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

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Abstract

The MobilED initiative is aimed at designing teaching and learning environments that are meaningfully enhanced with mobile technologies and services.

The MobilED deliverables are to develop a set of scenarios and guidelines of how mobile technologies could be used for teaching, learning and empowerment of students within and outside the school context; a set of concepts and prototypes that will be developed into a MobilED platform that facilitates and supports the scenarios and guidelines developed and testing, evaluation, dissemination and sustainability strategies for the MobilED platform in real contexts with real people.

The first phase of the project included the design, development and piloting of a prototype platform where multimedia and language technologies (voice, text, images) are used via the mobile phone as tools in the learning process.

The first 2 pilots focused on the use of low-cost mobile phones, which are readily available in the developing world. It consisted of the development 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 application was tested and results compared between a poor, rural school environment and an affluent private school environment in South Africa.

The second phase of the project looked at the use of more advanced mobile phones with multimedia capabilities. It consisted of a joint project between the "advantaged" and "disadvantaged" schools, called "Street Memory" which enabled learners to gather multimedia (sound, voice, video) information and make the results available to the community.

Pilots in South Africa are being replicated in Finland and will also be replicated in different developing world contexts in India and Brazil. MobilED will thus explore the cultural, social and organizational context of young people in and out of school in a developing world context (South Africa, India and Brazil) as well as in the developed world (Finland) in their utilisation of mobile phones in a learning environment.

The current principle 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 the Centre for Research on Networked Learning and Knowledge Building, University of Helsinki (FI); Tshwane University of Technology (SA); University of Pretoria (SA); Escola do Futuro Universidade de São Paulo (BR); WikiMedia Foundation, (US) and the Center for Knowledge Societies (IN). Handsets were donated by Nokia and airtime was donated by MTN (South African network operator).

In this paper we will discuss the vision of MobilED, cover the role of mobile phones in young people's everyday knowledge acquisition and problem-solving situations, the applicability of this in an educational environment with a specific focus on the differences and similarities between the developing and developed worlds. We will present some of the concepts, prototypes and platforms developed in MobilED and discuss the results of the first tests carried out in formal school environments in South Africa.

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

Mobile technologies, particularly the mobile phone, are set to have a major role in the development of the information society in developing countries. According to the International Telecommunications Union, Africa's mobile cellular growth rate has been the highest of any region over the past 5 years, averaging close to 60% year on year. The total number of mobile phone subscribers continent-wide at end 2004 was 76 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 the PC and Internet-connectivity is almost ubiquitous, currently mobile phones are 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, Lynch, & Poole, 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 & 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 happen 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 one-hundredth of the energy (Oelofse, 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 a SMS message we use (1) the "computer" of the mobile phone, (2) 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 on 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." The South Africa 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 lack of infrastructure and insufficient funds have resulted in very little use of modern technologies in government schools in South Africa (Oelofse, 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 within

South Africa, with mixed results. Many have been PC-specific, sporadic and often adopt

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. Educators have used

computers for drill and practice, automated tutoring and instruction and only lately as a tool for

communication, collaboration and problem solving (Statham & Torrell 1996). The use of technology or media in itself does not improve students learning achievements. Learning is more influenced 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 whilst 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 used widely. We call our colleagues and friends to seek information and reciprocally help them in their knowledge acquisition and problem-solving situations. 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 **'Umuntu ngmuntu nga bantu'** 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 Sotho and Tswana and **'Umbabtu'** in the Nguni languages, this concept is about a strong sense of community where people co-exist in a mutual 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 programs. 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 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 customised to local conditions by the communities themselves (Go OpenSource, 2006)

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 the 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 around mobile devices through a participatory design process with users. Within the research work the project implements several prototypes that can be tested and disseminated in real environments, which includes schools, youth clubs and other informal groups.

Project participants

The current principle 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 (FI); Tshwane University of

Technology (SA); University of Pretoria (SA); Escola do Futuro Universidade de São Paulo

(BR); WikiMedia Foundation, (US) and the Center for Knowledge Societies (IN). For the pilots,

handsets were donated by Nokia and airtime was donated by MTN (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 includes

educators, educational researchers, educational psychologists, designers and technologists) a

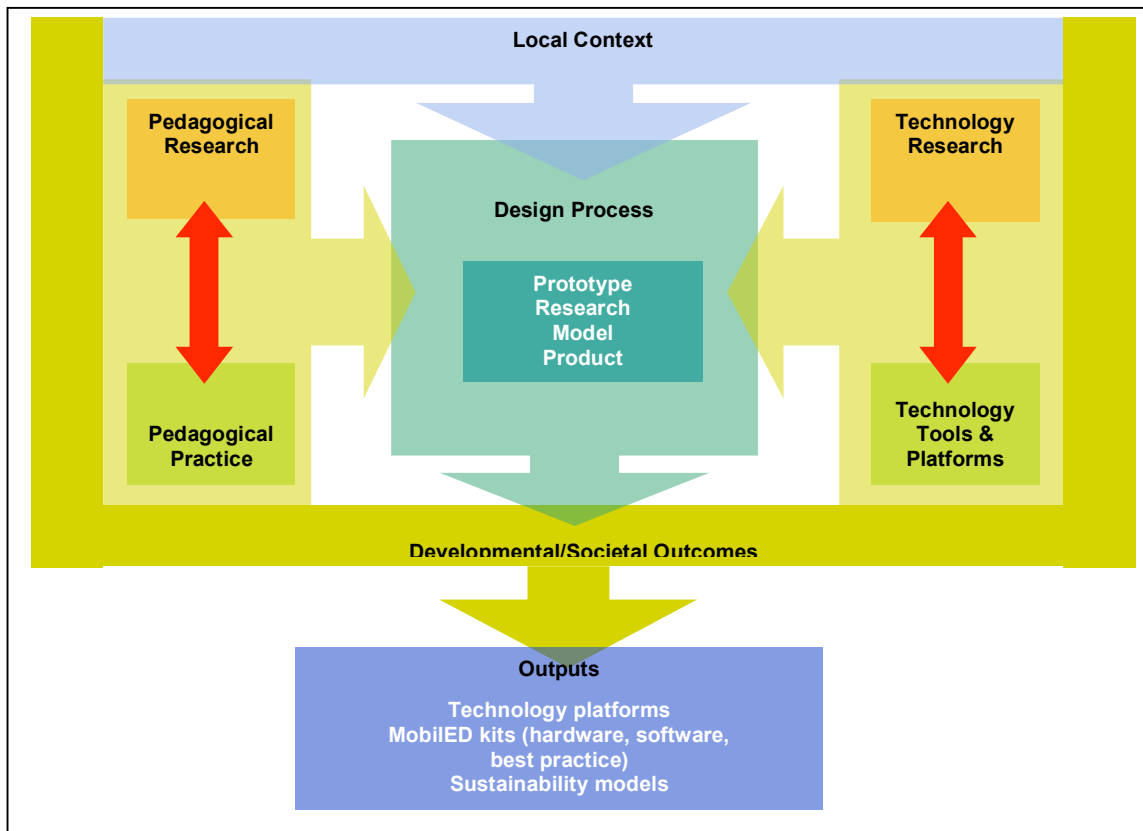research framework was developed and is shown in Figure 1 below.

Figure1: MobilED research framework

Each intervention needs to 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. We are employing 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). This methodology looks at the results of an intervention as a behavioural change of 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; seeking to understand ways in which communities contribute to change rather than trying to attribute change to a single intervention (Smutylo, 2001).

Technology

The basic technology components that are used in the project are:

- Mobile devices and network(s): GSM/SMS phones, multimedia phones, Internet tablets, PDAs, the $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 where multimedia and language technologies (voice, text, images) are used via the mobile phone as tools in the learning process. A scenario-based approach was taken 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, whilst ensuring that participants not only access information, but contribute information as well. Based on these pre-requisites, 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 a sms-message to the server,

(2) The server then calls the user, and

(3) A speech synthesizer will read the article found in the Wikipedia.

(4) If the term is not found in 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 version 1 MobilEd platform. MobilEd employs three main technology platforms to achieve its goal:

- An SMS communication interface/gateway, such as Kannel

    (http://www.kannel.org) or Alamin (http://www.alamin.org/) to send and receive

    SMS's,

- the Asterisk Open Source PBX (http://www.asterisk.org/) for audio telephony

    communications, and

- a MediaWiki (http://www.mediawiki.org/) server with suitable content, such as

    en.wikipedia.org" (Aucamp, 2006)

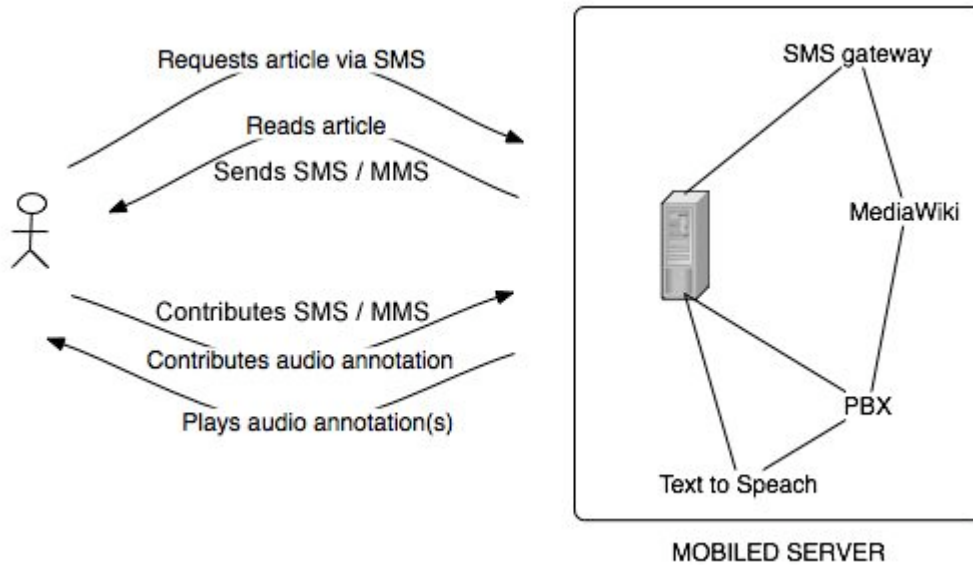A typical high-level use case of the system is provided in Figure 2, below.

Figure 2. Simple high-level usage scenario (user's perspective). (Aucamp, 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 group is the "thematic expert groups". 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**"; skip 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 article section

- "**Pause**"; pauses playback - if any other DTMF key is then pressed, playback continues from where it was paused.

The photos below show examples of the instruction sheet and the use of the audio Wikipedia.
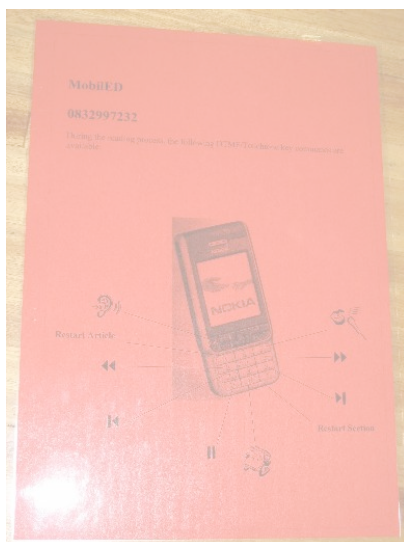

Figure 3: How to navigate the audio encyclopedia

Figure 4: Using the audio wikipedia

The results of the information retrieval and discussions were then 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 that was recorded via MobilED 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 towards 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 fulfill the study tasks and peer support and learning was 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 analog tape recorder – it was most interesting to note that more learners had more trouble figuring out how to use a tape recorder than using 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 didn't 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 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 school. Most learners did not own their own mobile phone, 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 learners had a similar lesson on HIV/AIDS, based on the same lesson plans 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, isiZulu), the lesson was given in English. They were divided into groups as per 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 find out information about many other topics (particularly World War 2 and Adolf Hitler, which was the current topic in their history lessons). Figures 5 and 6 below shows the groups "playing" with the mobile phone and accessing the MobilED service.

Figure 5. Trying out the MobilED service   Figure 6. Hard at "play".

Although the learners were not ICT-literate and very few had access to mobile phones, they took 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 and we will be 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 10 learners (aged 13 – 14) 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 re-usable multimedia slide show about 3 technology projects

developed by the Institute. The following photo shows some of the learners who were involved

in the pilot.

Figure 7. Learners from Cornwall Hill College
and Irene Middle School.

The learners were divided into groups of 2 (1 learner from each school). An icebreaker

activity was used to familiarise 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 as follows:

- capturing information

- taking photos

- recording and storing

- compiling a slide presentation with all the above and MMS'ing 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. As a 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 analysed. The following figure shows the good spirit of cooperation that existed between the participants.
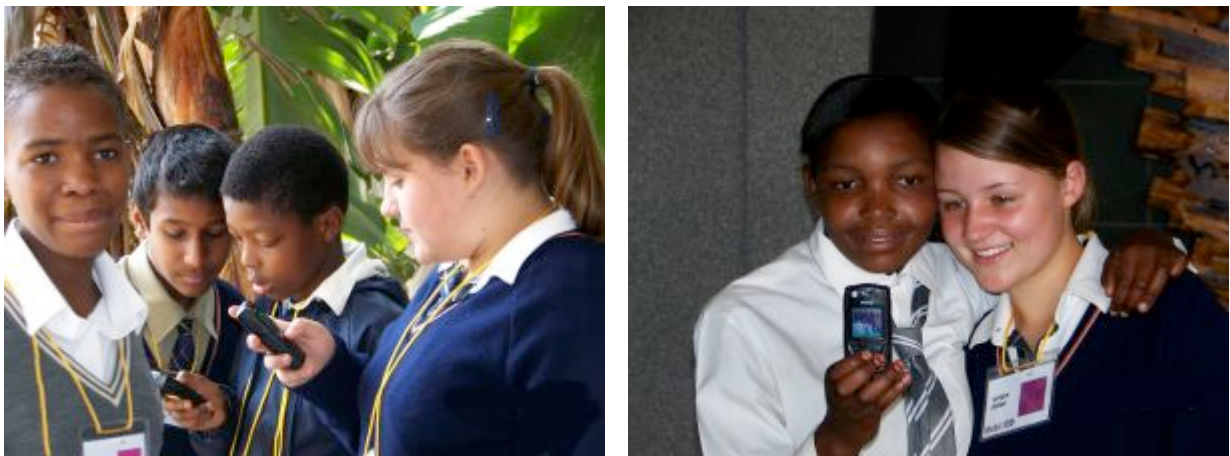

Figure 8. Collaboration and peer-learning.

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 touted 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 11 of South Africa's official

languages. A teacher could send an SMS with the title of the lesson to the

server, and will be sent the slideshow (if they have an MMS-capable phone) or

he/she will 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 it's own

MobilED pilots next year. 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

encyclopedia) 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, of tremendous importance in places where there is a strong culture of mobile

phones, but Internet and WWW are not widely used (Leinonen, Ratna Sari, Aucamp, 2006).

Thus, the platform could be used for e-government, e-health, NGO support, SMME support, etc.

in developing countries – all integral to socio-economic growth.

The MobilED platform not only enables all people in the developing world to access

information, but 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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