

MobilED – An Accessible Mobile Learning Platform for Africa?

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Abstract: MobilED is a 3-year international collaborative project aimed at creating meaningful learning environments using mobile phone technologies and services. The outputs were a set of learning scenarios that were successfully tested in schools and a prototype MobilED technology platform that provides a mobile audio-wikipedia functionality. The MobilED audio-wikipedia utilises the basic texting capabilities of mobile phones and enables the user to send a text message (SMS) with a search term to Wikipedia. The server responds to the user-initiated query with a return call where the article is read using a speech synthesizer. Phase 1 consisted of exploratory research into the use of mobile phones in an advantaged private school and in a poor government school in Tshwane, South Africa. This paper reports on findings from the initial pilots in Year 1 of MobilED and proposes a way forward. It also explores the possibility of the mobile phone as the de-facto mobile learning platform for Africa.

Keywords: mobile learning, mobile phones, learning scenarios, school, technology platform, audio-wikipedia, text, SMS, search term, Wikipedia, speech synthesizer, information society

1. Introduction

Social, economic and technological changes and increased international competitiveness over the past decade have made the need for education crucial to all countries, particularly those in the developing world. In today's knowledge-driven world, a completely new set of skills are required. These skills include "information reasoning," a process in which reliable sources of information are identified, interpreted, understood, contextualized and communicated [1]. In the first world the PC and internet-connectivity are almost ubiquitous and these skills are quickly developed. In Africa, various strategies have been undertaken to prepare youth to compete in a world increasingly driven by information, technology, and knowledge.

Within South Africa, for example, there has been a concerted attempt to introduce computer technology into schools, with limited success. Many have been PC-specific, isolated and often adopt unsustainable models. Issues that are prevalent include [2]:

- 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.

The strategy in South Africa and many African countries who have introduced computer technology into schools has been the introduction of computer labs. This, despite

the fact that many schools have a student-teacher ratio as high as 80:1, and where there is a computer lab of 10-20 computers for the entire school [1]. This sporadic use of computer technology does not give either the teachers or the learners the prolonged exposure that is needed for ICT-literacy or, more importantly, to integrate technology into teaching and learning practice. The effect of these computer labs on education is almost negligible [3].

In addition, Africa faces many other practical problems, such as a severe lack of infrastructure and resources. Most of the existing telecommunications infrastructure in Africa cannot reach the bulk of the population, with 50 percent of the available lines concentrated in the capital cities, where only about 10 percent of the population lives. In more than 15 countries in Africa, over 70 percent of the lines are still located in the largest city [4]. Generally the level of technology penetration in Africa is low compared to developed countries, primarily because the general population cannot afford it [5].

However, the advent of mobile and wireless technologies is rapidly changing this, and the mobile phone, in particular, is set to have a major role in the stimulation 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 [6]. The economic and social benefits of mobile phones are evident at all levels of society and the penetration rate of mobile phones is significant, especially given the fact that access is often shared [7].

Thus mobile phones can be seen to be the most important networked knowledge exchange technology used in Africa today. 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 [8-10]. These mobile devices are also 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. 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 [11].

The challenge is to ensure that the use of mobile phones in a learning environment makes use of the technology in a pragmatic way, using the obvious advantages of the tool, rather than trying to replicate a computer's functionality. Africa needs to take to heart the lessons learned from the introduction of computer technology into schools in the developed world, where 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 [12]. 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 [13].

There is thus a need for new approaches to integrate technology into the classroom, particularly in an African environment. The model needs to take into account the lessons from the developed world and merge them with the realities of Africa. This paper examines Phase 1 of the MobilED (Mobile Education) initiative which consisted of exploratory research into the use of mobile phones in an advantaged private school and in a poor government school in Tshwane, South Africa and examines the possibility that the mobile phone could be the de-facto learning support tool in Africa.

2. Objectives

MobilED is a 3-year initiative that seeks to take advantage of the only effective technology device in the hands of Africans – the mobile phone. Although mobile phones do not play an active role in formal education in South Africa (where most schools ban the use of

mobile phones during school hours), in an informal learning context, mobile phones are widely used. We call our colleagues and friends to seek information and reciprocally help them in their knowledge acquisition and problem-solving situations [14]. Simultaneously, we build up our social networks and strengthen the links that are considered very important in modern theories of learning [15].

The approach of MobilED 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.

The MobilED project has 4 key scientific, technical and developmental objectives:

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

The partnership is a collaboration between the Meraka Institute of the CSIR, Tshwane University of Technology, University of Pretoria (all South Africa), the Media Lab of the University of Art and Design Helsinki (Finland), Escola do Futuro Universidade de São Paulo (Brazil) and the WikiMedia Foundation (United States). For the pilots in 2006, Nokia donated handsets.

3. Methodology

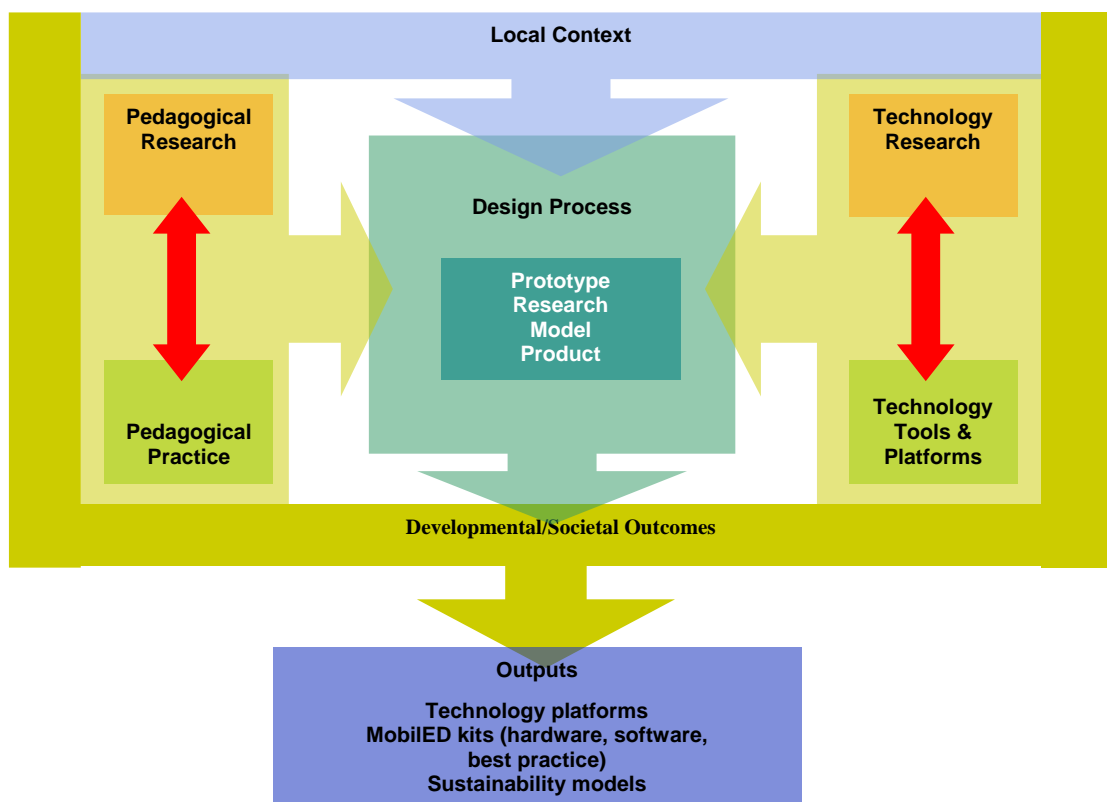


Figure 1: MobilED research framework

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 above.

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. 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 [16].

4. Technology Description

The basic technology components that we decided to employ in Phase 1 of the project were:

1. Mobile phones and network(s): GSM/SMS phones and multimedia phones;
2. Wikipedia: The Free Encyclopedia;
3. Social Software: MediaWiki, blogs;
4. Open Source Language technologies: Speech interfaces, audio usage, etc; and
5. Open Source telephony and software frameworks and platforms.

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.

5. Developments

During Phase 1 we focused on access to learning and reference materials for both learners and teachers. We also wanted to investigate the use of low-cost mobile phones, which are readily available in Africa, whilst ensuring that participants not only access information, but contribute information as well. In addition, we wanted to ensure that we supported appropriate pedagogical models, in particular social constructivism. Based on these prerequisites, we developed the concept of a mobile audio-wikipedia, using SMS and text-to-speech technologies. A scenario-based approach was taken to develop potential uses of the tool in formal learning environments and various small video clips were created to simulate these.

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, 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. OR
- (4) A user can contribute any information to any section of the article by dictating it to the system.

5.1 Pilot 1

The first pilot was conducted at a private school, Cornwall Hill College, in Tshwane, South Africa in March 2006. The learners at the school are from a wealthy community and have access to information and communications technology (ICT) and are fully computer-literate. It was decided to pilot at this school first in order to test and improve the technology platform before exposing the concept to a more disadvantaged school.

The learners consisted of 51 Grade 11 Biology learners that ranged from ages 15 to 17. The theme of the pilot was HIV/AIDS and was undertaken over the period of a week in three different classes, using normal lesson periods. Teachers involved in the pilot were also the main pedagogical researchers and partners in the project, as they were studying for their Masters degrees in Computers in Education at the University of Pretoria. This ensured full interest and buy-in from the teachers. The teachers/researchers were thus part of the project team and were instrumental in providing support and knowledge to the design and technology teams.

The pilot followed the principles of the Jigsaw cooperative learning technique [17], where learners are members 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 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 and (see Figure 2):

- “**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.



Figure 2: Handout given to the learners showing how to navigate 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 were very enthusiastic and supportive of the concept throughout the pilot period. Research questions were grouped together in themes and included those related to the group interaction, access of information, text-to-speech voice, reaction of the service, service settings and audiocastings.

Some of the results of the pilot are listed below.

1. It was not necessary to “teach” the learners how to use a phone – it was an everyday skill that they had already mastered. Although these learners did not like the fact that the phones were shared in the group, the use of shared phones with speakers supported collaboration towards the shared task and video data shows that peer learning and support took place.
2. The boys tended to “dominate” the technology usage.
3. Learners were uncertain about the synthesized voice. Feedback was that the voice was very difficult to understand and that the speakers didn’t work very well.
4. The learners were enthusiastic about the (legal) use of mobile phones in the classroom and enjoyed the audiocasting experience.

5.2.1 Pilot 1A

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 a 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 [18].

5.2 Pilot 2

Pilot 2 was run at a local government (or previously disadvantaged) school, Irene Middle School in Tshwane, South Africa in July 2006. The learners are from very poor backgrounds and most travel long distances from outlying rural areas on a daily basis to get school. Most learners do not own their own mobile phone, and many had never used a mobile phone before. Although the school did have a computer lab, the computers had been stolen and the learners were not at all ICT-literate. The school itself is about 2 km from Cornwall Hill College and there is an existing relationship between the two schools. The learners do not speak English as a home language, but are educated in English from Grade 6.

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 pilot consisted of 90 Grade 9 Life Orientation learners, aged 14 to 17 and was undertaken over a period of two weeks in two different classes with minor changes made to accommodate the bigger learner numbers. Two teachers from the school were included in various planning sessions, where the technology was introduced and demonstrated to them. Since the teachers were new to both the concept and the Jigsaw learning technique, they did not facilitate the sessions themselves, but played a joint supporting role with the researchers.

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.

The themes/topics explored and investigated were chosen in an effort to explore and add to our rich “African Philosophical Thinking” so as to promote the preservation of indigenous knowledge and encourage sensitivity across a range of social contexts. Learners were encouraged to delve into their own life experience and relate their own personal stories in their efforts to actively participate and contribute to the existing body of knowledge [20].

The experience for the learners during this pilot was once more very positive. In scripting and practising their audiocastings, a lot of indigenous song was used to contextualize their script. Their castings contained a lot of excitement, and some were very emotional in their recordings. The heightened emotions can be relayed to the topic of HIV/AIDS and their own personal experience of this disease [20].

Some results were as follows:

1. The teachers and learners wholeheartedly supported the concept. Learners were motivated and energized and clearly enjoyed the learning process.
2. The teachers, however, needed a lot of support to develop the lesson plans, and depended a lot on the work done by the Cornwall Hill teachers.
3. Many of the learners spontaneously used the tool to find out information about other topics that they were currently studying. This was evidenced by the server log data recorded.
4. 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. For example, they discovered that the mobile phones had FM radio capabilities, and before long they had tuned in to the local radio station. They also discovered the games on the phones.
5. 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.
6. 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.
7. They were also less critical of the artificial voice (which had been improved in the interim).
8. They said in interviews that they preferred using English as their language of choice for learning. 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.

6. Findings

The following conclusions about the use of the MObiled platform and mobile phones emerged from the pilots:

- Mobile phones can create an inexpensive, reliable, one-to-one personal learning environment for students.
- The technology is sufficiently portable and powerful to sustain a link to trustworthy sources of information and possible assistance. The server relayed information to the students whenever they requested it in authentic real-world settings. By doing this, the spatial and temporal constraints imposed by a conventional physical classroom was eliminated.
- The personal engagement of the students with the information they required engendered autonomous learning as students devised new and ingenious ways of storing, accessing and utilising the information they needed to further their learning.
- Mobile phones extended and enriched the collaborative activities of students. Students extended their collaboration and added a dimension of technical collaboration as they strove to compensate for the limitations of individual members’ abilities.

- Mobile phones proved to be a reliable and convenient technology for communicating essential information to the students. They also proved to be an effective medium for small-scale content delivery that reinforced learning and supported student learning activities.
- Mobile phones integrated effectively and seamlessly with existing technology and enhanced the capabilities of desktop technology.
- The skills that the students acquired were easily and effectively transferred to other areas of their lives. These skills enriched the students' appreciation of how a technology of this kind can be used to achieve desired personal and school-related outcomes.
- The access to information that was facilitated by the mobile phones altered the students' perception of the facilitator's position in the formal structure of the learning event. The facilitator therefore progressed from being an *instructor* in the student's eyes to being a *participant* in the learning process. As this inversion of roles became more and more comfortable and natural to the students, they began to see themselves as co-experts who could also "teach" their teacher. This set the stage for students accepting a greater responsibility for their learning.
- The integration of mobile phones in a learning event not only demonstrated the potential of the technology as an aid in teaching and learning, it also demonstrated its capacity to function as motivational tool that enhanced learning by creating, extending and enriching a collaborative learning environment.
- A functional stable platform that is able to support the learning events was developed and is available as open source software, which may be downloaded and contextualised for other learning concepts and customised for other scenarios, cultures and languages. It has potential beyond the educational environment.
- Although this research has documented the fact that the students in the study found the synthesised voice somewhat difficult to comprehend, a case has been made for the utility of this feature. We are currently investigating alternative voices be used or alternative methods of voice production to be made available.
- The participants have indicated that the response times before requests are processed are too long. A desirable characteristic of a mobile learning environment is real-time access to information. The response time therefore was reduced to an acceptable level.
- An error response from the platform occasioned by a protocol breach or non-existent content was incorporated to be communicated to the user. This will prompt initiative from the user's side — either another request using the correct protocols or a request for another article.
- Since the navigation of available articles was deemed desirable, a facility was created which sends an SMS which lists and describes available articles according to a theme.

7. Conclusions

Will the MobileD technology transform the way in which teaching and learning will take place in Africa? It certainly has the potential to enhance existing practices and extend the capabilities of currently established forms of technology without any special redesigning of the basic tool. It also extends the use of mobile phones to incorporate a particular learning project - this was accomplished with relative confidence and ease.

The results of the pilots show that the use of a mobile phone as technology tool to aid the learning process can work extremely well in Africa. The barrier of entry was very low - the learners themselves were very open to using the technology and the teachers could focus on facilitating the learning process, rather than having to grapple with new, unfamiliar technologies (as is the case with traditional computers). Thus both learners and teachers felt empowered and confident in using the phones as learning tools. In addition, a

mobile phone is a portable device and can be used anywhere, anytime – the teacher does not need to take her learners to the technology (as per the computer lab model), but is able to take the technology to the learner – it also opens up the possibility of using the technology on field-trips and out of typical classroom environments.

The concept of a mobile audio-wikipedia is particularly of interest in Africa, where the access to information, both paper-based and electronic is limited. It also supports the strong African oral tradition. Since the mobile phones used were basic models and only needed to support the ability to send an SMS, the cost factor for the handset was small. However, the network costs (sending an SMS and providing the content via a phone call) could become prohibitive if the service were to be provided widely in South Africa and Africa. As part of subsequent phases in Years 2 and 3 of MObilED, the issue of sustainability will need to be clearly understood and various models explored. It seems obvious that some kind of support would be needed from the mobile network operators in the various countries where MObilED could be implemented.

With regard to potential models for making the technology of practical use in schools, especially in the light of many schools in South Africa banning mobile phones, some initial ideas have been developed by the MObilED team. One such idea is the creation of a MObilED “kit” - a secure and rugged box that contains a set of mobile phones with places for charging them, speakers to attach to them, pedagogical guidebooks with descriptions of learning events, some reusable physical "learning objects" (e.g. laminated paper sheets) that will help teachers and learners implement mobile learning events, and a DVD with video footage of example projects. The MObilED kit could be part of the school’s facilities, just like blackboards, overhead projectors, computers, etc. When a teacher wants to implement a mobile learning project it will be easy to take the MObilED kit to the classroom and when the project is over to return it to a secure environment (such as the teacher’s room or school library).

Further development of MObilED will include the integration of more advanced technologies (MMS, data services) and the development of additional scenarios, concepts, models and processes for formal learning environments. It will focus on massification strategies, i.e. how to cost-effectively implement the platform in as many schools as possible in South Africa and what would be needed to expand into the rest of Africa. This will include a strategy to collaboratively develop a set of lesson plans for teachers to include in their teaching activities, using the open source model for content creation.

The MObilED mobile audio wikipedia developed in Phase 1 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 [19]. 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.

Potentially, the MObilED platform not only enables all people in the developing world to access information, but to contribute information as well – thus becoming active participants in the Information Society. It is making a significant step towards eradicating the Digital Divide. It is poised to become the first truly accessible mobile learning platform in Africa.

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