

MobilED – A Mobile Tools and Services Platform for Formal and Informal Learning

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Abstract

MobilED is a South African initiative aimed at designing teaching and learning environments that are meaningfully enhanced with mobile technologies and services. The deliverables are the development of a set of scenarios and guidelines on how mobile technologies could be used for teaching and learning within and outside the school context. The applicability of mobile phones in an educational environment is examined, with a specific focus on the differences and similarities between the developing and developed worlds. The first phase of the project in South Africa focused on the use of low-cost mobile phones, which are readily available in the developing world, and the second phase examined the use of more advanced mobile phones with multimedia capabilities. Pilots in South Africa are being replicated in Finland, India and Brazil to explore the cultural, social and organizational context of the utilization of mobile phones in and out of school in a developing and developed world context.

Introduction

Mobile technologies, particularly the mobile phone, are set to play a major role in the development of the information society in developing countries. According to the International Telecommunications Union (ITU), Africa's mobile cellular growth rate has been the highest of any region over the past five years, averaging close to 60 percent year on year. The total number of mobile phone subscribers continent-wide at the end 2004 was seventy-six million (ITU Report 2006). The economic and social benefits of mobile phones are evident at all socio-economic levels of society and the penetration rate of mobile phones is significant, especially given the fact that access to these devices is often shared.

Contrary to trends in the developed world, where PC and Internet connectivity is almost ubiquitous, mobile phones are currently the most important networked knowledge-exchange technology used in the developing world. From a developing country perspective, features such as limited or no dependence on permanent electricity supply, easy maintenance, easy-to-use audio and text interfaces, affordability and accessibility are the most important considerations for using mobile phones as potential learning tools (Masters 2005, Mutula 2002, Stone *et al.*, 2003). The contention that a "socially and educationally responsible definition (of mobile learning) must view the learner as the one being mobile and not his/her devices" (Laouris and Eteokleous 2005), and the ability for "anytime, anywhere" learning is still applicable in the developing world, but more as a positive side-effect. If we separate "mobile learning" into "mobile" and "learning", the "learning" aspect is the most important concept in the developing world. The computing device just happens to be mobile.

These mobile devices are becoming increasingly powerful computers, with built-in advanced multimedia facilities. It is interesting to note that today's high-end mobile phones have the computing power of a mid-1990s PC — while consuming only one-hundredth of the energy (Oelofse *et al.* 2006). Even the simplest, voice-only phones have more complex and powerful chips than the 1969 on-board computer that landed a spaceship on the moon (Prensky 2005). In addition, if we have a closer look at the whole mobile phone infrastructure, we will realize that the actual device can be seen as a terminal for using several computers in a network. When making a simple call or sending an SMS message we use (1) the "computer" of the mobile phone, (2) the server computers of the operators and (3) the "computer" of the receiver's mobile phone. When mobile phones are perceived as terminals for using computers, we open up a new perspective for the design and development of practices relating to how mobile phones could be used in different human operations and processes, including formal and informal learning.

Context: ICT in Education in South Africa

South Africa's education system has undergone a dramatic change over the past 10 years, with the introduction of "outcomes-based education" (OBE). Spady (1994) defines OBE as a "comprehensive approach to organizing and operating an education system that is focused on and defined by the successful demonstrations of learning sought from each student. Outcomes are clear learning results that we want students to demonstrate at the end of significant learning experiences and are actions and performances that embody and reflect learner competence in using content, information, ideas, and tools successfully." South Africa's education policy is thus one of the most forward-thinking in the world. However, the implementation of this policy has put tremendous pressures on the education system, and especially on teachers. This focus, combined with a lack of infrastructure and insufficient funds, has resulted in very little use being made of modern technologies in government schools in South Africa (Oelofse *et al.*, 2006).

In order to drive a strategy for implementing ICTs in South African schools, the Department of Education published the national e-Education White Paper in November 2004. In this context, e-Education is defined as the use of ICTs to accelerate teaching and learning goals, particularly in a developing world context. ICT is seen as an enabler, rather than an end in itself. It enables teachers and learners to connect to better information, ideas and to one another via appropriate and effective combinations of pedagogy in support of learning goals (White Paper on e-Education 2004).

There has been a concerted attempt to introduce computer technology into schools in South Africa, with mixed results. Many have been PC-specific, sporadic and have often adopted unsustainable models. Hence, scalability is a major consideration. Issues that are prevalent include (White Paper on e-Education 2004):

- Lack of ICT literacy at a general level amongst teachers
- Stringent and structured forms of teaching with little or no scope for lateral thinking
- Realization of the importance of technology but inability to incorporate this due to lack of training, adequate infrastructure and integration with the current curriculum. This is more apparent as we move from the urban to the rural centres.
- In most places, there is a gender skew in access to education and this gets reflected in access to information technology

Even in developed countries where computer technology has been used for educational purposes for several decades, the delivery has rarely met the expectation. Teachers have used computers for drill and practice, automated tutoring and instruction and only lately as a tool for communication, collaboration and problem-solving (Statham and Torrell

1996). The use of technology or media does not in itself improve learners' learning achievements. Learning is influenced more by the instructional strategy than by the type of medium used (Clark 1985).

There is thus a desperate need for a new approach to integrating technology into the classroom, particularly in the developing world environment. The model needs to take into account issues of usability, accessibility and affordability, while ensuring that appropriate pedagogical models are adhered to.

MobilED Philosophy and Principles

Currently, mobile phones do not play an active role in formal education in South Africa. In fact, most schools ban the use of mobile phones during school hours. In an informal learning context, however, mobile phones are widely used. We call our colleagues and friends to seek information and reciprocally help them with their knowledge acquisition and problem-solving. Simultaneously, we build up our social networks and strengthen the links that are considered very important in modern theories of learning (e.g. Senge 1990). In African traditional culture, *Umntu ngmntu ngabantu* means literally, "a person is a person because of other people". In other words, "you are who you are because of others". Expressed variously as *Botho* in Sesotho and Setswana and *Umbabtu* in the Nguni languages, this concept is about a strong sense of community where people co-exist in a mutually supportive life-style.

The idea of the MobilED project is to create technology that supports existing social infrastructures; increases the potential of current practices with mobile phones by introducing new opportunities for knowledge-sharing, community-building and shared creation of knowledge in the authentic context of studying and learning. With this technology the participants may be encouraged to increase the value of their current practices through knowledge-sharing and collaboration across boundaries of time and place. Freedom from the constraints of time and place enable the timely use of technology wherever knowledge acquisition and problem-solving are situational and contextual.

The approach of the MobilED project is to integrate research-based ideas of using mobile technologies in teaching/learning with active scenarios of real learning programmes. The project includes the design, development and piloting of prototype applications where multimedia and language technologies (voice, text, images) will be used via the mobile phone as tools in the learning process. In order to work within a contextual framework, the project will rely on the advances made in the psychology of learning, which emphasize the collective nature of human intellectual achievements and the use of the mother tongue in the learning process. The aim will be to enable

all members of society (especially those in the developing world) to become active participants in the information society by being contributors to, and not just passive recipients of, information.

From a technology perspective, all tools and platforms developed will be made available as Open Source Software (OSS), in support of the collaborative, knowledge-sharing philosophy of the project. Probably the most important benefit of OSS is that it stimulates the local IT sector in a country, which is crucial in developing countries to ensure full participation in the information society. From the social angle, OSS is highly beneficial because it allows software to be customized to local conditions by the communities themselves .

MobilED Objectives

The MobilED project has four key scientific, technical and developmental objectives:

- Explore and comprehend the cultural, social and organizational context of young people in and out of school in three developing countries (South Africa, India, Brazil) and in a developed country (Finland) in their utilisation of mobile technologies, particularly mobile phones.
- Develop research-based models and scenarios of how mobile technologies could be used for teaching, learning and empowerment of students within and outside the school context.
- Develop concepts, prototypes and platforms that will facilitate and support the models and scenarios developed.
- Test, evaluate and disseminate the scenarios, models, concepts, prototypes and platforms in the four countries.

The project aims to contribute to scientific and technical know-how about how groups of young people in and out of school environments are using mobile devices in their everyday knowledge-acquisition and problem-solving situations. It also aims to uncover user innovations and concepts relating to mobile devices through a participatory design process with users. Within the research work that the project implements will be several prototypes that can be tested and disseminated in real environments, which includes schools, youth clubs and other informal groups.

Project Participants

The current principal partners of MobilED are the Meraka Institute of the CSIR, South Africa, and the Media Lab of the University of Art and Design Helsinki, Finland. The network of associated partners and advisers includes Nokia (Finland), the Centre for Research on Networked Learning and Knowledge Building, University of Helsinki (Finland); the Tshwane

University of Technology (South Africa); the University of Pretoria (South Africa); the Escola do Futuro Universidade de São Paulo (Brazil); the WikiMedia Foundation, (U.S.A.) and the Centre for Knowledge Societies (India). For the pilots, handsets were donated by Nokia and airtime was donated by MTN (a South African network operator).

MobilED Research Framework and Process

The strength of the multi-disciplinary nature of the consortium, as well as deep roots in cognitive, learning and design sciences, lends a multi-pronged perspective to this initiative. In order to ensure cohesion and understanding between the different disciplines (which include teachers, educational researchers, educational psychologists, designers and technologists), a research framework was developed and is shown in Fig. 1.1 below.

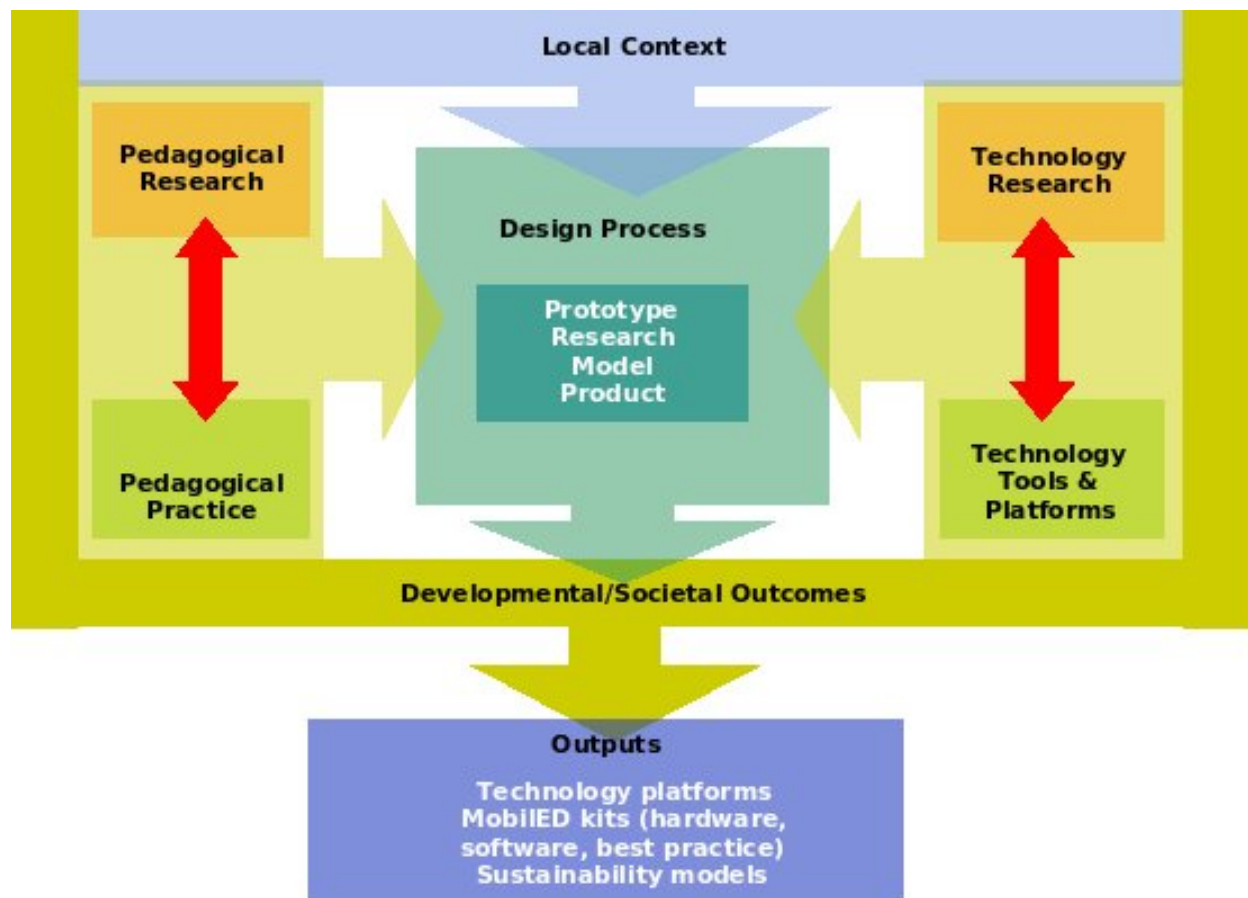


Figure 1.1. MobilED research framework

Each intervention needs to be grounded in the local context. Central to the intervention is the design process, which is fed by both the appropriate

pedagogical models and the potential of the technology itself. Since South Africa is a developing country, any intervention needs to take cognizance of the developmental and societal outcomes. The *outcome mapping methodology* (as designed by IDRC in consultation with Dr Barry Kibel of the Pacific Institute for Research and Evaluation as an adaptation of the *outcome engineering* approach) is being employed. This methodology looks at the results of an intervention as a behavioural change in the project participants. Outcomes are seen as desired changes which indicate progress towards large-scale development goals. At the heart of outcome mapping is documenting contribution rather than attribution, i.e. seeking to understand the ways in which communities contribute to change rather than trying to attribute change to a single intervention (Smutylo 2001).

Technology Used

The basic technology components being used in the project are:

- Mobile devices and network(s): GSM/SMS phones, multimedia phones, Internet tablets, PDAs, the US\$100 laptop (OLPC project of MIT), etc.
- Wikipedia: The free encyclopedia
- Social software: Mediawiki, blogs, knowledge-building tools, etc.
- Open Source language technologies: speech interfaces, audio usage, etc.
- Open Source telephony and software frameworks and platforms.

MobilED Pilots – 2006

The first phase of the project included the design, development and piloting of a prototype platform in which multimedia and language technologies (voice, text, images) are used via the mobile phone as tools in the learning process. A scenario-based approach was adopted to develop potential uses of the technology in formal learning environments. One of the main problems in South African schools is access to learning and reference materials for both learners and teachers. The focus was on how to use low-cost mobile phones, which are readily available in the developing world, while ensuring that participants not only access information, but also contribute information. Based on these prerequisites, we developed the concept of a mobile audio wikipedia, using SMS and text-to-speech technologies to enable access to information, as well as the contribution of information using voice. The mobile audio wikipedia works as follows:

- (1) A user can search for a term by sending an SMS message to the server.
- (2) The server then calls the user.
- (3) A speech synthesizer will read the article found in the wikipedia.
- (4) If the term is not found in the wikipedia, then the user can contribute his/her story by dictating it to the system.

Prototype Platform

Based on the scenarios developed, the technology development team built the version 1 MobilEd platform. MobilEd employs three main technology platforms to achieve its goal:

1. An SMS communication interface/gateway, such as Kannel (<http://www.kannel.org>) or Alamin (<http://www.alamin.org/>) to send and receive SMSs
2. The Asterisk Open Source PBX (<http://www.asterisk.org/>) for audio telephony communications
3. A media wiki (<http://www.mediawiki.org/>) server with suitable content, such as <http://www.en.wikipedia.org> (Leinonen *et al.* 2006)“

A typical case of a high-level use of the system is provided in Fig. 1.2 below.

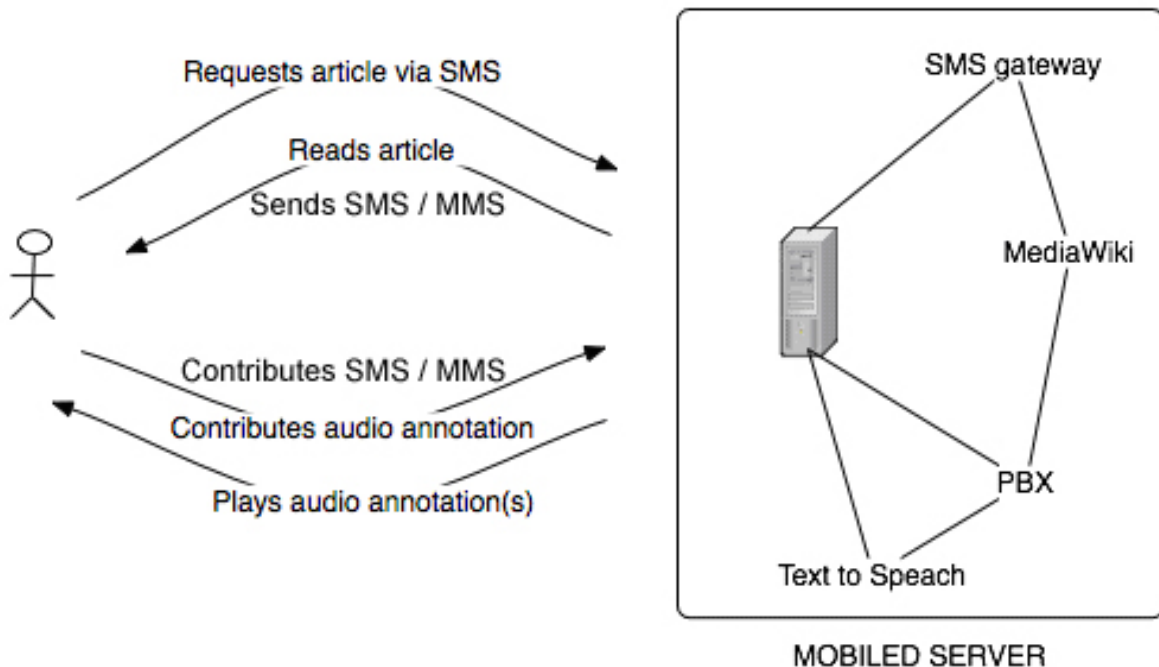


Figure 1.2. Simple high-level usage scenario (user's perspective) (Leinonen *et al.* 2006)

Pilot 1

The first pilot was conducted at a private school, Cornwall Hill College, in South Africa. The learners ranged from age 15 to 16. The theme of the pilot

was HIV/AIDS. The project followed the principles of the Jigsaw cooperative learning technique (Aronson *et al.* 1978), where each learner is a member of two groups. The first kind of group is the “home group”; in our case we called them the “audiocasting groups”, referring to the idea of podcasting. The second kind of group is the “thematic expert group”. Each thematic group consists of one member from each home group.

The thematic group discussed different aspects of HIV and used the MobileD server with the English wikipedia content to search for information related to their theme.

Learners could navigate through the audio of the article as follows:

- *Fast forward*: skips ahead one sentence in the same section
- *Rewind*: skips back one sentence in the same section
- *Next section*: skips to the next section of the article
- *Previous section*: skips to the previous section of the article
- *Pause*: pauses playback – if any other DTMF key is then pressed, playback continues from where it was paused.

Figs 1.3 and 1.4 below show examples of the instruction sheet and the use of the audio wikipedia.

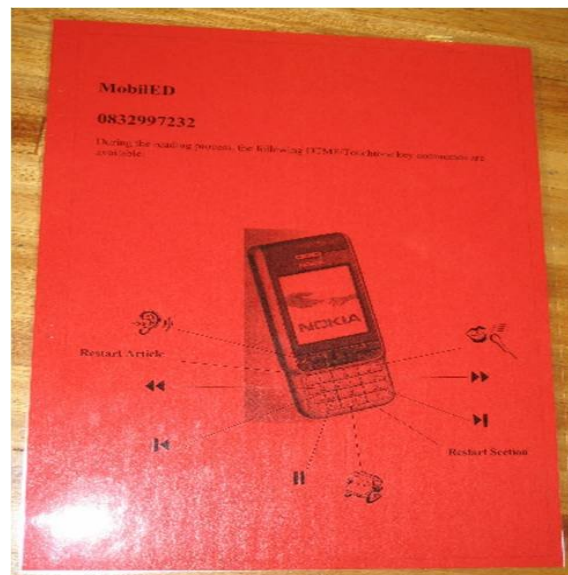


Figure 1.3. How to navigate the audio encyclopaedia



Figure 1.4. Using the audio wikipedia

The results of the information retrieval and discussions were reported back to each audiocasting group. The audiocasting group then discussed the most relevant issues of HIV/AIDS for their own age groups and communicated the results to the school community as an audiocasting show which was recorded via MobicED onto the wiki. To access the audio encyclopedia and the audiocasting service, the students used shared Nokia 3230 phones with speakers.

The learners from Cornwall Hill College were all from affluent homes and most already owned a mobile phone. They were also fully ICT-literate. It was decided to test the service with these learners before testing with learners from disadvantaged backgrounds so that we could improve the platform based on their input.

The learners were given very little time to experiment with the phones before the pilot started, and although they supported each other and figured out all the main functions of the phones in a short period of time, they felt they needed more time to “play” with the devices. It was not necessary to “teach” the learners how to use a phone – it was an everyday skill that they had already mastered. In addition, these learners did not like the fact that the phones were shared in the group – each said they would have preferred their own phone. However, the use of shared phones with speakers supported collaboration in the shared task. Based on the observation and the video data, it was obvious that the use of the shared phone made it possible to distribute the cognitive load related to the use of

the technology and to fulfil the study tasks. Peer support and learning were obvious.

We also noted that the boys tended to “dominate” the technology usage. During the pilot there were a few technology “hiccups”, and at one stage a temporary measure was instituted to record their audiocasts onto an analogue tape recorder – it was most interesting to note that more learners had more trouble figuring out how to use a tape recorder than how to use the MobilED service! Other input we received from these learners was that the “voice” used for the text-to-speech engine was very difficult to understand and that the speakers did not work very well. Overall, however, there was overwhelming support and enthusiasm for (legally!) using their mobile phones in the classroom.

An unexpected consequence of the first pilot was that the school requested another pilot. Although this was not planned as part of the original intervention, an additional pilot (Pilot 1A) was run. In this pilot learners went on a trip to a theme park as part of a science lesson on energy. All interactions between the teachers and learners were via SMS. Some content was “seeded” on the wiki and the MobilED platform was expanded to include information retrieval via SMS as well. The learners used their own mobile phones and there was spontaneous sharing of mobile phone capabilities (such as photos, audio and video). Once again, there was much excitement about and support for the concept by the learners (Botha *et al.* 2006).

Pilot 2

Pilot 2 was run at a local government (or previously disadvantaged) school, Irene Middle School. The learners were from very poor backgrounds and most travelled long distances from outlying rural areas on a daily basis to get to school. Most learners did not own their own mobile phones, and many had never used a mobile phone. Although the school did have a computer lab, the computers had been stolen and the learners were not at all ICT-literate. The learners do not speak English as a home language, but are educated in English from Grade 4.

The MobilED platform was significantly enhanced and upgraded to version 2, based on the results of Pilots 1 and 1A. The Irene Middle School learners had a similar lesson on HIV/AIDS, based on the same lesson plan developed for Cornwall Hill College. The learners were given a longer period of time to familiarize themselves with the mobile phones and they were also given a printout of a typical wikipedia article. Since very few articles exist on wikipedia in their home languages (Sepedi, Setswana and isiZulu), the lesson was given in English. They were divided into groups as with the first pilot.

This MObiled pilot was once again a success, with wholehearted support from both learners and teachers. Learners were motivated and energized and clearly enjoyed the learning process. In fact, the server logs showed that many of the learners spontaneously used the service to get information about many other topics (particularly World War 2 and Adolf Hitler, which was the current topic in their history lessons). Figs 1.5 and 1.6 below show the groups “playing” with the mobile phone and accessing the MObiled service.



Figure 1.5. Trying out the MObiled service

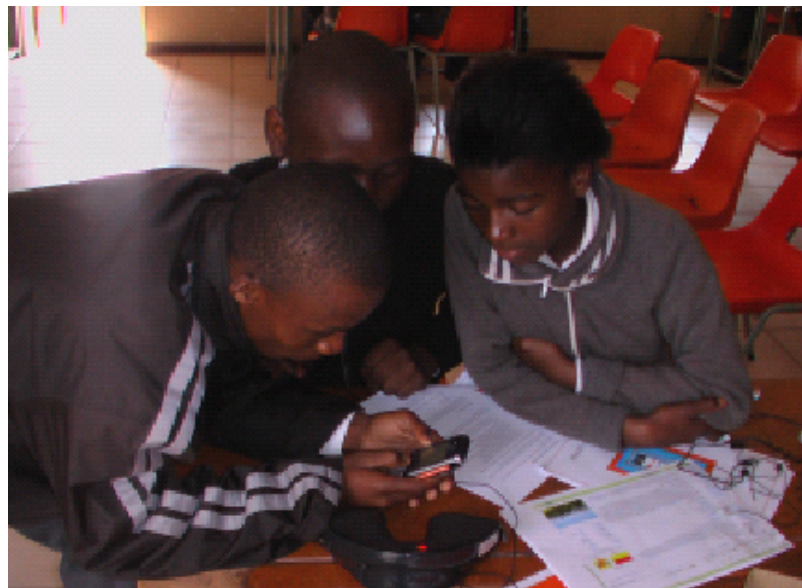


Figure 1.6. Hard at “play”

Although the learners were not ICT-literate and very few had access to mobile phones, they took only a very short time to familiarize themselves with the technology. Since many mobile phones are shared in their culture, they did not have a problem with sharing the mobile phone during the lesson and enjoyed the collaborative aspects of the tasks. In addition, it was interesting to note that the boys did not dominate the technology as in the previous pilot – there was equal use by both sexes.

They were also less critical of the artificial voice (which had been improved in the interim). When asked about their language of choice for learning, every group chose English – they see English as the “academic” language and the gateway to opportunities later in life. It was interesting to note that interactions between participants were in their home languages, but most produced audiocasts in English. They were excited that their contributions could potentially reach a huge audience worldwide. It was obvious, though, that using English as the language of instruction was a major problem for some of the learners, as evidenced by the written responses to some of our questionnaires, which were in poor and broken English.

During this pilot there were very few technology problems and this contributed to a much better experience for these learners. The audiocasts were passionate and uninhibited and included spontaneous harmonizing of songs and rap songs. As part of the outcomes mapping methodology, some mobile phones were left at the school for the teachers and learners to use, with the idea of monitoring the use of the service over the next few months.

Pilot 3

In pilot 3 we wanted to observe the collaborative behaviour of groups of children from different cultural and socio-economic backgrounds when using the mobile phone as a tool for learning. We also wanted to introduce and test the use of MMS technology as part of the MobilED platform. Another aim was to test the platform with younger children. The first part of the pilot, in mid-October 2006, consisted of ten learners (aged thirteen to fourteen) from Irene Middle School and from Cornwall Hill College, who were invited to the Meraka Institute as part of a learning activity to create a reusable multimedia slide show about three technology projects developed by the Institute. The photo in Fig. 1.7 shows some of the learners who were involved in the pilot.



Figure 1.7. Learners from Cornwall Hill College and Irene Middle School

The learners were divided into groups of two (one learner from each school). An icebreaker activity was used to familiarize the learners with each other. Thereafter they were given a short period of time to “play” with the mobile phones and experiment with sending SMS and MMS messages. Their task was to use the mobile phone for the following purposes:

- capturing information
- taking photos
- recording and storing
- compiling a slide presentation with all the above and MMSing to the server

The learners seemed to enjoy the activities and were extremely creative with their photographs. There was a marked difference at the beginning of the pilot with regard to usage of the mobile phones, but the less-experienced learners soon “caught up” and were able to do most of the tasks with ease. Most pairs worked well in their groups, although there were instances of incompatibilities. On the whole, the girls tended to work better in their groups and there was spontaneous sharing of knowledge in these pairs. This pilot is still incomplete and data is in the process of being analyzed. Fig. 1.8a and b shows the good spirit of cooperation that existed between the participants.

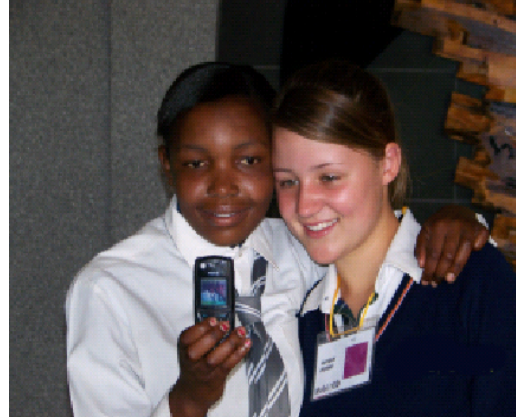


Figure 1.8a and b. Collaboration and peer learning

The Future

Over the next months, the MobilED consortium will be reflecting on the results of these pilots and will use the results to develop next year's strategy. Some of the ideas that have been suggested in South Africa include:

1. Using the service to disseminate ideas and lesson plans to teachers by creating slide shows of lessons with audio narrations in all eleven of South Africa's official languages. A teacher could send an SMS with the title of the lesson to the server and this would be sent the slideshow (if they have an MMS-capable phone) or he/she would be phoned back and the audio played. The teacher could add an audio/video annotation to add his/her ideas to the lesson plan.
2. Making existing educational video/animation "bytes" available to teachers and learners via MMS and data services.

Interest in the project has been overwhelming worldwide. Brazil will start its own MobilED pilots in 2007. Colombia and Mexico are also planning pilots. New Zealand is showing interest. For more information on the status of the project and future plans, the MobilED website – <http://mobiled.uiah.fi> – can be accessed.

The MobilED technology developed in the first year of the project (the mobile audio encyclopaedia) has many different possible applications, beyond that of education. Since the basic content source is a wiki (in the pilots, specifically the wikipedia implementation), this mobile audio wiki can be seen as a community information system that can be used with a mobile phone, which would be of tremendous importance in places where there is a strong culture of mobile phones, but where the Internet and worldwide web are not widely used (Leinonen *et al.* 2006). Thus, the platform could be

used for e-government, e-health, NGO support, SMME support, etc. in developing countries – all aspects integral to socio-economic growth.

The MobilED platform enables all people in the developing world not only to access information, but also to contribute information back – thus becoming active participants in the information society. It is making a significant step towards eradicating the “digital divide”.

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Biographies

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Merryl Ford is the Manager of the ICT in Education Research Group of the Meraka Institute of the Council for Scientific and Industrial Research (CSIR), South Africa. The ICT in Education Research Group works in partnership with local and international tertiary and research institutions to accelerate the application of ICTs in the education sector to ensure social and economic development in South Africa and Africa. Merryl has 15 years of expertise in the ICT domain and was responsible for setting up and managing the largest ISP in South Africa as an incubation project within the CSIR. Merryl has also worked for IBM, where she was a member of a team that provided e-business consulting services to industry. After returning to the CSIR to pursue her passion for innovation, she now focuses on how the digital knowledge economy can be harnessed to benefit all sectors of the community.

Teemu Leinonen

Teemu Leinonen leads the Learning Environments Research Group (<http://legroup.uiah.fi>) of the Media Lab (<http://mlab.uiah.fi>), University of Art and Design, Helsinki, Finland. The group is involved in the research, design and development of New Media tools, as well as their use and application, in the field of learning. Teemu has more than a decade of experience in the field of research and development in web-based learning, computer-supported collaborative learning (CSCL), on-line cooperation, educational planning and educational politics. Teemu conducts research and publishes in different forums. He has delivered a number of papers at national and international conferences, has given in-service courses for teachers and has carried out consulting and concept design for ICT and media companies. He is currently undertaking doctoral dissertation research on learning and design with collaborative computer tools in unconventional learning communities.

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