning. It is unreasonable for a user to keep track of software versions, last but not least it influences the stability and acceptance of the system.

## 3. A speaking agent

In this section a solution for a specific problem will be discussed: the organisation of schedules by a speaking agent which acts on behalf of the lecturer before the scheduled lecture starts. At a given time before the next lesson in a room starts the students should be informed via speech.

Messages are repeated in a given interval. Schedules are located in a central database, managing the system should be done by a central point under control of administration.

The network used for this project will be the intranet of the university, but the system can be easily extended around the world because the use of the internet would be completly transparent to the user, in this case the lecturer.

Integration of different devices is achieved by using the platform independent programing language Java. It is available for a wide variety of device architectures ranging from common PCs to PDAs and mobile phones.

The self-organizing feature of the system is achieved using Java Intelligent Network Infrastructure (JINI) technology. JINI provides the system with the necessary Plug'n'Play possibilities needed for independance of physical location. If a new room has to be added only a control software is required on the computer and the network cable can be plugged in to initate integration into the system. The software will inform the system of its presence as well as its possbilities and the control software will be distributed to the computer. So JINI also solves the problem of distributing and versioning software. If the control software of the speaking agent is updated in a room it will be automaticaly updated in the system.

The behaviour of every speaking agent can be changed independently from other agents including the type of the voice e.g. male of female, the speed of the voice and so on.

## 4. Speaking room schedule (SpeaR)

SpeaR is a speaking room schedule we have developed at Harz University. It is designed to inform all people present in a room or lab about events which are going to happen there in the near future. Customizable warning messages will be generated by a speaking client for each room in three definable intervalls. A client is located in every room. The invocation of the warning messages, depending on the schedule for that room, is forced by the SpeaR-Server.

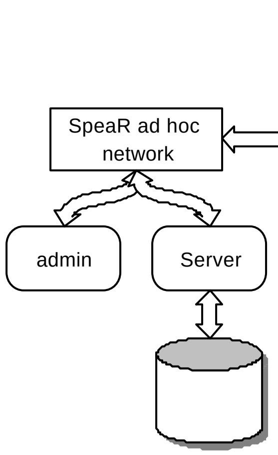


*Figure 2: SpeaR arcitecture*

The entire SpeaR project is based on the Java 2 platform. The interface to the speech synthesis engine is represented by the JavaSpeech API (JSAPI). There are several implementations of JSAPI available. SpeaR uses the IBM ViaVoice Spech API. Room schedules are managed by a database. Connections are made by using the JDBC technology. The database was designed to be able to be used with other related applications, such as a syllabus, evaluation of lectures, or keeping record of assignments.

The services and the server communicate using JINI. Furthermore the linking between the services and the server is done with so called ad hoc networking. This means that services offer their capabilities. They can be found by lookup-services without knowing any IP adresses. Clients can use the services found by lookup-services (see Figure 3).

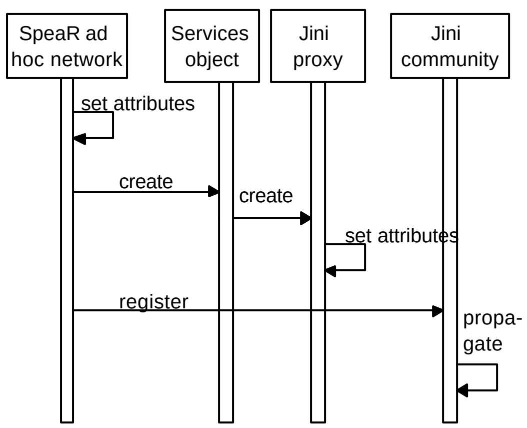


*Figure 3: Ad hoc networking by service look-up*

The SpeaR project is devided in three logical components to be as flexible and extensible as possible.

## 4.1 Administration-tool

The Administration-Tool, a frontend for the entire application, allows complete administration of the Spear-Server and Spear-Services. After logging on, there are several administration tasks and status information available. The adminstrator can

- turn the server on or off,
- change the status of an individual service (Figure 4),
- change the voice font used by a service,
- change the warning messages and intervalls,
- change the database connection, and
- can send manually edited messages to a special service or groups of services.

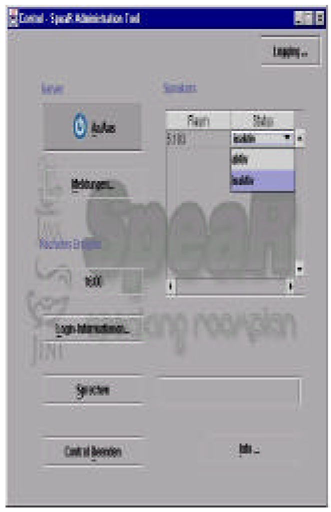

*Figure 4: Admin Tool for SpeaR*

## 4.2 SpeaR-service

The SpeaR-Service is responsible for speech synthesis and provides information about its location (building, floor and room). Once the service connects to an lookup-service it can be used by other components. A SpeaR service provides its own administration GUI which will be transmited over a JINI connection (a GUI-Bean is provided by a HTTP-Server running on the service side). This makes the remote configuration possible. Another advantage is that the administration GUI can be modified and extended without informing the Admin-Tool. The Admin-Tool will get the new version automatically. The service provides a simple shell to configure start or stop of the service.

## 4.3 SpeaR-server

The SpeaR-Server acts like a JINI-Client. It is searching for an available lookup-service and registers itself at the lookup-service. A lookup-service provides information about the network location of the registered services. The SpeaR-Server is now able to connect with the SpeaR-services. New SpeaR-services will register itself at the lookup-service to provide their speaking capability. The lookup-service will then fire an event that a new service registered. The SpeaR-Server will listen for those events and can now connect to the new service.

## 4.4 Administrative view

In addition to distribution of services, schedules are described in an Oracle database. A separate Windows client has been developed to allow administration of rooms. Both a web-based listing of room allocation and links to syllabus description have been integrated around a common database.

# 5. Conclusion and outlook

Linked rooms allow for nomadic teaching and more frequent changes of passive listening to presentation and active processing of tasks individually. Nomadic teaching benefits from an agent-like speech-based representative, who informs students on behalf of the human lecturer about organizational matters and issues notifications.

While web-servers and browsers offer web-based organisation of courses, a JINI-based architecture achieves more flexible and actively speaking clients. Both the Java programming language and ad hoc networking allow integrating heterogeneous devices. Java's speech and multimedia API offers to implement a non-visual user interface suitable for a room-agent.

SpeaR's interaction techniques now can be extended in order to

- individualize messages issued on handheld devices,
- recognize teaching activities through better planning aids,
- assist teaching itself by controlling equipment,
- prompt for answers to questions by students or lecturers, or
- authoring-on-the-fly.

On the long term we expect to investigate further chances for mixing self-driven learning in lab rooms with lecture hall teaching.

# 6. Acknowledgments

We want to thank Ine Langer, Horst Heineck, Kurt Meissner, Bernhard Zimmermann for their comments and help to set up VIL.

# 7. References

[1] Marchionini, G.; Nolet, V.; Williams, H.; Ding, W.; / Beale, J. / Rose, A.; Gordon, A.; Enomoto, E.; Harbinson, L. (1997) Content + Connectivity => Community: Digital Resources for a Learning Community, DL'97: Proceedings of the 2nd ACM International Conference on Digital Libraries, pp. 212-220.

[2] Roseman, M.; Greenberg, S. (1997) A tour of teamrooms, Proceedings of ACM CHI 97 Conference on Human Factors in Computing Systems, pp. 208-209.

[3] http://www.hs-harz.de/AI/Labore/VIL/html/index.htm, retrieved on 26/04/02.

# Implementing a Student Learning Organiser on the Pocket PC Platform


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## Abstract

*The paper describes the development of a learning organiser for students on Pocket PC computers that utilises a connection to a wireless network. The methodology and design principles aimed at creating a useful and usable system are explained.*



*Keywords: mobile learning, user interface, learning organiser, handheld computers, wireless networking*


## 1. Introduction

For many years, computers have been used to enhance the learning experience for students in Universities. In 1997, the Dearing Report published the findings from an extensive review of the Higher Education System in Britain. The report predicted that students will increasingly expect to have continuous and seamless access to the computer network of the institution at which they study (NCIHE, 1997).

Powerful software and the Internet have extended the possibilities for computer-based learning. Many universities have adopted Virtual Learning Environments (VLE), such as WebCT, as a method of facilitating student learning. These provide tools to support a wide range of teaching and learning styles that make the most of a University's existing network of desktop computers (WebCT Inc., 2001).

There have also been rapid developments in the potential hardware platforms to support learning aids. Due to the increasing power and miniaturisation of computers it is now feasible to have a handheld mobile computer that delivers rich media content to the palm of the user's hand. Recently, wireless technologies have further extended the usefulness of these mobile computers. Wireless access to a network provides the potential for instant communications and ubiquitous access to learning tools and materials.

This paper describes a project that was undertaken to maximise the benefit of the latest developments in mobile computing and wireless networking.

## 2. Project aims

The general aim of the project was to design and implement an effective Student Learning Organiser for students in the Department of Electronic Electrical and Computer Engineering at the University of Birmingham. The system takes advantage of a Wireless Local Area Network (WLAN), using the IEEE 802.11b standard, which has recently been installed in the Department.

It was important to involve the potential users of the system at all stages in the project in order to ensure that the design met their learning needs and aided their learning activities. The aim was to develop a useful and usable system that adds value to the current teaching and learning methods. A survey questionnaire was distributed to one hundred undergraduate students in the Department in order to gain an understanding of their current learning practices and to identify areas for improvement. 27 questionnaires were returned. The two topics identified as key areas for development were that of time management and the ease of accessing course materials. The tools for achieving the aim should be closely integrated into a single learning environment.

It was clear from the user survey that the users wanted a system that could be personalised to meet their individual needs. Therefore, the target of the project was to produce an integrated and customisable system that would make it easier for students to handle their time and course material more effectively in order to facilitate their learning.

## 3. Hardware platform selection

The choice of hardware on which to implement the software was informed by the results of the student survey. It was apparent that, in general, students required small palm-sized devices. The decision was taken to target Pocket PC devices that run Windows CE. This platform has a large number of applications available and also provides a significant processing power advantage over Palm devices. The software was developed and tested on the Compaq iPAQ H3870, although care was taken to ensure that any Pocket PC should be able to run the software. This allows for a great deal of flexibility in the choice of the exact hardware on which to run the system.

The Compaq iPAQ does not yet have built-in WLAN capability. This was added using an expansion caddy that accepts any WLAN PCMCIA card. Other Pocket PC devices can be expanded in a similar way.

## 4. System design

From the outset, it was decided to implement the system as a series of small independent tools that could be joined together to provide the complex integrated learning environment that was required. An extensible framework was designed that allowed tools to be added as and when necessary.

The 'Time Manager' tool was designed to provide the time management functionality identified as necessary by the students. This includes the ability to create, delete and view timetable events and deadlines. An additional feature is provided for importing large numbers of timetable events and deadlines from a text file. This mechanism allows the distribution of a timetable file that contains all the required timetable information for a module of the course.

The 'Course Manager' tool allows a student to download course material packages via the wireless network. These course material packages are created by lecturers using the complementary tool, called 'Course Builder', that was designed and built to run on a Windows PC. The 'Course Manager' tool allows students to browse locally stored course material as well as providing a seamless link to remotely stored data that is published on the Department network or even the Internet. The 'Course Manager' supports learning materials published with Microsoft Word and Microsoft PowerPoint*. Portable Document Files (PDFs) and HyperText Markup Language (HTML) are also supported for providing rich media materials.

The need of students to personalise their learning environment was addressed using a customisable information system based on the Today screen that is available on all Pocket PCs. The Today screen allows users to add and remove components that show information relating to their current day. New components were written to show a timetable overview and detailed information of the next timetable event (see Figure 1). These components can then be turned on or off as required by the user.


*Figure 1. Today screen showing newly developed components (bottom two items)*

## 5. User interface design

In order to create an intuitively usable system, Object View Interaction Design (OVID) was used throughout the design stage. OVID provides a rigorous methodology for creating useful software with a usable interface (Roberts et al, 1998). The basis of the approach is to identify real-world objects that can then be implemented in the software. For example, the real-world object of a timetable event (e.g. a lecture) was used in the learning system. By translating real-world objects and events into software objects, users should be familiar with the objects and find it more intuitive to interact with them.

All interactions with objects are performed through views. A view is what the user sees on screen and is used for showing or setting the properties of the objects in the system. While designing the views for the user it was important to consider the screen size of the Pocket PC device, which is only 320 by 240 pixels. This made it essential that only the information that was absolutely necessary was shown on screen at any one time. The OVID approach aided this process as each view is

* With iPresentation Mobile Player, Presenter Inc. (Website: www.presenter.com)

intended for a specific purpose and, hence, the necessary information can be easily identified.

Although the information had to be compact, it was important that the readability of the data was not sacrificed. Therefore, a group of students were consulted throughout the design and implementation in order to ensure that a good solution was found. An example of a view that was developed was the 'Timetable Overview' (see Figure 2). This view represents the commitments of a student in a simple way that can be interpreted at-a-glance. The timetable is shown as a series of boxes representing hourly slots from 9am to 6pm. A colour scheme is used to represent the status of each hourly slot.


*Figure 2. Timetable overview*

This 'Timetable Overview' was then combined with a 'Timetable Event View' that provided details of a specific timetable event. These two views, combined with a date selector* produced a powerful and compact method for browsing a user's timetable. The resulting combined view was called the 'Timetable Browsing View' (see Figure 3a).

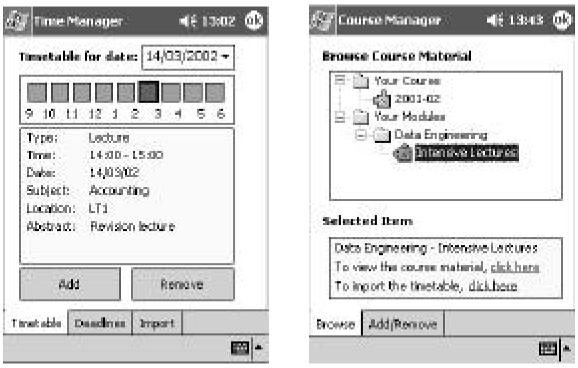


*Figure 3. a) Timetable browsing view*
*b) Course browsing view*

Likewise, a compact view for the 'Course Manager' also had to be found. A tree view was chosen for browsing the course structure (see Figure 3b). At the top level, there are the 'Your Course' and 'Your Modules' nodes. 'Your Course' contains details that are general to the whole course, such as yearly timetable files containing term dates and holidays. 'Your Modules' contains all the modules that a particular student is studying. Within each module node, there are all the learning packages that the user has downloaded to their device. If applicable, the course material in the learning package can be viewed and the timetable file can be imported.

## 6. Implementation

The system was coded mainly in eMbedded Visual Basic. The Today screen components were developed in C++.

It was decided that the new system should be closely integrated with the Pocket PC platform. This meant that existing Pocket PC applications should be reused where applicable and that the interface of the new software should be consistent with the standard Pocket PC interface. By providing this consistency of operation, it was hoped the usability and the time to learn the system could both be improved.

### 6.1. Integration with Pocket Outlook

Pocket Outlook is the application that comes with all Pocket PC devices for managing diaries and commitments. While the Pocket Outlook tools such as 'Calendar' and 'Tasks' did not provide the required functionality, the database and the background functionality, such as the search facility, were useful. It was decided to use the database to store all timetable events and deadline information.

Access to the Pocket Outlook database is carried out via the Pocket Outlook Object Model (POOM). The objects from the OVID design process had to be translated to objects in POOM. Using POOM eased the development of the 'Time Manager'. It also ensured that information entered using the 'Time Manager' was accessible via the standard Pocket PC time management tools. This tight integration was found to provide a clearer and more usable system for the user.

### 6.2. The Pocket PC installation mechanism

The Pocket PC includes an advanced software installation system. This installation mechanism was used for the distribution of course materials. The 'Course Builder' tool used by teaching staff combines the course material files of a learning package into a single installation Cabinet (CAB) file. This file can then be installed directly to a Pocket PC from the web using Pocket Internet Explorer. By using this standard installation mechanism, the standard uninstall procedure is immediately available. The reuse of this technology helps to reduce the time taken for users to learn the system.

* vbceDateTimePicker from vbce.com
(Website: www.vbce.com)

## 7. User trials

A user trial was carried out with a sample of 12 undergraduate students. Each student was given a scenario to perform using the system. After becoming familiar with the software, a structured questionnaire was used to assess the users' attitudes towards the software.

The response to the software was very positive. The views for showing the information in the 'Time Manager' and 'Course Manager' scored highly. The main weakness of the software was identified as the speed at which it operates. Modest increases in speed could be obtained from optimisation of the code of each of the tools. A larger increase could be obtained by switching implementation language from Visual Basic to C++.

Overall, many students seemed excited at the possibilities of a truly mobile, wireless-enabled learning system. The way that resources could be accessed on demand was of particular interest to the user trial group.

## 8. Conclusions

This newly developed system provides functionality intended to meet the needs of students. Whilst the feedback relating to the system was positive, some usability issues were raised and these would need to be addressed in future versions. It will be important to develop more tools to add to the framework that perform tasks other than time management and course material management. Further utilities might address more of the needs of students that were identified in the student survey. These could include concept mapping and student collaboration tools.

## 9. References


[1] NCIHE, Report of the National Committee (Dearing Report), NCIHE, 1997

[2] WebCT Inc, Leveraging Technology to Transform the Educational Experience, WebCT Inc, 2001

[3] D. ROBERTS et al, Designing for the User with OVID: Bridging User Interface Design and Software Engineering, Macmillan Technical Publishing, New York, 1998

# Supporting Learning in Conversations using Personal Technologies

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## Abstract

*We describe the design and evaluation of the CASL (Conversation Augmentation by Semantic Links) software. The learner creates a concept map on a mobile computing device while conversing with a (relative) expert. The device also holds a complete map of the topic (initially hidden from view). As the learner creates nodes, the device compares these with the hidden map and displays matching nodes with their immediate links.*
*It is theorised that this extra information will help the learner to guide (scaffold) the conversation from the edge of their existing knowledge towards the topic area(s) that are most useful for their current needs. Preliminary results show the software to be effective in providing the necessary environment, with distinct changes to the conversation based on the augmentation.*

## 1. Introduction

Our focus is learning outside of formal teaching, where one adult learns from another as they discuss a topic together, especially over the telephone, and take notes. For example, one person in a company attends a training course. Later, another employee needs to learn a small portion of the course material, and may ask the attendee. In such circumstances it can prove difficult for the learner to ask appropriate questions, since (s)he knows only their problem, whereas the course attendee will have knowledge of the course but not necessarily the experience to select the most useful information based only on the learner's questions. The object of this research is to find a way to support such convers ations, assisting the learner to guide the conversation more effectively towards their learning objective.

We propose that the learner uses a hand-held computing device to build a concept map as the conversation, and their learning, progresses. As the learner adds nodes to the concept map, the computer system compares each new node to a hidden 'teacher's map' - a complete concept map of the domain (which for the example above would have been prepared as part of the training course). When a match is found, semantically linked nodes in the hidden map are displayed for the learner. It is envisaged that these prompts will help the learner to explore the other person's domain knowledge in a more structured and effective manner.

We describe the design and evaluation of the CASL (Conversation Augmentation by Semantic Links) software. CASL follows from an earlier pilot study using a manual simulation [1]. Its main functionality is a very-easy-to-use node and link editor, with automatic word matching and display of related nodes from a secondary (hidden) concept map.

## 2. Theoretical basis

### 2.1. Zone of Proximal Development

The theoretical basis for this work begins with Vygotsky's 'Zone of Proximal Development' (ZPD) [2]. This determines learning as taking place in the ZPD between what is understood and what cannot be understood at present, even with the help of another person.

The intention is to apply the ZPD concept to adult learning during a conversation, since similar factors are involved to children's learning [3, pg.2]. The other person would act as the 'more knowledgeable peer', with the computer using the learner's emerging notes to help locate his/her current ZPD.

### 2.2. Scaffolding

Each new note (node on the concept map) then can provide the basis for estimating the domain area currently being learned, while the ZPD concept suggests that semantically linked nodes may relate to areas that can be learned with help (from the other person). The system's objective is to prompt the learner to discuss domain areas that (s)he is ready to assimilate. It is not the system's role to decide which potential area should be discussed. Rather, the system suggests areas that logically follow from that currently under discussion (i.e. the latest note taken).

In this way, the learner is presented with a continually updated scaffold [4] of related ideas to discuss. This enables the learner to ask about any of the domain areas that relate directly to the current area, not just those (s)he already knows, can extrapolate from existing knowledge or are mentioned by the other person. This scaffolding can help the learner to direct the conversation in whatever they consider to be the most useful direction to move their ZPD towards their overall learning objective.

## 3. The software

An Object Oriented approach was used for the design and programming, with the CASL software being written in JAVA, making it easy to port to a number of mobile devices.

### 3.1. Concept maps

For the software to monitor the learner's current area of study, there must be some form of externalisation of the learning process by the learner. Attempts have been made to categorise the many forms of external representation (see Blackwell and Engelhardt [5] for an overview). From this and other work it was decided to ask the learner to create a concept map of the domain as (s)he learns.

While this may assist the learner to visualise the domain, the main purpose is to provide the system with constantly updated information on the current focus of the learning process. It also serves a secondary purpose of providing a convenient tool for an expert or teacher to create - in advance - a comprehensive 'teacher's map' for the computer to refer to.

### 3.2. Example

Figure 1 shows an example of the CASL software (only the top-left quarter of the screen display is shown). The very top-left of the screen is reserved for displaying the automatic prompts. The remainder of the screen is initially blank and available for the learner's concept map. When a node is attended by the learner (created, amended, moved or 'hovered on' - if the hardware allows this), a word matching algorithm searches the hidden map and displays the text from the nearest matching node, along with up to four linked nodes.

The example in Figure 1 shows a learner's concept map of an artificial domain (an imaginary 'murder-mystery' - created for the purpose of evaluating the software). In the example, the node 'Medicine bottle and dropper' is highlighted (in blue, on the screen) since the cursor has recently 'hovered' over that box. The matching algorithm has found a match - in this case, also 'Medicine bottle and dropper'. The text of this matching node is displayed in the reserved area; underneath is shown the text from linked boxes in the hidden map.

In this case, the prompts 'Bedroom 1' (where the bottle was found) and 'Heart medicine' (the bottle's contents) have already been discussed (they appear on the learner's map). However, the prompt 'Fingerprints-medicine-Jane/Frank/???' does not yet appear on the learner's map. This is therefore something that the learner could, at this point, ask the other person about. Fingerprints on the bottle is something which the learner may not think to ask about. Similarly, the other person may not think to mention it - they may have forgotten, or perhaps think it was not relevant (to them, but possibly not to the learner). Thus, the learner is prompted to consider a relevant domain area which they may otherwise not find, or may reach by a round-about and time-consuming route.

### 3.3. Interface

The interface takes into account potentially restricted input devices, using only single-key mouse, or pen commands. In particular, there are no menus or buttons in order to minimise the extra cognitive load on the learner through using the software while carrying out a conversation.

Pressing on empty space creates a box at that location and allows input from a keyboard (real or virtual) or a handwriting recognition system, while pressing within a box allows the text to be edited. In either case, subsequently pressing outside the box, or using the RETURN key, ends input. Links are created by dragging from one box to another. Boxes may be relocated by dragging (the links follow the box), or deleted by dragging to a 'delete' area.

The text prompts that appear at the top of the screen may also be dragged into the main area, where they become boxes.

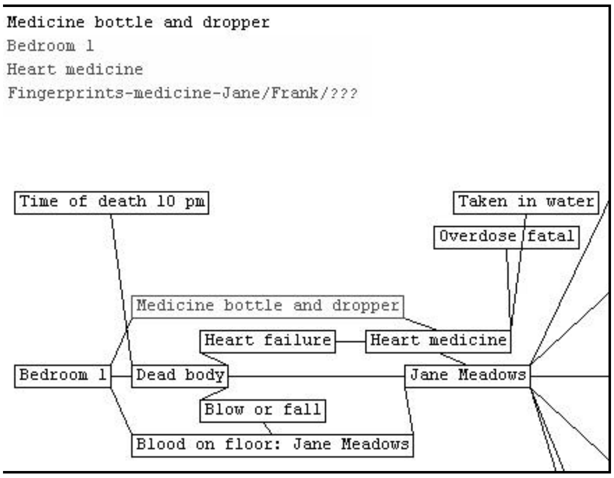


**Figure 1 - Partial screen of the CASL software**

### 3.4. Word matching

When a node is to be matched against the hidden map, it is first broken into individual words, with common words, such as 'and', removed. The remainder are compared against all words in the entire hidden map using a adaptation of the 'Term Frequency inverse Document Frequency' (TFiDF) algorithm [6]. This searches for the 'term' (word in the learner's node) which appears with least frequency in the 'document' (hidden map) to find a matching node. If more than one node is found then the next-least common word is used as the term within the 'document' (nodes matched to the previous term) to reduce the number of matched nodes, as far as possible to one node. The text from this node is then displayed, followed by up to four linked nodes.

## 4. Evaluation

The CASL software has been evaluated using the artificial domain described above. A brief overview of the experiment is given here.

Eighteen undergraduate participants were allocated into pairs. First, they were introduced to the domain. One participant from each pair was given, on paper, all the information available (which (s)he retained for the whole experiment). The other participant (the 'learner') was shown a sub-set (which (s)he did not have access to during the main part of the experiment).

During the actual experiment, the learner had only the CASL software (with or without prompts enabled) or, in the third condition, pen and paper. The learners task was to create a comprehensive concept map of the domain and to solve the crime by obtaining information over a telephone link from the more knowledgeable person.

Observation of the participants found rapid learning of the interface with only a few, brief interruptions to the experiment due to interface-related problems. Informal interviews of the participants revealed a consistent liking for the system, with most finding it helpful and easy to use.

A full analysis of the results from this experiment is currently being prepared. However, it is clear that the pairs given prompts by the CASL software were able to cover a greater proportion of the domain in the time given. Indeed, several of the non-augmented pairs stopped, believing they had finished, without having considered one or more crucial aspects of the domain.

Based on this, other versions of the software are planned. It is intended to ensure the system's ease of use and effectiveness for a future trial within a relatively realistic learning situation.

## 7. Acknowledgements

We would like to thank the EPSRC and British Telecommunications plc for their support of this research.

## 8. References

1. Rudman, P.D. *Supporting Conversations with Vicarious Learning using Personal Technologies*. in *Interact 2001*. 2001. Tokyo, Japan: IOS Press.
2. Vygotsky, L.S., *Mind in Society*. 1978: Cambridge MA: Harvard University Press.
3. McKendree, J., *et al*. *Why Observing A Dialogue May Benefit Learning: The Vicarious Learner*. in *PEG '97*. 1997. Sozopol, Bulgaria.
4. Bruner, J.S., *Child's talk: learning to use language*. 1983, Oxford: Oxford University Press.
5. Blackwell, A.F. and Y. Engelhardt, *A Meta-Taxonomy for Diagram Research*, in *Diagrammatic Representation and Reasoning*, M. Anderson, B. Meyer, and P. Olivier, Editors. 2002, Springer-Verlag.
6. Salton, G., *Automatic Text Processing. The Transformation, Analysis and Retrieval of Information by Computer*. 1988: Addison-Wesley, Reading, MA.

# The AD-HOC Project: eLearning Anywhere, Anytime

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## Abstract

*The AD-HOC project[1] aims at the development of an innovative advanced multimedia language learning tool for European travelers who on location are willing to acquire certain language skills, in order to communicate with locals in the country of their destination. The main outcome of the project will be the AD-HOC system that will be composed of three levels: content, service provision and learning environment. By creating mappings between content and services using database technology and metadata, the system will maximize reusability of existing content. By supporting wireless networking the users is placed at the center of an ambient, always available, device independent educational environment. This paper presents the basic principles of the AD-HOC system and the current status of its development*

## 1. Introduction

- The *AD-HOC* project's [1] innovative application allows travelers (for business, leisure or educational purposes) to access the web through the advanced new communication applications (PDA applications, GPRS and UMTS). These new applications allow for fast transfer of data (text, sound, picture and video) through the mobile device (phone, palmtop) of the user. The *AD-HOC* system will serve users regardless of time and location. An on-line manual, acting as an on-line tutor, will be developed also in order to support the self-directed ad-hoc learning.

The system aims to present linguistic content embedded in its cultural context furthering the understanding of European's cultural and multilingual diversity. It is evident that the mutual understanding in the communication process depends not only on linguistic competence but also on the awareness and perception of cultural behavior, cultural differences and similarities. Only the need and wish to communicate in a foreign country, motivates individuals to learn a language or at least acquire specific limited language skills, but usually in travel situations no learning tool is available and back home often lack of time and appropriate learning material absents individuals from language studies. Increasing mobility of individuals, either for business, training or educational purposes, indicates the need for innovative, flexible, fast retrievable and user-friendly language learning tools, catering the needs of the modern «mobile» European, who does not have the time or intention for in-depth involvement and requires an immediate limited information.The *AD-HOC* project's objectives are to encourage linguistic diversity throughout the EU and support the 'life-long learning' by motivating and aiding individuals to learn languages any time and in any place. The new technology application of *AD-HOC* project supports the pedagogical method of autonomous self-directed learning [2] and allows for a self-directed acquisition of language skills to meet users individual communication needs.

## 2. Usability issues

Handheld devices have become very popular information devices for millions of users. Many applications have already been developed for public agencies, commercial companies [3], [4], even for

[1] The AD-HOC project is a European cooperation project (2000-2002), co-financed from the European Commission, DG Education and Culture.

University courses [5]. A key problem for handheld devices is usability: the screens are too small, they don't have keyboards but scribble pads, and the available speech recognition programs do not really work. The small glass displays of the current handheld devices essentially limit how much information can be presented at one time. Lack of screen space is not a problem that can easily be improved with technological advances; the screen must fit on the device and the device must be small; screen space will always be in short supply. A second usability problem is represented by the fact that presenting dynamic information on devices with small displays is difficult. Techniques for large displays again do not generalize well to small ones. Given these limitations, "mobilizing" existing PC-based e-learning applications can result in a frustrating or nearly unusable mobile service. The solution exists in taking a different approach to how the information is streamlined and targeted to the user. The first step toward this solution is to integrate a user centered investigation into the e-learning system's development cycle.

According to the 1998 ISO 9241 standard for usability [6] one must include the following parameters in system's usability, usefulness, functionality, learnability, memorability, effectiveness, efficiency and desirability. Even with such a checklist, it is still very easy for a designer to make a tool, which is quite unusable. This is partially because design is not sequential process – design decisions affect which people can use a tool, thus requiring the original design to be rethought, and partially because designers are not the potential users and driven by other forces such as a love for technology. Nevertheless there is hope. There comes a time when the design of a system is no longer driven by technological advances, but instead drawn forward by the users who have expectations of usability and take for granted the basic performance. The methodological approach of the *AD-HOC* project plays a fundamental role for the development of such a system: user-centered design [7] and scenario based design [8] are means for assuring that the final system is appropriate to the user and to the context of use.

The *AD-HOC* system will fulfill the following general requirements:

**Interactivity**: it should provide means of communication between learners and teachers. It should allow for feedback by the teachers that will be accessible to learners.

**Interdisciplinary**: Content should be presented in an interdisciplinary way incorporating information of different disciplines, thus promoting the idea of informal learning.

**Unobtrusiveness**: so that the student can capture situations and retrieve knowledge without technology obtruding on the situation.

**Availability**: its functions should be available anywhere and it should provide seamless communication inside and outside buildings.

**Adaptability**: it should adapt to the learners' evolving skills and knowledge.

**Usefulness**: it should be suited to everyday needs for communication, reference, and learning

**Suitability**: Content should be corresponding to specific learning needs of users, e.g. content for the same subject should be presented in several ways and provided according to the specific users' profile;

**Easy to use**: it should be intuitively easy to use, by users with no computer experience.

## 3. Technical description of the ad- hoc system

The aim of the *AD-HOC* project is to develop a device-independent platform that will make Internet services available with GSM and UMTS terminals. At the time of access the user will inform the service provider of her/his terminal characteristics (display dimensions, computing capacity, graphic processing capacity, etc.), and the provider will transmit the required information, adapting representation to the indicated characteristics. Consequently the same information will be presented in different ways, according to whether access is from a desktop computer or from a mobile terminal. The *AD-HOC* platform will have the capability to specify information and represented graphically, to integrate profile and service management, while it will allow for fast application development through a visual programming environment.

Another important objective of the *AD-HOC* project is to develop and evaluate communication patterns and possible infrastructures for interconnected embedded technologies among devices. Communication between devices can take place by using RF technologies like Bluetooth or 802.11b. The utilization of Bluetooth seems to be a good option, as it is low power and cost, with data as well as speech transmission capabilities, although there are some important open issues. Problems like power consumption of Bluetooth devices, their integration in embedded systems with tight memory capabilities and successive devices management have to be researched and dealt with.

The platform services will be delivered via an advanced user-interface, where the user will have to log in. The first major component of the user-interface will be the Personal Learner's apprentice : This is the core software agent of the system and the main part of the user-interface. It is responsible for interacting with the user. It will:

- Manage the user-system dialogue
- Support students in declaring their goals, by using each user's personal ontology and the domain ontology
- Perform skills gap analysis by matching the user profile and personal ontology against the domain ontology
- Pro-actively suggest content to the student, based on his/her profile and ontology, the domain ontology and the available educational modules
- Attend to users queries about content and suggest modules that meet his/her declared needs, based on the available educational modules
- Decompose the user queries and goals into sub-goals to be met by the system and then co-operate with the response planner in order to compile a list of suggestions
- Monitor the correct delivery of courses and record user's learning behavior in order to update his/her profile
- Optimize the delivery of content with respect to momentary network availability and device capabilities

Based on user's model and profile, this agent will synthesize "on the fly" the user interface for the particular educational session, using frames that combine interaction templates with aspects of context. By decomposing the user-interface into dialogue description, content, layout and device capabilities, the system will support flexibility, adaptability of interaction, while taking into account linguistic and cultural preferences of the users.

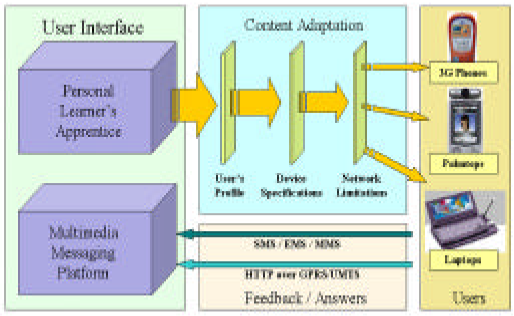


**Figure 1: The platform services will be delivered to the user via an advanced user-interface. The main components of the user-interface will be the Personal Learner's apprentice and the Multimedia Messaging Platform**

A Multimedia Messaging Platform (MMP) will be developed that will provide two-way communication. The MMP will be the second major component of the user-interface. A web-based application will provide the interface for the delivery of the multimedia messages. A web server will be used to collect user responses either through the web or directly from the mobile network. Certain work can be delivered to learners using this platform and questions or feedback can be collected from them. Collaboration among the learners will be enhanced with such a service that allows for easy and immediate exchange of information (transmission of quality photographs, sound and video will be possible enabling instant, high quality collaboration among the users.

## 4. Educational content

Educational content is what the *AD-HOC* system actually delivers to its users. The project is developing a generic software platform for storing, retrieving and dynamically synthesizing educational modules to meet each learner's goals. To achieve this, the content will be broken into small, independent multimedia educational modules. These will be stored and retrieved using a database management system. Content modules will present domain topics in many different formats. Meta-data will be used to describe the modules. An international standard (or near-standard) such as the IEEE P1484 will be adopted. Aspects to describe using meta-data include the format of module and other technical aspects, its language, its technology requirements, its duration, its role in the learning, pre-requisite knowledge or modules etc. Then, a set of software modules will be used to dynamically synthesize a course, according the user's profile and language, and the learner's goals. The system will:

- Decompose a query issued by the learner into educational sub-goals, or perform an analysis of his/her skills profile
- Retrieve the appropriate educational modules from the database
- Synthesize the modules into a Personalized Virtual Document (PVD) based on a methodology that will be developed during the project. The methodology will take into account the user's context of learning, his/her personal ontology and his/her goals, and will implement an appropriate instructional strategy

When applying this methodology for course synthesis, the system will come up with a range of educational modules for the learner to select, depending on the constraints set by the learner. These may include educational objectives, duration, delivery platform, etc.

The approach, which will be adopted in the framework of the project, is to use scenario-based design methods [8] as a means of defining suitable educational applications of the mobile technology. Scenario building is one of the partnerships main design techniques to explore new forms of interaction in which the physical environment is able to react to human behavior, using handheld devices as a mediator. In the framework of the *AD-HOC* project a series of scenarios will be developed describing different situations. Language will be presented through written text, audio and, where applicable, through animations or video. The language modules will be divided in very limited sub-modules to help the learner in the fast access to the specific language patterns he/she is looking for. The learner will receive choices for links to little scenes, to the cultural context, to grammar explanations and to interactive exercises, also to similar language content/scenes/cultural context in the other languages. The interactive exercises will allow for voice recognition and will offer the option for correction and reply. In this way the learner will be able to create a live dialogue or even use the device as assistant during his/her communication with another user.

## 5. Current status

So far we have focused on two axes: PDA's multimedia capabilities and short-range wireless communications technologies.Using Embedded Visual Tools like Embedded Visual Basic 3.0 and Embedded Visual C++ we develop testing applications from scratch, to take full advantage not only of the mobility of the device but mainly of the exploitation of all multimedia capabilities, like download and reproduce audio and video files.Moreover, we are not only examining mobile Internet connectivity but we are extensively research for different download methods. In these methods the content is pushed to the PDA whenever the user "syncs" the device with the *AD-HOC* system. Another programming challenge on which we are working is the availability of "device-to-device" networking using Blue tooth. So there is already under development a Blue tooth wireless LAN for testing wireless communications and downloads using some exemplary AD-HOC scenarios. The piloting of the application is taking place in repeated cycles of learner-centered trials in Greece, Italy, Austria and Germany. Each cycle includes the design, the development, the trials and the evaluation, which is the input for the next cycle in the student-centered product's development approach. The in-situ trials are not only meant for evaluation purposes but involve both students and teachers offering them the chance to provide feedback to the project and its technical and pedagogical aspects.

## 6. Conclusions – Future work

The *AD-HOC* partnership considers that the challenge for the future generation of educational systems at the dawn of the third millennium is to develop learning environments for mobile phones and mobile computers as the availability of mobile devices spreads to a billion of users. The mobile telephone is becoming a trusted, personal device with Internet access, smart card usage, and a range of possibilities for keeping the learner in touch with the institution's student support services, in contact with learning materials and fellow students, while at home, at work or traveling. During the application an extensive usability evaluation that will offer the guidelines for the human computer interaction and psychological contents required for the development of the final version of the *AD-HOC* system.The consortium aims to investigate the impact that handheld technology has on how final users experience wireless e-learning applications.

## 7. References


[1] www.ellinogermaniki.gr/ep/ad-hoc

[2] A. Aviram, International Review of Education 39(5), 1993, pp 419-433.

[3] J.Fleischman, "Going Mobile: New Technologies in Education", Converge Magazine, May 2001, www.convergemag.com

[4] J.R. Anderson, L.M. Reder, & H.A. Simon, "Situated learning and education", Educational Researcher, 25(4), 1996, pp 5-11.

[5] "Leaming's WWW, Web based learning, Wap based learning, Web mining", Proceedings of CAPS'3, Ed. K. Zreik, ISBN 2-909-285-18-9.

[6] G. Casteli, "Universal mobile Telecommunication system: terminals and applications" in Communications through virtual technologies, Ed. G.Riva, IOS Press,2001

[7] D.A.Norman, "The invisible computer", MIT Press, 1999, ISBN 0-262-14065-9.

[8] G. Ringland, Scenario Planning: Managing for the future, Chichester: John Willey and Sons, 1998.

# The MOBIlearn project: exploring new ways to use mobile environments and devices to meet the needs of learners, working by themselves and with others


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## Abstract

*The MOBIlearn project, co-funded by the European Commission and the National Science Foundation, and strategically positioned to provide relevant research outcomes, explores new ways to use mobile environments to meet the needs of learners, working by themselves and with others. State-of-the-art mobile devices will be available. A new m-learning architecture will support creation, brokerage, delivery and tracking of learning and information contents, using ambient intelligence, location-dependence, personalization, multimedia, instant messaging (text, video) and distributed databases. Field trials will cover "blended learning" (as part of formal courses); "adventitious, location-dependent learning" (during visits to museums); and "learning to interpret information sources and advice" (acquiring medical information for everyday needs). The high connectivity and functionality may lead to new group behaviours, akin to the SMS phenomenon.*



*Keywords: mobile, learning, ambient, intelligence, location-based, personalisation, collaborative*


## 1. MOBIlearn: project scope

The integration of new technologies (e.g., personalization, multimedia, ambient intelligence, haptic interactions, mobile devices) in education and training is in essence a culturally driven process, with the need to bring about change not only in people, but in the entire learning environment. This is a key part of the MOBIlearn project. The need for this socio-technical element in projects has now been recognised in the new eLearning Action Plan [1]. This is a part of the comprehensive eEurope Action Plan [2] for European adoption of digital technologies, in which a basic objective is for education systems to use developments in information and communication technology.

Another important part of the MOBIlearn project is the free circulation of knowledge, in forms that are appropriate for individual users. In recent decades political and social progress has emphasised the need for free circulation of knowledge, as the most advanced answer to the increasing needs of new skills related to new technologies and new socio-economic models formed by the Information Society.

The recent "e-mobility 2001 EU Information Society" International Conference on mobility in the Knowledge Economy [3], convened in Goteborg in preparation for the European Council, highlighted priorities that we shall explore: the need to define new work paradigms (e.g., mobile worker) together with innovative models for their social, economical, cultural and environmental deployment, while preserving the local nature of content (national and regional) and cultural heritage. At the same event it emerged that the sustainable social and economic deployment of such models within the Information Society of the third millennium will see a key role of new technologies for mobile access to knowledge. On these social and technological premises, the MOBIlearn project aims to improve access to knowledge for selected target users (such as mobile workers and learning citizens), giving them ubiquitous access to appropriate (contextualised and personalised) learning objects, by linking to the Internet via mobile connections and devices, according to innovative paradigms and interfaces.

The Goteborg Conference also underlined the need for pilot experimentations and applications for the fast spread and uptake of envisaged models and related services to preserve Europe's leadership in the exploitation and innovation of mobile technologies. The need for this is becoming urgent. Thus, the MOBIlearn project is justified in two ways: its pioneering research and development directly targets priority areas for the knowledge society, and its exploitation directly addresses the need for Europe to stay dominant in the important area of mobile applications.

To deliver these crucial results, the MOBIlearn project will exploit a partnership that is truly international, capable and influential, including well-known Universities with a large user-base (such as the Open University and the University of Birmingham), and calling on expertise from two US World-level academic institutions (Stanford University and OKI/Massachusetts Institute of Technology). The project consortium also involves mobile operators from four countries (Telefónica, Cosmote, Deutche Telekom, Telecom Italia), European-leading commercial organisations (Space Hellas, Giunti Ricerca, Emblaze Systems, Peter J. Bates) and World-class mobile devices manufacturers (Compaq, Nokia), and Australian on line learning content providers (education.au) enabling them to communicate with each other and exchange information at all levels.

The partners bring a real cross-disciplinary know-how, with expertise in pedagogy, adaptive interfaces, collaborative learning, context awareness, business modelling and e-learning technologies. The scope includes studies of conceptual models and new methodologies, with prototypes to implement them. These will be evaluated in trial application fields set up and managed by international partners participating within the MOBIlearn project. The objective is to improve the knowledge level of individuals through cost and time optimisation of learning processes. This maximises the opportunities of three representative groups:

- Workers, to meet their job requirements and to update their knowledge continually;
- Citizens as members of a culture, to improve their learning experience while visiting a cultural city and its museums;
- Citizens as family members, to have simple medical information for everyday needs.

### 1.1. Expected results

The MOBIlearn system will investigate ways to meet user needs and build knowledge spaces. The MOBIlearn project has international relevance by proposing the conception, development, experimentation, and exploitation of new models of learning, via next-generation mobile networks, through:

- creation of pedagogical paradigms to support learning in a mobile environment (such as collaborative learning, organisational learning, dynamic knowledge creation in a group);
- new architectural layouts to support creation, brokerage, delivery and tracking of learning and information content on mobile networks, which extend existing systems;
- selection and adaptation of existing eLearning contents for mobile devices, enabling automatic multi channel and multi device versioning;
- realization of new business models, based on existing success-cases (e.g., DoCoMo iMode), for self sustainability and deployment of the conceived solutions beyond the research timeframe within Europe's Knowledge Society of the third Millennium.

The goal of the MOBIlearn project is the creation of a virtual network for the diffusion of knowledge and learning via a mobile environment where, through common themes, it will be possible to demonstrate the convergence and merging of learning supported by new technology, knowledge management, and new forms of mobile communication. This also creates a virtual point of mobile access to content that could be used at a European and International level. A subsidiary goal is to develop deeper understandings of the social processes and interactions that arise when connectivity reaches a critical point, so that we are alert to the possible emergence of "ambient intelligence" equivalents of the widespread take-up by users of SMS.

## 2. Acknowledgements

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## 3. References

[1] eLearning Action Plan: http://europe.eu.int/comm/education/elearning/index.html

[2] eEurope Action Plan, COM(2000) 330, 14.06.2000: http://europa.eu.int/comm/information_society/eeurope/index_en.htm

[3] Report of the International Conference "e-mobility 2001 EU Information Society" on Mobility in the Knowledge Economy, Goteborg, December 2001

# Pathway to m-learning

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## Abstract

*This paper intends to outline the steps in the design of scenarios for learning in environments of ubiquitous communication. In particular it will give an overview of the incoming 3G mobile communication technologies that raise the possibility of merging several different media (Internet, mobile Internet, iTV, smart-house). Special focus will be given to the problematic and usability aspects of designing interfaces for learning purposes in wireless devices.*

*The paper will draw upon the authors' experience in the integration of Information Communication Technologies (ICT) in learning environments; in particular it will focus in the pros and cons for pedagogically sound integration of ICT in order to enhance learning processes. It will do so by sharing wireless experiences at present undertaken at primary and third level institutions.*

*The main goals of this paper are: to sensitise designers to the particular interaction design issues in these kind of communication scenarios; to explore learning models for m-computing; to share experiences on the ground, and to extend the research community in the field.*

*Keywords: wireless devices, mobility, context-based services, education, collaborative learning, interaction design, and usability.*

### 1. The 3G and Learning

The incoming 3$^{rd}$ generation communications technologies (3G) providing mobile access to internet-based services will enhance and extend mobility in many areas of our lives [1].

Foreseeing innovative and interesting applications of 3G in many fields such as the smart-house, health, entertainment and commerce is not a difficult task, nor should it be to visualize learning environments where mobile technology will no longer be the exception, but rather the premier learning tool like what the book is to the present day classroom.

Although there is evidence of the beneficial effects in learning of "almost" ubiquitous communication systems that guarantee connectivity anytime, anywhere [2] [3, 4], and some recent researches evidence the valid contribution of mobile devices such as PDAs for teaching and learning [5], some authors are still sceptical about it.

Several conditions support the premise that Mobile devices (mobile phones, PDAs and Pocket-PCs) can rapidly become efficient and effective teaching and learning tools. In the first place, mobile devices are personal, and information that is provided across an interface that is 'perceived' as personal (agenda, notebook, etc.) captures higher levels of user's attention. In a learning environment this could lead to the enhancement of two learning approaches often difficult to conceal: independent, autonomous learning and collaborative learning [4]. Two other characteristics that added to the ownership factor make mobile devices suitable learning tools are: portability, high levels of interaction and familiarity with handsets.

Secondly, the daily access rate to mobile interfaces is very high covering most of the day and often the night. This fact will completely revolutionize traditional mental models associated with learning in terms of where and when learning takes place. Learners and practitioners will be able to extend the learning experience to other environments, such as their home [2, 4] and their community. At the same time they'll be able to share it with people often considered outsiders to the learning community. Moreover, interaction with mobile devices takes place quite frequently and users' perceive it as a positive experience [6]. A clear example that supports the latter point is the extensive use of SMS [7] even as an interactive channel in children's channels such as Fox Kids and Nickelodeon. There is a demographic overlap between mobile phone/SMS usage and the audiences to these channels [8].

Thirdly, the limitation in screen size forces textual information to undergo a process of prioritisation (first block: title, second block: abstract, third block: further information, etc.) [9]. In this context naming plays a major role as titles must be short and self-evident. In terms of the educational value of this kind of information processing, higher order thinking skills are promoted. Users mainly apply the three higher levels of competence in Bloom's Taxonomy: analysis, synthesis and evaluation [10], although the lower three, knowledge, comprehension and application [10] are also utilized. Due to the higher order thinking skills involved in the process and the format of the information display one could argue that this makes content easier to remember.

Furthermore, recent research states that services across wireless devices succeed when they reach an acceptable level of personalization just by automatically profiling the users' needs and interests (using artificial intelligence technologies for tracking their click-streams) [11]. In theory, this fact could make them suitable for individualised education based on multiple learning styles, although much work remains to be done in the area.

Finally, context-dependent systems will soon characterize 3G mobile devices and will have a non-indifferent impact on learning processes. These systems will deliver customized information, based on the specific context of the user: location, time, identity and environment [12], across mobile devices. Hence, it will be possible to correlate the learning experience to where, when and how it takes place. Location, whether physical or electronic, refers to the exact position of the user. Identity represents the user's interests, preferences and knowledge. Time stands for date, actual time, sensorial time (day/night), perceived time (early/late), occupational time (work/leisure) and so on. The environment correlates to the task or activity the user is carrying out, the presence of other users, things etc.

## 2. Designing the Interaction

This section aims to provide an overview of the steps to follow and issues to take into consideration when designing interfaces for educational purposes in 'almost' ubiquitous communication scenarios.

The first step is to hypothesize a scenario of use for a precise didactic scope. Next an m-learning format needs to be identified that will enhance users' interactive experience with mobile devices (or generally speaking wireless) within a predefined context and circumstance.

Once the 3G scenario is well identified, it will be possible to pin point the expectations, limitations and behaviour of mobile users; to design appropriate interaction models; to reassure their distrust in terms of security; to verify the trans-cultural adaptability; to valuate the ethic aspects; to ensure good communication with the services provider as to guarantee a satisfactory added value to the user (e.g. providing personalised services); to maintain a coherent and relevant multi-channel identity (e.g. with the related website).

Finally, it will be necessary to test the level of usability of an interface according to its potentiality towards self-learnability (predictability, synthesizability, familiarity, generalizability and consistency), to the satisfaction of users' expectations and users' perceived value of the services provided, to their speed in task completion, to their number of irreversible mistakes, to the level of interaction enabled, etc.

## 3. Scenarios on the Ground

While developments in technology are taking place very rapidly, and governments are making substantial investment in technology for educational institutions, the stakeholders, learners, practitioners and researchers in the field of ICT integration in learning, are still engaged in the construction of knowledge about the pedagogically sound applications and implications of new technologies in learning environment.

To date only privileged students and teachers are able to enhance their learning experience with cutting edge technology [4]. ICT interventions are yielding lofty models of best practice and very rich learning experiences however, the levels of technology adaptation and implementation on the ground do not match those of the developments in wireless technologies.

On the one hand, wireless networks such as Personal Area Networks (PANs) (requiring no infrastructure and connecting devices), Wireless Local Area Networks (W-LANs) (providing wireless connection to a wired environment), and Wide Area Networks (WANs) (providing connection to a network remotely), are already a reality [13] and they have exceptional potential to make a paramount contribution to the integration of ICT in teaching and learning. And on the other hand, practitioners are still trying to overcome the barriers to successful integration of technology in learning.

Although the advent of mobile technology will release technology from its imprisonment in computer labs, eradicating some logistic problems derived from this dominant model of ICT presence in educational institutions, it will not overcome others such as the lack of time in very robust curriculum, the lack of technical and overall pedagogical training for those in charge of integrating technology in learning, the lack of technical support and educational policy [2, 14, 15].

The following sections aim to portray two pictures of the present state of wireless technology implementation and application in learning, and provide a vision of future scenarios.

### 3.1. A Primary School Scenario

Web@Classroom is a project within the auspice of the EU Education Programme, Socrates. The students and teachers involved in it are undergoing their first wireless laptop experience in the classroom. The project involves four countries: Ireland, Portugal, Spain and the United Kingdom, 12 researchers, 12 action researchers and over 200 students between the ages of 9 and 13.The participants are involved in collaborative learning activities and the main aims of the project are to promote change in ICT practice in the classroom, and to develop students' research and communication skills.

The presence of a wireless environment allows for greater collaborative work, knowledge sharing and construction, not only within the same classroom, but also across classrooms within the same school and across countries. In this sense the students are engaged in activities such as peer editing, generation of newsletters, problem solving and research projects in a variety of subject areas such geography, history, religious education and language among others.

Furthermore, the students are encouraged to take the laptops home. Regardless of the fact that wireless connectivity is only available within the school, the mobility provided by laptops has brought a new learning dimension that helps bridging the gap between the learning experiences taking place in school, at home and in the community. It has also allowed us to broaden our own definition of school community, a definition that now includes, students, teachers, parents and other members of the communities of all the schools involved. This sense of belonging to a broader community is especially relevant in the case of the two rural schools involved in the project.

In spite of the efforts being made on the ground and the very enriching learning experience[1] encompassing an evaluation approach that merges the mean and the message (integrating technology to evaluate the integration of technology in learning processes) [16,17], there are still issues haunting the successful implementation of m-learning models.

None of the countries involved in the project are able to provide the ideal 1:1 student-laptop ratio. Constraints imposed by time, curriculum and assessment in every single country do not allow teachers and students to explore and implement models of m-learning integration throughout the entire school day. The lack of permanent technical support and the teachers' inability to tackle technical problems translate into long periods of "technology inactivity" (For example one of the schools involved in the EU project has had problems with Internet access for the past month and the problems are not likely to come to an end before the end of the academic year).

[1] For further information on the project and examples of work produce see http://www.cs.tcd.ie/crite/projects/minerva & http://www.

### 3.2. A Third Level Scenario

The MSc. IT in Education[2] does not suffer from the widespread constraints of ICT integration. The learning environment is a wireless one where the laptop to student ratio is 1:1. This is far from the cruel 19.6:1 and 10:1 reality of primary and secondary schools in the Republic of Ireland [14]. This allows the students to identify their laptops as personal and to adopt them not just as another learning tool but rather as the 'sole' learning tool when attending lectures.

The programme is founded on the principals of Social Constructivism, and the participants are constantly required to design, develop, implement and evaluate ICT's pedagogically sound approaches, applications and artefacts to enhance learning. The students' work has a significant impact in real education environments since, when undertaking their projects, they are encouraged to tackle learning difficulties experienced in their work place.

The rapidly changing nature of technology implies that programmes enhancing learning through ICT must be open and receptive to change, they must be extremely flexible. The MSc in IT in Education is flexible in that students are not constrained to a physical presence. Regardless of whether students are present at lectures the course material is available to them online. Also there are no physical constraints. Within the classroom students can choose the physical layout; they have the freedom to form groups if they so wish or to work alone. Ad hoc group work is a feature of the course.

With respect to the course curriculum, it is by its design flexible. Students are allowed to explore areas of direct relevance to themselves. Thus it is not uncommon to find in one classroom a range of students studying differing topics. The curriculum has been designed to coexist with the changing nature of ICT's integration in learning. The assessment chosen is continuous and formative rather than summative. The students are assessed on their projects and they are required to build ICT artefacts to teach "something". The artefacts must be accompanied by a written piece of research work that supports the pedagogical added value of the artefact.

### 3.3. Future Scenarios

[2] For Further information on the course & a showcase of the students' work see http://www.cs.tcd.ie/crite

Given the widespread current state of technology imprisonment in computer labs and the financial inability to meet the 1:1 ratio; it seems that the way forward in m-learning in formal educational settings is the introduction of handheld devices, in particular personal digital assistants (PDAs).

Although, PDAs' detractors will accurately argue their significant limitations in terms of screen size, difficulty to input text, low power to handle multimedia and battery life, the frequent access to this type of "limited" technology is always better than sporadic incursions to the computer lab, or the use of a computer in the best European ration (5:1)[14].

With the developments in Bluetooth and 802.11b (short-range wireless protocols) and handheld devices that support both, we foresee a leading role for this kind of technology in m-learning.

PDAs greatly lend themselves to collaborative learning and the current concern is to develop pedagogically sound handheld applications that support learning processes. In this sense members of the Centre for Research in IT in Education are at present developing applications that will comply with the above criteria.

### 4. Conclusion

There is a profound mismatch between the current levels of development in m-learning technology and the levels of adaptation and implementation of any kind of technology in learning institutions.

As long as technology remains imprisoned in computer rooms and the ration of student to computer (in the best scenarios) is still 5:1, it is difficult to foresee the complete integration of ICT in learning processes.

Although PDAs have undeniable limitations, their advantages such as ease of use, low cost, portability, and "natural trait" for collaborative learning, will without doubt pull down some of the present barriers for ICT integration in learning processes.

## 5. References


[1] A. Cereijo Roibas, "Examining the UI Design challenges of supporting multimedia applications on next generation terminals and identifying ways to overcome these", User Interface Design for Mobile Handsets Conference, London, September 2001.

[2] Rockman et al., "Powerful Tools for Schooling: Second Year Study of the Laptop Program," Rockman et al., San Francisco, CA October 1998.

[3] V. Crawford and P. Vahey, "Palm Education Pioneers Program: Round I Preliminary Evaluation Report," SRI International October 2001.

[4] V. Crawford and P. Vahey, "Pal Education Pioneers Program: March 2002 Evaluation Report," SRI International March 2002.

[5] B. B. Ray ET AL., "Personal Digital Assistents in the Middle School Classroom: Lessons in Hand", Meridian, A Middle School Computer Technologies Journal, NCSU, Raleigh, 2001.

[6] R. Grinter, E. ET AL. "y do tngrs luv 2 txt msg?", in Proceedings of 7th European Conference on Computer Supported Cooperative Work (ECSCW '01). Bonn, Germany: September 18-20, 2001. 219-238.

[7] "Ora C'e' anche il 'Wappario' Dizionario per I Cybernauti", (Now there is the "Wappario", the Dictionary of the Cybernauts), La Reppublica, Rome, 01/10/2000

[8] B. Flynn, "Why Cable Networks Love SMS", Multichannel News International, April 2002.

[9] A. Cereijo Roibas ET AL., "Physical and Cognitive Skills/Limitations of Mobile Users", Mobile User Interface Conference, London, September 2001.

[10] B. S. Bloom, *Taxonomy of Educational Objectives: The Classification of Educational Goals: Handbook I, Cognitive Domain*. New York: Longmans Green, 1956.

[11] A. Cereijo Roibas ET AL., "Quando il prodotto diventa luogo. I microambienti come scenari del design e contesti dell'innovazione tecnologica", Ed. FrancoAngeli, Milan, 2002.

[12] R. Klemke, "Context Framework – an open Approach to Enhance Organizational memory systems with Context Modelling Techniques. In PAKM -00: Practical Aspects of Knowledge Management", Proc. 3rd International Conference, Basel, Switzerland, 2000.

[13] "Warming to Wi-Fi", LATIMES, 18/04/2002.

[14] Princewaterhouse Coopers, "The Impact of Schools IT 2000," National Policy Advisory and Development Committee, Dublin 2001.

[15] I. Arnedillo Sánchez, L. Benson, C. Brophy, B. Holmes, and B. Tangney, "Reflections on the KIA Initiative," Technical Report, Department of Computer Science, Trinity College, Dublin TCD-CS-2002-05, 2002.

[16] I. Arnedillo Sánchez and B. Tangney, "Reflections On Reflections: A Communal Constructivist Approach of an ICT Intervantion," *In press*.

[17] I. Arnedillo Sánchez and B. Tangney, "Webbing Evaluations: A Web-based Artefact to Enhance Shared and Collective Knowledge Construction in Evaluation Processes," to appear on the proceedings of the Annual Conference of the Association of Information Technology for Teacher Education, Dublin, Republic of Ireland, 2002.

# Wireless Networks Case Study
# Djanogly City Technology College Nottingham

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## Abstract

*This paper takes a case study approach and describes, from a practitioner's viewpoint, a success story of using mobile computers and wireless networking technology in a secondary school setting. The project has resulted in benefits to school administration, teaching and learning styles and educational outcomes.*

*Keywords: education, learning, wireless, mobile, computers, technology*

## 1. Introduction

Site-wide wireless coverage has transformed how we do things round here. Mindsets have been altered, practices revolutionised and approaches reformed. The change really has been that dramatic.

In the past, subject teachers would get their classes settled (within an elastic temporal window), take a paper register, and then announce to the assembled throng that for that day's lesson in Maths, English, Geography, or whatever, they would be going to the computer room. Great cheers and whoops of joy eventually die down. Then would ensue the scraping of chair legs against polished floors, the bashing of knees (sometimes one's own) against tables and the general hubbub and kafuffle involved with the summary relocation of a bunch of teenagers. Odds on of course that because the ICT classes are block timetabled into virtually all the computer rooms, the only one the teacher would have been able to book would be the one right over the other side of the campus, as far away as possible from her own classroom. Having trudged across what seems like miles of corridor, our poor forlorn heroine suffers the ghastly realisation that she has forgotten to pick the key up from the begrudging troll-like Guardian of All Things Computerised, the Network Manager. Knowing that said troll would never allow a key into the hands of students (all renowned master criminals, naturally), she has little choice but to order the class to line up and wait patiently and silently for her return ('Yes, Miss, of course we will, Miss.') Ten frenetic minutes later, having finally tracked down the itinerant guardian of the computer room key, she does indeed return, although, needless to say, to a far from orderly and quiet class. Assuming said teacher actually manages to shepherd all her herd into the desktop-filled pen without having lost any wandering strays, by the time all the students have completed the Ceremony of Flinging the Bag Under the Desk and the Litany of But Miss That's My Seat, there may, if she's really lucky, be about half an hour of the lesson still remaining. It is at this point that she suffers yet another ghastly realisation: this time that the set of text books from which she had planned the students would work were back in her cupboard in the department's staff base, right over the other side of the school. Oh well, she sighs, at least this time I can send a couple of students to fetch them. They may even come back with the right ones and we can get ten minutes of work done before the little darlings have to log off the network and traipse back to whence we began.

It's about learning, it's about teaching and it's about time too. That's why we installed a wireless network. That's why we gave all our teachers and many of our support staff wireless laptops. That's why we gave departments their own class sets of laptops in Lapsafe units.

Computers are toolkits for learning. If you were half-way through building your own greenhouse, you wouldn't try to pick up the greenhouse and carry it over to the other end of the garden, to the shed, where your toolkit was kept. That would be a nonsense.

It's just the same with ICT. When you take the technology to the work, rather than the other way around, a profound and fundamental paradigm shift occurs. In the old model the computer was the focus:

**Father**: What did you do at school today, son?
**Child**: Oh, we did computers.
**Father**: I thought you had History on Thursdays.
**Child**: We do, but Mr Spoutfact took us to the computer room.

In the wireless world, the laptop computer is the learning toolkit: like textbooks, maps, a protractor or a pair of compasses, it is just another resource upon which to draw (albeit an immensely powerful and multitalented one). The technology becomes transparent whilst the content of the subject matter, the context of the curriculum area and the focus of skills development all rise to the surface once more.

Not to mention the fact that it saves an inordinate amount of time too, time better spent learning.

### 1.1. Background Information

Djanogly City Technology College, a state-funded 11-18 mixed comprehensive school, is one of only 15 CTCs in the UK. It was the first to be purpose-built in 1988 and began operation in 1989. Erected on the site of a former John Player's bonded warehouse, the College is surrounded by housing and a busy road runs past the front boundary.

We currently have more than 80 teaching staff and over 40 support staff, who do an excellent job of relieving our teachers of administrative and clerical burdens, as well as providing in-class and technical support. This army of support staff includes at least one technician for every department and a full-time Intranet developer, charged with working with teachers to produce relevant and motivating teaching and learning resources.

CTCs were originally designed to be Research and Development establishments and this approach is very much in evidence at Djanogly. We benefit greatly from our partnerships with Toshiba and Microsoft, often getting to trial new products before they go to market. We try to use time as efficiently as possible: we operate the five term year, which makes curriculum delivery and assessment much easier than in the more traditional pattern of three terms; most subjects have long blocks of time, especially useful for completing and evaluating practical work; some subjects use lead lectures to deliver content to a large number of students at once; we use vertical grouping and fast-tracking of students in order to meet the needs of individual learners.

Our specialisms are Maths, Science and Technology and our ICT courses are particularly popular and successful. However, we do all the National Curriculum and a bit more. The creative arts are extremely strong, with excellent drama, dance, media and music departments who do supremely well, both within the curriculum and in extra-curricular contexts. Sport is also very strong: we have several league and cup winning teams and we were successful in gaining the Sportsmark quality award last year.

We have excellent links with schools and other organisations in Germany, France, South Africa, Japan, Lithuania, Mozambique, Jamaica, Thailand, Taiwan and China. We teach Russian, Chinese and Japanese, the East Midlands China Centre is based here and we are doing work for the DfES to disseminate the teaching of Mandarin Chinese. Last year two of our teachers completed work on authoring a multimedia course in Chinese, in partnership with the language software company, Vektor.

We are heavily oversubscribed: we received more than two applications for every place for this year's Year 7. We have 1075 students at the moment, over 200 of them Post-16. They all live within the city boundaries and almost 40% are eligible for free school meals. They represent a mixture of races and faiths; about half are from ethnic minority groups. They represent the full range of ability, although the profile is skewed towards the lower end. They are self-confident, dynamic, enthusiastic and great fun.

## 2. Reasons for Implementing Wireless Technologies

Two years ago, the problem, born of success though it was, was twofold.

Firstly, we were running out of space. Back in the late eighties, the building had been under-designed and the architects had not envisaged the proliferation of computer technology and the concomitant accommodation requirements of multiple servers and hundreds of desktop computers (350 at last count). Over-subscription and a burgeoning Post-16 setup had led to extremely cramped conditions. New buildings on a very restricted site completely surrounded by residential streets were simply not an option.

Secondly, although specialist ICT courses, particularly Intermediate and Advanced GNVQ were immensely popular and successful, indeed had become the college's core business, Heads of Department from across the curriculum had given up on trying to get access for their subjects. Use of ICT elsewhere was pretty much limited to a bit of CAD/CAM in Technology and some CD-ROM packages in Science. This was hardly leading edge stuff and an unacceptable state of affairs in any secondary school, not to mention in a specialist technology college.

Something had to be done and it had to be done fast.

Fortunately, Djanogly CTC benefits from excellent structured cabling, and in the year 2000 had at least one RJ45 outlet in all but a handful of classrooms. However, the cost of additional outlets and attendant active hardware, in conjunction with the fact that, as already mentioned, we simply could not afford the space premium of turning more classrooms into computer suites, all meant that a traditional desktop solution was simply not the answer.

The obvious solution was to go wireless.

**Figure 1. The mobile wireless ICT classroom**

## 3. Choosing the Wireless Network

The wireless strategy was developed by the newly-appointed Deputy Principal, who had had considerable experience of testing and installing initially 2-3Mbps and then 11Mbps systems in his previous post at King Edward VII School in Melton Mowbray, Leicestershire. Experience had shown that, bizarrely, best throughput could be achieved by deploying Cisco Aironet access points with Lucent PCMCIA cards.

Djanogly CTC had just formed a strategic alliance with Toshiba for the supply of servers, desktops, laptops and projectors. When Toshiba came to market with their own-branded wireless cards, it transpired that they were based on Lucent technologies. Three separate site surveys were commissioned (all carried out FOC) and the different companies invited to quote for supply of the wireless equipment. The companies were selected because they had all provided reliable supply and service in the past and each had experience of wireless LAN installations.

Eurotechnix, the accredited Toshiba education reseller selected by Djanogly, were appointed. The appointment was made on the grounds of an existing relationship, cost factors and a service level agreement guaranteeing excellent response times and the support of a local engineer and repair service. Eurotechnix also agreed to work alongside the college's technicians during the installation in order to train them and assist them in configuring the access points.

## 4. Implementing the Wireless Strategy

Implementation consisted of a number of strands and phases. First of all, we wished to have complete coverage of the campus with access points mounted in the suspended ceilings in order to provide general connectivity for staff. Secondly, we decided to trial the use of a class set of 25 Toshiba Satellite laptop computers in the Maths department. These were fitted with PCMCIA wireless cards and housed in a Lapsafe integrated storage and charging unit, in which two Cisco Aironet 340 access points had been installed. Given that wherever within the Maths department the Lapsafe was used there was also an access point in the ceiling void, this effectively meant that the ratio of client machines to access points was always around 8:1. This afforded a very good level of performance.

With the advent of the Wi-Fi machine, initially in Toshiba's Satellite Pro range, with the antenna built into the screen lid and with an integrated mini-PC card, improved throughput could be gained. It was these laptops that were procured for the staff.

An INSET day was set aside for the staff 'out-of-the-box' session, during which hardware and software training was delivered, led by the Deputy Principal. Seating plans were carefully organised so as to encourage team training, coaching and peer mentoring, and all user guides (which had been authored by the Network Services Team) were posted on the College Intranet. It was a joy to see, for example, the Head of Maths conversing with the Head of Art about how ICT can be used in their respective areas. You simply cannot buy that kind of professional development.

Six months later, all staff laptops were replaced with upgraded models incorporating DVD-Rom drives and the original staff machines were deployed in class sets. There are now over 200 wireless laptops and 5 Lapsafes in daily use in the college.

Such was the impact of the first trial that the college decided to bid for DfES community funding in order to provide a set of 20 wireless laptops for loan to six of its feeder primary schools. Toshiba generously provided the 50% matched funding required and the scheme is proving so popular with the primary schools that Djanogly CTC has made a repeat funding bid in order to double the provision.

The laptops are transported to the different schools using Lapsafe Traveller units. Up until now, a higher specification laptop has acted as the server in the current mini wireless LAN. With the advent of Toshiba's Z300 and SG20 products, a dedicated portable wireless server specifically designed for the purpose will be supplied in order to support data storage, file and print sharing, in combination with a Virtual Private Network Firewall Router which will be utilised to provide Internet access and access to certain areas of Djanogly CTC's computer network.

## 5. Evaluating the effects of Wireless Technologies on the Standards of Teaching and Learning

So, have outcomes improved as a result of our wireless strategy? Well, last year we achieved 53% 5 or more A*-C grades at GCSE or equivalent, 23 percentage points above the average for Nottingham City LEA schools and 16 percentage points above YELLIS predictions. This Value Added figure was twice that achieved by the previous year's cohort. The average points score for Post-16 was 15.4, a wonderful achievement for our inner city teenagers and a huge increase on the figure of 4.8 from two years earlier.

The use of Bromcom software on the teachers' laptops means that electronic registration can be performed in real time and any instances of truancy can be quickly and easily identified and acted upon. Teachers now have convenient and ready access to up-to-date information. A query generator module of the MIS is accessible from the teacher's laptop, supplying timetable, assessment and contact information. Imagine how powerful it is to be able to say to a student, 'Right, I've just pulled up your parents' contact details so I'll email them straightaway with details of your poor behaviour.' Of course, the parental contact could just as easily be on the subject of attainment, or attendance, or extra-curricular involvement and could be to do with praise and reward rather than sanctions or discipline.

All staff now use Microsoft Outlook and the functionality it provides in respect of email, scheduling and task management has been of immense benefit to staff. Once again, communication about students is instant and automatically recorded. Teamworking and the sharing of lesson plans, resources and ideas has increased and improved exponentially.

The motivational aspect of ICT is often cited but never could we have hoped to experience the results of introducing wireless laptops into students' learning that we have. For example, we have had numerous instances of students doing online end of term assessments – assessments that when they were paper-based were usually the most tedious, nerve-wracking and demotivating of experiences – actually requesting to be allowed to stay in over breaks and lunchtimes to spend more time doing their tests! Even History and RE tests at that!

PowerPoint presentations, other multimedia and web-based resources, some harvested from external resources but many created in-house, are all being used on a regular and frequent basis by teachers for both didactic teaching and individualised learning using wireless. More lessons are addressing the range of preferred learning styles through the use of the technology. Lessons are more engaging, more relevant and more fun. Increased enjoyment is leading to more and better learning. Students are developing transferable skills and building intellectual capability that will ensure their success as lifelong learners: in short, they are learning how to learn.

## 6. Future Plans

We are now at the most exciting stage of our development, as we finalise our plans to establish a City Academy for Nottingham. In partnership with the LEA, we shall be taking on the site of the nearby Forest School, which will become our 11-14 centre. A multi-million pound injection of capital will see the creation of state-of-the-art facilities on the site. The specialism of the City Academy will be ICT, whilst maintaining the broader specialisms of the CTC, namely Maths, Science and Technology. By taking in an additional hundred students every year for the next five years, our number on roll will expand to over 1700. The proposed curriculum for the City Academy is predicated on the provision of 1:1 access to wireless laptops for all as a means to accelerate achievement and provide the emerging adults in our care with the very best life chances possible.

# Meeting the challenge: producing m-learning materials for young adults with numeracy and literacy needs


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## Abstract


*M-learning is a European funded project investigating Mobile Communications Technologies for Young Adult Learning and Skills Development. CTAD have produced a range of content in collaboration with the project partners. The content is delivered on mobile phones and Pocket PCs and includes materials about issues around moving into a flat and football refereeing.*

*This paper considers a range of the learning resources and technologies that are being developed for piloting with 60 young people in June and July.*

*A presentation at the European Workshop on Mobile and Contextual Learning will include demonstrations of some of the prototype content that has been developed.*


## 1. The Project

m-Learning is a 3 year pan-European collaborative research and development programme supported by the European Commission under the Learning Citizen strand of their Information Society Technologies (IST) initiative. The Learning Citizen initiative aims to facilitate and enhance lifelong learning for all members of society.

m-Learning addresses 3 problems relating to many young adults in the EU:

- *Poor literacy/numeracy - see e.g. Improving Literacy and Numeracy: A Fresh Start (UK DfEE 1999) and Literacy in the Information Age (Statistics Canada & OECD 1997)*
- *Non-participation in conventional education - see e.g. Learning Works (UK DfEE 1999)*
- *Lack of access creating ICT "haves"/"have nots" resulting in inequality of opportunity -see e.g. "Closing the Digital Divide: ICT in Deprived Areas" (UK government 2000).*

The m-learning project is developing prototype products and innovative approaches to delivering learning experiences through the medium of hand held information and communications technology (ICT) 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 life long 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.

The m-learning consortium is a partnership of organizations (LSDA, CTAD and Ultralab from the UK, Lecando from Sweden and CRMPA from Italy) combining skills in pedagogy and technology. Research activities, and user trials of products developed within the project, will be carried out working in partnership with education and training providers and organisations that reach out to disadvantaged young people.

The technologies being explored within the project range from leading edge (location-aware devices, hand-held browsers, WAP, advanced voice technology) to those in widespread use, but normally outside education (SMS on standard mobile phones).

The focus of the m-learning project is on those young adults (16 – 24 years old) in Europe who are most at risk of social exclusion. They are not involved in education or training and have not previously succeeded within the education system. They may not be able to read and write adequately and have problems with simple calculations except in familiar contexts.

## 2. Initial Prototypes

CTAD is developing initial sample content to provide modules of learning via portable devices. These will be piloted with groups of young people during June. The pilots will be evaluated and the outcomes will inform the developments in the second, two-year phase, when more extensive pilots and substantial products are planned.

The technologies are developing fast and it is not possible to know which technologies will emerge as the most popular by the end of the project in 2004. Therefore, m-learning is initially developing materials for a variety of devices, Applying open specifications will maximise interoperability across products and within environments. In particular some of the ADL SCORM, IEEE LTSC, and IMS specifications are under consideration. In the longer term, it is expected that learner preference and performance information will be integrated into delivery mechanisms.

It is expected that the learning episodes will be short. For the prototype phase, a typical piece of aggregated m-learning content will have a maximum typical learning time of 20 minutes. The size of a resource will clearly be limited partly by the bandwidth of connection and by the richness of the media, but an assembly is likely to have a maximum size of 2.5Mb. Assemblies will be broken down into modules that can provide an effective piece of learning in a just few minutes or less. The learner should be able to seamlessly stop and restart.

CTAD will build on its relationship with several initiatives and community based centres that are supporting young people. This will have the advantage of ensuring that the learning is contextualized and blended into existing, real-life learning experiences.

Some of the initial content will be integrated into specific projects that the centres have already begun and where materials are already being used. Other content will be created around themes that initial research has shown are popular with the target audience.

## 3. The Themes

In consultation with young people and with the staff at centres based in the community, CTAD has selected the following themes in which to develop some initial content. The initial resources may be fragmented, but should integrate into other meaningful learning experiences. If justified by the pilots, these will be developed into more substantial products.

### 3.1. Urban Survival

A problem many young people face is taking the step of setting up their own home and becoming more independent. Issues include dealing with legal complexities of tenancy agreements, managing finances and cost effective decorating a new room. Some units will help deal with support for “on-the-street” situations. Modules will support both literacy and numeracy in real life situations.

### 3.2. Football Refereeing

Refereeing is popular with some of the young people. m-Learning will be used to provide sample resources to support, or help people prepare for, a short course leading to a qualification. This will include the use of voice and text to deliver information about the rules and video clips to support examples of decision-making. The materials will aim to remove literacy and numeracy barriers that may make it difficult to complete the refereeing course.

## 4. Technology

A variety of technologies will be used to deliver the materials. These will fit into the following broad categories, though there will also be various hybrid systems or content.

1. Online devices, such as the Pocket PC, that can provide interactions with a server or online managed learning system. Even though these devices are capable of delivering multimedia, the bandwidth is usually relatively low so the file transfers need to be small
2. Off line devices, such as Palm, Pocket PC or possibly Game Boys, that have to load content from a computer or using a form of storage media such as a cartridge. These can include interactive multimedia resources.
3. Audio, with a simple interface, such as an MP3 player or a mobile phone. There are already many commercial support services that a user can access via a telephone, using key presses or voice commands for multiple-choice navigation. Some of the learning content will exploit these kinds of technologies and voice XML.
4. Text only messaging is very popular amongst young people. When combined with server driven content, with SMS broadcast and the development of communities of learners this, is a potentially powerful means of delivery where the barriers to access are low.

Not all the learning will be delivered to individuals. There are several events planned that will use m-learning to deliver collaborative spaces and activities.

## 5. Accessibility

CTAD is aware of many of the issues of accessibility surrounding existing and emerging m-learning devices and content. In the second phase of the project it is anticipated that there will be materials specifically written for parts of the target audience that have specific accessibility problems. This may include using text and voice technologies to enable visually and hearing impaired young people to take part in learning communities and to access personalized content.

## 6. Summary

As part of the m-learning project, CTAD will be producing a small range of targeted learning resources that can be delivered using different mobile technologies.

# Evaluating m-learning

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## Abstract

*m-learning is untried combinations of pedagogy and technology., offering portable, voluntary, spontaneous, unstructured and informal learning. The learning will be highly individual and highly contextualised. Many forms of educational evaluation based around courseware, web sites and computers are tied to educational formats involving building and courses. Some of them focus closely on the short-term cognitive consequences of an episode of learning whilst neglecting longer-term, social and affective consequences. These forms of evaluation will not be effective with m-learning. This paper, based on work for the EU's m-learning Project, reviews these forms of evaluation and identifies principles that support evaluation strategies congruent with the pedagogy and technology of m-learning.*

## 1. Introduction: the *m-learning* Project

*m-learning* is a 3-year EU project [1], addressing three social and educational issues relating to young adults. They are:

- Poor literacy and numeracy.
- Unwillingness to take part in education.
- Lack of access to computers.

*m-learning*'s objective is to develop and prove prototype products and services which will provide information and advice and small modules of learning via technologies which are inexpensive, portable and already owned by or easily accessible for the majority of young adults. The design of the prototypes will be informed by:

- Research into the use of mobile phone technology: needs, preferences, attitudes and habits of young adult mobile phone users.
- Research into computer game design and their users' preferences.
- Research and development seeking knowledge representation, leamer models and standards.

## 2. Evaluating the *m-learning* Project

The complete evaluation looks at the specifics of the current developments and at aspects of the concepts implied in them. The current discussion will focus on the educational aspects of *m-learning*. The *m-learning* Project is an exemplar for mobile learning and challenges evaluators to develop techniques that match the work of the educators and the technologists.

In seeking to evaluate something as novel as *m-learning*, it is necessary to step back and to ask about the exact nature of the *m-learning* experience and to devise the evaluation accordingly. *m-learning* is voluntary, spontaneous, unstructured and informal. Consequently, any successful implementation and delivery will depend on substantial and enduring attitude change (to learners' goals, aims, priorities, expectations and behaviour) rather than just specific and possibly short-term cognitive improvement, and will probably be broader than purely educational change, embracing possibly vocational and lifestyle change. This success will depend on a match between *m-learning*, content and technology, and the lifestyles of the learners. *m-learning* must teach well but must also motivate students to learn. This means that the content must have meaning for the learners and that the delivery and technology must be effective..

The target learners for the *m-learning* Project are people seeking literacy and numeracy. This poses extra challenges for educators and evaluators. The adult literacy movement, rejuvenated in the 1970's, took as axiomatic that literacy students were autonomous and independent adults. As such, they should set the agenda, negotiate the curriculum and manage their learning. Any learning managed, assisted or mediated by computers faces a considerable challenge in the light of such a radical view of student-centred learning and any evaluation based on the evaluator's priorities, as expressed in questionnaires, would be as inappropriate as an education based around the educator's priorities, as expressed in exams.

Furthermore, *m-learning* is a lightweight phenomenon, in that it is informal, instantaneous and spontaneous. Evaluation, to be congruent with the style of *m-learning* must also be lightweight. Any evaluation that is more ponderous, protracted, formal or compulsory than *m-learning* itself will not produce valid conclusions.

Finally, any evaluation must be consistent with the technologies of *m-learning*. The evaluation must be woven into those rather than imposed in different and additional ones.

## 3. Courseware Evaluation

Courseware evaluation would be the tool of choice for learning experiences mediated by technology. It is mature and there are comprehensive tool-kits [2] and cookbooks [3]. Its objective is the educational worth of sessions where learners interact with educational software. It can involve the active participation of learners (they fill in questionnaires or sit tests). It may only involve learners insofar as their reactions and improvements are logged by video. It may not involve learners at all, if "experts" or checklists are used instead.

Courseware evaluation is suitable for evaluating didactic expositions where sedentary learners interact with software on an individual basis. There are situations were it is less appropriate. One is open-ended learning, where for example students discover or construct meaning. Another is where students interact to form a learning community. A third is where the software-based learning is a component of a "blended" learning experience.

## 4. Alternative Approaches to Evaluation

For *m-learning* a more radical approach is to ask:

- what do evaluators want to find out from learners?
- how can this information be characterised?
- what are most appropriate techniques to access this information?

Gordon Rugg and others have used this approach in constructing ACRE, a Questioning Methodology [4] based on a systematic analysis of types of knowing. (Knowing includes conventional knowledge and also self-knowledge about attitudes, values and goals) It allows the questioners to choose an appropriate questioning technique. Rugg classifies what subjects know as:

- Tacit knowledge – not available to conscious introspection
- Explicit knowledge - available to conscious introspection

Tacit knowledge will not be relevant but explicit knowledge will be. It is accessible to conscious introspection but may be subject to distortions, omissions and misrepresentations. This might occur when the information being sought has implications for the learners' perceived self-esteem or social worth. With basic skills this is an issue, and the technologies (mobile 'phones) bring issues of status.

There is also semi-tacit knowing, only be accessed by specific routes. It includes:

- Short-term memory
- "Not-worth-mentioning" knowledge
- "Taken-for-granted" knowledge
- "Front" and "back" versions

Much that we might like to hear from learners will be semi-tacit. They will have versions of reasons to explain their involvement in the Project. Some of these will be for public consumption ("front"), others will not ("back"). There will be factors about the learners' use of technology they will omit to tell evaluators (mistakenly assuming a shared understanding with the evaluators. These factors are "taken-for-granted" or "not-worth mentioning"). This may be a major factor because the Project uses technologies (mobile 'phones for example) with a highly differentiated significance amongst different sub-cultures. As *m-learning* is delivered in short bursts, short-term memory will be a factor in the learners' ability to report on learning. These examples illustrate the need to understand the factors at work when evaluators engage with learners to explore their attitudes and priorities. Rugg also provides a route into questioning techniques. A feature of Rugg's work is advocacy of Personal Construct Theory. This asserts that we understand the world by organising our perceptions and attitudes to it. We do this by the classifications we make, the "constructs". This is attractive since it asserts the primacy of the learners' views and proposes questioning techniques that are "light-weight". Examples are card-sorts, using packs of hand-written cards, and laddering, a structured dialogue. These can be implemented using WAP or SMS.

Methods derived from PCT are consistent with the adult literacy view of learners as autonomous adults. One techniques of adult literacy has been free writing. This has been recognition of learners' own voices. If learners' evaluation of *m-learning* can use free writing - as text-messaging - then such a tactic would be consistent with the ethos of adult literacy and produce an authentic evaluation, the learners' views in the learners' words.

## 5. Conclusions

The ideas outlined above have yet to be applied. The *m-learning* Project represents a unique opportunity to think through novel techniques in novel situations. This paper has identified some of the principles and techniques but effort, collaboration and ingenuity will be needed to implement them.

## 6. References


[1] http://www.ultralab.ac.uk/projects/m-learning/

[2] Harvey, J. *Evaluation Cookbook*, LTDI, Edinburgh, 1998

[3] Evaluation Methods and Procedures, http://iet.open.ac.uk/plum/evaluation/contents.html

[4] Maiden, N. A. M. and Rugg, G. "ACRE: selecting methods for requirement acquisition", Software Engineering Journal, IEE, London, May 1996.

# Mobile Computer Supported Collaborative Learning: MCSCL

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## Abstract

*We describe how the usability problems of coordination, communication, management and lack of mobility, encountered in collaborative learning (CL) applications can be solved with the technological support of Mobile Computer Supported Collaborative Learning (CSCL): in the form of a MCSCL environment with Handheld devices interconnected by a wireless network. Three different MCSCL applications for children have been implemented, its usability analysis indicates that solve the problems mentioned above.*

## 1. Why do we need mobility?

According to [2], [5] in face-to-face, same place CL environments, the social interactions between members of the group (3 to 5) are highly valued and the establishment of close contacts between them is necessary.

The observed results of a usability analysis performed in CL, show that: the majority of the members move to establish communications between them, often-used materials (e.g. paper, pencils) needs to be managed, the members do not always coordinate their activities.

One proposed solution to these problems consists in facilitating technological support for CL applications by means of handheld devices, interconnected by a wireless link. Some authors, [3] show significant advantages using the mobile properties of these wirelessly interconnected Handhelds to support CL applications.

## 2. What is MCSCL?

A Mobile CSCL or MCSCL application supported by wirelessly interconnected Handhelds is based on eight model of CL proposed by [1], which supports social interaction of 3 to 5 members. A CL application, applied in such model, achieves positive interdependence, individual responsibility, mobility, group processing and face-to-face communication. An extended model of MCSCL application (Figure 1, members are represented by $C_1$, $C_2$ and $C_3$) is built by introducing a wireless network to the group. The movement of the applications is maintained. Each of the collaborators $C_1$, $C_2$ and $C_3$ had Handhelds with wireless communication capabilities, with which s/he extends her/his area of communication through the wireless network; additionally the member can move her/his Handheld. Not only can members socially interact among themselves (inner bound circumference of Figure 1), but they can also do so through their Handhelds (outer bound circumference of Figure 1) that intercommunicate bi-directionally and wirelessly for an active and dynamic control of the CSCL application.

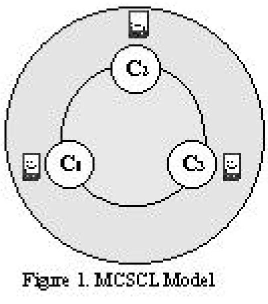

Figure 1. MCSCL Model

Three MCSCL applications have been implemented for children to 6 and 7 years old with language and mathematics objectives learning.

## 5. Conclusions

The usability analysis of a non-technological collaborative application helped identify those elements that could not be implemented without technological support. A usability analysis showed that the MCSCL applications implemented overcome the problems detected in CL applications. The use of wireless networks in collaborative applications opens a new world of possibilities. The MCSCL applications support transparently the collaborative work by:

- Organizing the managed information and providing a negotiation space.
- Providing the communication channel between the wireless network to the social face-to-face network, Figure 1.
- Encouraging coordination between the activity states.
- Encouraging the member's mobility.

The last two mark a difference in how collaboration is supported between MCSCL and CSCL applications.

## 6. References


[1] Davidson, N. & Worsham, T. (1992). Enhancing thinking cooperative learning. Published by Teachers College Press.

[2] Dillenbourg, P. (1999). What do you mean by "Collaborative Learning". In P. Dillenbourg (Ed.) Collaborative Learning: Cognitive and Computational Approaches. Elseiver Science.

[3] Inkpen, K.M. (1999). Designing handheld technologies for kids. Personal Technologies, 1999. 3 (1&2), pp. 81-89.

[4] Roschelle, J.; & Teasley, S. (1995). The construction of shared knowledge in collaborative problem solving. In C. O'Malley (Ed.), Computer -Supported Collaborative Learning. pp. 69-97. New York: Sp ringer-Verlag.

[5] Vygotsky, L. (1978). Mind in society: The development of higher psychological processes. Cambridge: Harvard University Press.

# Contextual information presentation for optimal learning: initial study

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For sportsmen and women, learning to improve their performance corresponds to understanding precisely what is happening. Working with complex machinery such as racing yachts or sports cars, the correct presentation of information at the right time is essential to allow them to understand what is going on, and how their efforts are being translated into more or less effective performance. This is essentially an ongoing contextual learning process; information on the overall performance is fed back, allowing the sportsperson to assess their approach, and adapt and modify it as necessary.

This work discusses the approach taken on a medium sized racing yacht (34') to try and provide the crew with context-sensitive information presented in the most effective manner. Whilst some of the information is specific to a race yacht, the general issues addressed of the appropriate presentation of relevant contextual information to improve the overall performance of users are of wider application.

A typical race crew consists of eight people:

1. bow - responsible for setting new sails on the front of the boat, and sorting out any tangles that occur at that end of the yacht
2. mast - helps bow with sail setting, and hoists the new sails as required
3. pit - controls all the ropes in the cockpit, particularly the controls that allow the sails to be lowered, and the rope clutches that hold sails up once they've been hoisted
4. trimmer - responsible for setting the front sails correctly
5. grinder - provides the muscle power to winch in the sails
6. mainsheet - sets and trims the mainsail (the largest sail)
7. helm - steers the boat
8. navigator/tactician - decides which way to sail the boat

Seat-of-the-pants feelings about sailing boats fast are being augmented by ever-increasing levels of instrumentation and processing. We can consider the different levels of data input and processing, present a coherent taxonomy, and discuss how to present this information to the crew at critical times. Data processed effectively should reduce the cognitive load on the crew, critical in a stressful race situation, allowing them to assimilate the information more rapidly and with less errors, and so should lead to an increase in performance. The bow needs different details than the mainsail trimmer, who in turn has different requirements to the navigator. Presenting the right information to the right people is a challenge, and one that can be assisted by technology. This work discusses the use of a wireless network communicating with 8.5" and palmtop displays, coupled with wearable computers, to present the right information to the right people at the right time. This is in addition to the more conventional approaches of standard instrumentation - typically, multipurpose displays in the cockpit and large repeaters on the mast, visible to all.

# Developing a Prototype Microportal for m-Learning: a Social-Constructivist Approach

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## Abstract

*This poster presents a social-constructivist approach to microportal development for the EU-funded m-Learning project. The microportal will engage and support young adults in improving their literacy and numeracy skills and will promote interest in lifelong learning. This will be achieved by exploiting young adults' use of mobile devices; the microportal will afford different modes of access to learning opportunities offered by the m-Learning partner organizations.*

*The approach adopted by the developers sees the pedagogical value of a successful microportal application in the extent to which it has the potential to promote a learning culture among target audiences. This in turn will depend on the extent to which the microportal can support virtual networked and collaborative learning which is need driven, not technology driven. Underpinning research informing the microportal development therefore includes field research which engages members of the target audiences as co-researchers, to ensure a focus on youth interests in designing for communication and rich interaction.*

## 1. A Prototype Microportal for *m-Learning*

*m-Learning* is a 3-year pan-European project funded by the European Commission under the Education Area of the Information Society (IST) Programme and led by the UK's Learning and Skills Development Agency. Other partners are CTAD and Ultralab, also in the UK, as well as CRMPA in Italy and Lecando in Sweden. The project began in October 2001 and develops prototype products which can attract young audiences back to learning and support life-long learning. Access to these products will be via a prototype learning microportal developed by Ultralab.

## 2. Towards a learning culture

M-learning microportal developers need to accommodate the constraints of handhelds in ways which attract target audiences. Mobile games and SMS have obvious outreach potential for m-learning. [1] How though can these best be exploited? Ultralab's substantial pioneering work with online learning communities points to the need for a social-constructivist approach [2] to design and development of the prototype. The underpinning research includes field research which engages members of the target audiences in order to ensure maximum product interest to young adults. Microportal will promote intrinsic learning through scaffolding via asynchronous peer to peer support and realworld mentoring. Learners will not only be able to choose different modes of access to the microportal, they will also be able to create their own microportals, and can choose between different learning environments, including a game environment. Opportunities for social interactions include opportunities for chat as well as for themed discussion and debate. These real world activities will be complemented by parallel activities in a virtual game environment. Participants will be further supported in becoming more autonomous learners via access to products created by project partners. These include help with considering their own learning goals, identifying learning needs and strategies in terms of these, exercising choice and liaising with others in putting together their own learning programme. In these ways microportal design aims to promote both self esteem and intrinsic motivation, enhancing learning outcomes in the short term and promoting life-long learning and interdependence.

## 3. References

[1] Brown, G and Dhaliwil, J., Mobile Youth, W2F at: http://www.cmsinfo.com/ZWFWY.html January 2002.

[2] Vygotsky, L. *Mind in Society: The Development of Higher Psychological Processes*, Harvard University Press, 1978.

# Anytime Anywhere: Empowering Learners with Severe Disabilities

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Mobile and contextual learning has particular significance for adult learners with severe disabilities.. For these people, technology has the potential to open the doors to further education and training by providing suitably adapted, specialist, accessible learning materials and environments, accessible from college, home, in respite care or wherever.

The Portland Partnership is an ESF-funded project (under the EQUAL initiative) consisting of nine national partners: a specialist college, universities, FE colleges, a consultancy firm and a software authoring company. The aim is to enable Pre-Entry level learners to use ICT to help them learn more autonomously, and thus offer a more meaningful way to develop, practise and demonstrate their acquisition of basic/essential skills. It will require a significant focus on access and enabling solutions for learners with physical access problems.

The successful development of such a project would mean that any learner, irrespective of the severity of their disability or learning difficulty, would have access to a national framework for basic/essential/key skills. Progression would be facilitated by the use of clearly structured and optimally accessible tools, supports and structures for learning.

The partners aim to explore the development of:

- Diagnostic assessment materials (pre-entry/essential skills).
- Accessible online learning materials for pre-entry level and essential skills.
- Adaptive technology solutions to enable people with disabilities to physically interact with the materials (e.g. augmentive communication devices)
- A fully inclusive and accessible (symbol compatible) virtual learning environment

The role of the Special Needs Computing Research Unit at the University of Teesside is to design and implement an accessible and innovative Virtual Learning Environment (VLE). The VLE will be designed to cater for all individual requirements and offer empowerment to the users in order for them to physically interact with open environments in terms of learning, working and general living.

Students with severe disabilities are likely to have very particular and often conflicting requirements in terms of the way they will interact with the VLE, its interface and its features. This raises a number of issues of configurability. Many VLEs are configurable to suit the corporate look and feel of the institution using them and may offer a degree of configurability for the teacher in terms of choosing the content, tools and the way they are displayed. However, a student with severe disabilities will need a much higher and more specific level of configurability. Some of the challenges we will need to meet are:

- It must be compatible with symbols based systems (Symbol systems augment language and literacy, and can be vital learning and communication tools for students with physical and communication difficulties).
- It will also need to be text based for those using screen readers.

- It will need to cope with different input devices.
- Crucially, once the student's individual requirements are set, for real anytime, anywhere learning the VLE must incorporate a roving profile so that the learner's configuration will be available on any PC, laptop or through wireless internet connection – possibly via an augmentive communication device.

This poster will illustrate our current progress in this exciting new research project.

# Mobile Communications Technologies for Young Adult Learning and Skills Development (m-learning) IST-2000-25270

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## Abstract

*m-learning, a pan-European research and development programme supported by the EC, attempts to encourage young adults to participate in learning via the use of mobile phones and other handheld devices.*

*Keywords: mobile phones, learning, m-learning, e-learning, basic skills, literacy, numeracy*

## 1. The Motivation and Aims of m-learning

In many European countries we are failing to deliver basic literacy and numeracy skills to many of our young people. The International Adult Literacy Strategy [1] found substantial literacy problems in all the countries studied. Many, including the UK, had rates of functional illiteracy of 20% or more and worse innumeracy levels. At the same time many young adults are not participating in post-compulsory education. However most young adults have a mobile phone and perhaps their enthusiasm for this device can be used to engage them in some small learning activities that may lead to later more substantial and sustained involvement in learning.

## 2. The Programme

The prototype products and services being developed by m-learning are designed to capture the interest of young adults (16 to 24) not currently in education or training. Learning themes focus on subjects of interest to young adults, e.g. football and music, and the modules include activities designed to develop aspects of literacy and numeracy. The target audience includes young adults who are unemployed, under-employed or homeless.

Research activities within the programme include:

- investigating of the features of current and forecast devices (including mobile phones, palm and pocket PCs) as well as the capabilities of current and predicted communications networks
- researching the motivation, preferences and behaviour of young adult users of mobile phones and handheld electronic games
- researching the needs and experiences of young people with sight or hearing difficulties
- reviewing current and emerging standards and specifications for learning materials development and meta-tagging to ensure interoperability
- monitoring research into possible health hazards associated with excessive use of mobile phones

Infrastructure includes a Learning Management System and a microportal interface layer is under development. These facilitate access to materials and services from a variety of mobile and other devices. For devices with little multimedia functionality, and for learners with sensory difficulties, SMS, speech-to-text and text-to-speech facilities are being developed. Support for collaborative learning and peer-to-peer interaction is being developed. m-learning development is an iterative process informed by work with groups of young adults.

Design of the prototype learning materials draws on the experience of partners in designing modular multimedia learning materials and is informed by the research. An intelligent tutor system is being developed which will help identify learners' needs and learning preferences and match these to available materials. User trials involving young adults from the target audience will take place in the UK and Italy in 2003/04.

The m-learning partners are the Learning and Skills Development Agency, Cambridge Training and Development and Ultralab at APU, in the UK plus the Centre of Research in Pure and Applied Mathematics (CRMPA) at the University of Salerno in Italy and Lecando in Sweden.

## 3. References

[1] International Adult Literacy Survey (IALS), *Literacy Skills for the Knowledge Society*, IALS, 1997

# Portable Learning and Assessment - Towards Ubiquitous Education

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For several years, the Department of Electronics and Electrical Engineering and the Robert Clark Centre for Technological Education at the University of Glasgow have collaborated over methods to enhance access to, and provide effective delivery of, course material in higher education. The work has focussed on the application of computer-based learning and assessment methods to undergraduate courses using campus-based delivery [1, 2] and have demonstrated that regular formative assessment and appropriate student feedback can have a marked effect on overall course results. The work is being extended to allow portable, ubiquitous access to learning and assessment materials via Personal Digital Assistants (PDAs), handheld computers optimised for ubiquitous, rapid access to limited amounts of data from a large data set.

A number of universities [3], and commercial concerns have recognised the potential of PDAs to enhance student learning by supporting and augmenting their Managed Learning Environments (MLEs) – allowing the transfer of materials such as e-texts, lecture notes and timetables to students. However none of these approaches takes advantage of the potential of PDAs in formative assessment. A PDA equipped student can carry question sets at all times. Their response to assessment questions can direct them to further stored learning materials. In addition, when new question sets are regularly loaded into the PDA, their journalled route through previous material may be archived for later analysis.

We have created PDA based 'quiz' applications – initially text based and multiple choice in nature – which may link to stored course texts to enhance practical student centred learning, and which journal the pattern of student usage. Quantitative analyses can thus be made of student learning styles both within the 'quiz', and in conjunction with other PDA tools.

Software has been developed to import questions from IMS QTI compliant applications permitting universal interoperability, and allowing use of pre -existent question banks, such as that being constructed in the Faculty of Engineering at the Universit y of Glasgow.

These learning and revision tools are aimed at sudents in foundational level technology classes and advanced level electronic engineering classes. The benefits of PDA use will be evaluated by summative assessment, interviews and analysis of PDA journaling for unique quantitative insight into student learning.

We will demonstrate applications for formative assessment and describe their use within the University of Glasgow.

## References

[1] J. V. Magill, *Example Assessment analysis - Electronic Materials and Devices*, in Blueprint for Computer-assisted Assessment, University of Luton, 2001,ISBN:1 -904020-00-3.

[2] M. McAlpine, J. Magill, S. Roy, J. Trinder and D. Whittington, *A dynamic resource for on-line formative assessment in engineering*, Association for Learning Technology Conference (ALT-C), Edinburgh, 2001

[3] http://www.palm.com/education/studies/index.html#campus
http://www.georgefox.edu/palmprof/proposal.html
http://www.cnnw.com/articles/articles9-01-4.html
http://concord.org/slic/

# M-Learning and E-Learning: a Review of Work Undertaken by the Learning Technology Research Group, Kingston University, UK.

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## Abstract

*This poster outlines the work undertaken by the Learning Technology Research Group (LTRG) in M-Learning and E-Learning:*

- *User-centred methodologies to assist the design and evaluation of multiple Learning Management Systems (LMS) – e.g. Grounded Theory [1,2,3,6], Action Research [6]*
  *We have used these methodologies for both E-Learning and M-Learning [3,4]; the key outcome has been gaining student perceptions of (1) LMS and (2) the use of mobile technologies in collaborative working. These have differed from expectations.*
- *SMS-based applications [4,5]*
  *We are developing SMS applications to support Kingston University students, in the light of the research outlined above.*
- *Educational objects and reuse in M-Learning and E-Learning (from SMS to 3G/4G)*
  *Reuse of educational objects designed with multiple delivery platforms will be key in scalable projects such as those being developed.*
- *New Technology Institute (NTI) –HE* **and** *FE.*
  *M-learning to take place across HE and FE – new research opportunities.*

The LTRG is currently engaged in the use of Grounded Theory as a methodology for studying students' uses of learning management systems (LMS). The Grounded Theory method requires that the full research process is grounded in the data that is collected. As with most qualitative methods, it accepts that the researcher cannot remain external to the collection and interpretation of data, but is inherently bound up in the process of the research. The process of collection and interpretation is cyclical, with low-level analysis of data providing grounds for simple levels of interpretation, which then provide the basis for reinterpretation of existing data and collection of additional data.

This process is an iterative one, and focuses on the subject's perspective, but also accepts that the researchers cannot approach the subject without their own endogenous bias (i.e. their personal views). There is an implication that the results will be dependent on the researcher's implicit involvement - this is managed through the careful recording of the process of interpretation, where the researchers' initial interests, subsequent comments and possible interpretations are treated not just as information external to the analysis, but are recorded as data within the project itself.

Some of the findings from the Grounded Theory research relating to Learning Management Systems (LMS) have a direct bearing on issues critical to the justification of the adoption of mobile learning - time and location.

We are identifying the combinations of technologies that students use, determine the contexts of use, to what extent students are already using these to support their learning activities, and which combinations they use (and how) when presented with more options. We are using these results to inform subsequent work, in addition to trialling applications which integrate with information and communication technologies (ICT) already in use. Examples include: using information screens on campus; the managed learning environment (MLE) deployed across the university; and the IT systems used by placement officers to support students in their industrial placement year.

A company, with which the Learning Technology Research Group has strong links with, has undertaken applied research trials which focused upon which combinations of SMS, email and web forms elicit the highest response rate amongst students. This has included data to inform how to maximise completion of a task, and detailed analyses addressing the duration and rate of responses from the initial time of sending interactive content. This expertise allows us to develop a roadmap of work that is most likely to be of use to students, optimise system design and timely interactions, and thus maximise participation.

The School of Computing and Information Systems (of which LTRG is part) has recently won a grant from HEFCE for £1.38 million to set up a New Technology Institute (NTI). The NTIs are a special initiative of HEFCE designed to respond to the IT skills shortage and to link FE and HE closer together. This will focus on providing development for IT staff to support E-business in small and medium sized companies in south and west London. This partnership with 7 FE colleges gives more potential for m-learning work to be done from FE to Postgraduate education.

## References

[1] Alsop, G. and Tompsett, C.P. "Interface Design In Learning Management Systems". Contact g.alsop@kingston.ac.uk for a username and password access to http://infosys.king.ac.uk/LTRG/. [Presented at ALT-C 2001 Edinburgh].

[2] Alsop, G. and Tompsett C. P., "A Grounded Theory Investigation of Students' Perceptions of Learning Management Systems", *Proceedings of the 9th Improving Student Learning symposium, 2001*, Oxford Centre for Staff and Learning Development, Oxford (in print), 2002.

[3] Stone, A., Alsop, G., Tompsett, C., "Grounded Theory as a Means of User-Centred Design and Evaluation of Mobile Learning Systems", *Proceedings of 2002 International Workshop on Wireless and Mobile Technologies in Education, IEEE*, Växjö, Sweden, 2002 (forthcoming).

[4] Stone, A., Alsop, G., Briggs, J.,.Tompsett, C., "M-learning as a means of supporting learners: tomorrow's technologies are already here, how can we most effectively use them in the e-learning age?", *Proceedings of the Third International Conference on Networked Learning 2002*, , Sheffield, UK, 2002, pp. 558-563.

[5] Stone, A., "Mobile Telephony and Learning: Nuisance or Potential Enhancement?", *Proceedings of 2002 International Symposium on Technology and Society (ISTAS'02) Social Implications of Information and Communication Technology, IEEE*, Raleigh, NC, 2002 (forthcoming).

[6] Alsop, G. and Tompsett, C.P. "Activity Theory and Grounded Theory – A Symbiotic Relationship for Studying The Use of Learning Technology?" *ALT-C*, 2002 (under consideration).

# Object Manipulation In Educational Multimodal Systems for Contextual Learning


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Learning does not need to be classroom based, but can occur in a variety of places and for a variety of reasons. This assumption is often referred to in terms of the context of learning. In this paper, we focus on multimodality, as a means of exploring contextual learning for children. By multimodality we mean the interaction between visual, actional and linguistic communication that can be employed in learning. The use of multiple modalities is believed that engages learners' interest and facilitates the process of learning.

The context in which learning occurs, influences the impact of different modalities upon learning. In science education, for example, aspects of multimodal communication become salient. Science shows an overriding importance of material things in relation to words; it connects with action through experiment and demonstration, and it uses images for knowledge representation [1]. These issues support multimodality in science education as being beneficial to children.

The aim of the research reported in this paper is to explore user requirements for a multimodal educational system. In this process, the context of learning gives shape to decisions regarding which modalities to employ and when. It also affects the ways of illustrating representations to different modalities. In science education, the integration of haptics (that is the use of tactile and kinaesthetic information) with vision and language may be beneficial to learners.

The introduction of haptics to the context of learning is related to the artifacts or the learning objects. The objects and the ways they are employed by children are part of the learning experience and they are not perceived separately. When students write notes, for example, they do not perceive the pen as a separate entity but as part of the note taking. The pen will be the focus of attention only when there is a break down, e.g. when it runs out of ink or when they get cramp in an exam [2,3].

The objects used in a learning experience provide extra information when they are touched than when they are seen only. There is experimental support in psychology literature saying that vision and haptics use different perceptual pathways when encoded which are not competitive [4].

On the other hand, it needs to be considered that physical objects have different importance in different learning tasks. Specific objects may offer a continuous engagement to learners and other objects may not add to the meaning construction. Research into haptic exploration of objects suggests that people employ stereotypical 'exploratory procedures' [5] and that these procedures are influenced by the properties of the object. In a like manner, we propose that the learning experience is constrained by the affordances of the physical objects. Affordances, according to Gibson [6], are properties of the environment that offer actions to humans, e.g. a banana affords eating or a chair affords sitting. The focus on affordances illustrates the material features that are relevant for behaviour, which can be useful for the design of learning environments.

In the force experiments which occurred during this research, it is claimed that the manipulation of objects provides children with a clear view of the weight as a contact force. They discriminated weight from gravitational force, which is a distant force. Thus, the physicality of objects can provide learners with additional information and prohibit confusions. As a result, in educational multimodal systems, issues of object manipulation are important.

## References


[1] Kress, G. and C. Jewitt, Ogborn, J., Tsatsarelis, C. (2001). Multimodal teaching and learning: the rhetorics of the science classroom. London, Continuum.

[2] Winograd, T. and F. Flores (1986). Understanding computers and cognition. New Jersey, Ablex Publishing Co.

[3] Sharples, M. (1999). How we write; writing as creative design. London, Routledge.

[4] Jeannerod, M., 1997, The Cognitive Neuroscience of Action, London: Blackwell

[5] Klatzky, R.L., Lederman, S.J and Reed, C., 1989, Haptic integration of object properties: texture, hardness and planar contour, Journal of Experimental Psychology: Human Perception and Performance, 15, 45-47

[6] Gibson, J. J. (1979). The ecological approach to visual perception. Boston: Houghton-Mifflin.

# Mobile Learning Proof of Concept

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## Abstract

The Mobile Learning Proof of Concept project set out to examine the technologies and media types available on the PalmOS platform, and look at how they could be used to present effective and engaging learning material to a mobile audience.

## 1. Introduction

LINE developed the proof of concept in August/September 2001 for Palm Computing. The project is an exploration of the possibilities of mobile learning on the Palm platform, and provides a tool to demonstrate the technical feasibility and potential benefit of extending e-learning to a mobile platform.

## 2. Device and Environmental Limitations

The project looked at and aimed to address two areas of constraint that mobile access places on learning materials: the functional limitations of the device, and environmental constraints on the learner.

Personal Digital Assistants (PDA) in general have limited capabilities when compared to the typical desktop computer: limited storage, low processor power, small screen size, potential lack of colour, user interface limitations and expectations all need to be in order to deliver effective training to a PDA. How would the average learner use a mobile device? How much time will they have available and in what environment will they be located when accessing the learning material?

## 3. Interface Design

One of the project's aims was to examine what functionality is required by the learner, and look at technically feasible ways of accessing and maintaining a catalogue, and delivering learning materials. Questions the project set out to answer are: what access technologies are available? How would the learner use them? How would the mobile component fit in with more traditional e-learning? How is assessment approached?

## 4. Use of Media

The use of rich media in learning materials has dropped somewhat in the early-networked, post-CDROM e-learning era, but this is gradually changing as technology progresses. On a PDA the constraints felt by networked training are magnified many times. At the time of the project, delivery of audio was not possible on the Palm platform at sufficient quality to justify inclusion. The project looked at the use of larger-than-screen graphics on a PDA, and at situations where the use of video would be appropriate.

## 5. Demonstration Platforms

Versions of the Mobile Learning Proof of Concept are available optimised for colour (PalmOS 4) and greyscale (PalmOS3.5) devices. An emulated version is available for demonstration on Windows-based PCs.

## 6. Example Screens


Question 2.2
Assessment
Drag the correct items to the box.
2 of 5


H&S 1.2

# Wireless Learning with eClass2go

R. Harrison
Toshiba

As the world leader in mobile computing, Toshiba is working to help children and students access information and applications that will enhance their learning throughout the education process - from their earliest schools days up until the time they venture into today's competitive commercial world.

A wireless LAN network, using Toshiba's wireless-enabled server the Magnia® SG20 and the Satellite® 1800 notebook with embedded wireless technology, provides students and teachers with instant access to key information anywhere on site, without having to find a plug socket and a cable connection. Course content, college news, e-mails and internet access are all at students' or teachers' fingertips, saving time and inconvenience.

"It's amazing how a wireless communication technology has made a big difference to everyday tasks and revolutionises the way people communicate, share ideas and learn," said Willem Poterman, general manager of Toshiba's European Computer Marketing Division. "Together with Toshiba's "eClass2Go" solution we offer a complete wireless ready classroom."
Wireless technology has unlimited possibilities within a school or campus
environment, to increase a student's efficiency and eliminate stress. Our demonstration will show how wireless technology can be used :

- For real-time access to study group meetings and research links.
- When you want to share notes and homework with other classmates.
- When you need to send a paper or assignment to your tutor's e-mail or the campus intranet.
- For a classroom presentation.
- When you need to access the Internet wireless will enable much more feasible and cost-effective options to students, offering a wider range of readily accessible services and possibilities to make academic life a lot more fun and run more smoothly.

Toshiba has everything you need for a complete Internet and email solution - Internet access, unlimited email, intranet software, security, reporting, fileserver, Access Management, Anti-Virus scanning, Remote Access to email, files and support when out of the office and what's more - 'One-step' means the Magnia SG20 arrives configured ready for the Internet.

More importantly for schools there is an option of a managed database of 1 million URL's for Content Filtering in 22 categories which is automatically updated. This means that we can protect children against undesirable web content .and also gives us the possibility to control the amount of access and what is accessed for an individual student.

# The $c^3$ wearable computer and WECA PC

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## Abstract

*We describe the $c^3$, a mobile context-aware system smaller, lighter, more powerful and more wearable than those before. An application of the $c^3$ is also shown.*

## 1 Introduction

A large amount of research into the development and applications of wearable computers has taken place in recent years, many applications focus on context-awareness. An early example of such applications was the 'Universal Touring Machine' [1] which demonstrated some of the key components of WCAT (Wearable Context-Aware Technology). However, it had some key technological problems: size, weight and the display devices. Recent research has also demonstrated applications WCAT and different methods of attempting to ascertain the users context [1,2]. To date, technological restrictions have rendered high-end so-called 'wearable' computers un-wearable due to their size and weight.

## 2 The $c^3$

The $\chi^{3\dagger}$ shows advances in the hardware and the software components of wearable computers thereby reducing their size and making them truly wearable.

### 2.1 Hardware

The $\chi^3$ is based on a PC104 board, with a Pentium class 166Mhz, processor, 64Mb of RAM and a 6Gb hard drive. The power supply was designed by James Cross [4] and custom built for the project. This optimised the power consumption and allowed for smaller battery while still giving long life (up to 10 hours). A custom case has been machined in solid aluminium, reducing size and weight. A MicroOptical head mounted display is used as the display device and its performance is improved by a SVGA to NTSC converted. This allows the users to zoom in to areas of the screen, making on screen text readable. A Garmin Global Positioning System (GPS) is used give the system a degree of context-awareness.

### 2.2 Software

The system runs Windows 98se which allows the PC to have all the versatility and compatibility of a standard PC. The $\chi^3$ is made context-aware by the WECA PC Portal. This takes the output from a GPS and removes the latitude and longitude of the users position. A database contains latitudes and longitudes of buildings around the university campus.

Figure 1. The first author wearing the $x^3$

## 3 Experimental application

The present application displays web pages to a user as they move around the university campus. As the user moves into an active zone around one of ten building on campus a web page associated with the building is loaded on a head-mounted display. If the user is standing near a building of interest, the database returns the URL corresponding to that building or area in which they are standing. WECA PC Portal sends the URL from the database to Internet Explorer Then thus giving the user instant contextual information about their position.

Recently trials have begun to be test how useful contextual information is to the user and how well WECA PC performs

## 4 Conclusions and future work

The $\chi^3$ has shown considerable advances in the size of wearable computers and has also been shown to aid the user by displaying contextual information. Future work will include the conclusion of the trials.

## 5 References

[1] Finer, S., MacIntyre, B., Hollerer, T., Webster, A. (1997). *"A Touring Machine: Prototyping 3D Mobile Augmented Reality Systems for Exploring the Urban Environment."* The First International Symposium on Wearable Computers: 74 - 81.

[2] Dey, A. K., Salber, D., Abowd, G. D., and Fetakwa, M. (1999). *"The Conference Assistant: Combining Context-Awareness with Wearable Computing."* Third International Symposium on Wearable Computers: pp 21-28.

[3] Pascoe, P. (1998). *"Adding Generic Contextual Capabilities to Wearable Computers."* Second International Symposium on Wearable Computers: pp 92 - 99.

[4] Cross, J., http://www.wear-it.net/papers ECPaper.pdf

† The name *x3* represents an amalgam on the acronym 'chi' (pronounced 'ki'), used in the computer-human interaction conference, with the statistical test chi-squared. The number 3 denotes the version number – hence with system is called ki-3.

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