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A Pragmatic Framework for Integrating ICT into Education in South Africa

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Abstract: The goals of South Africa's e-Education White paper is for every school learner in the country to be ICT capable by 2013 and for teachers to use information and communication technology (ICT) to enhance teaching and learning. Many initiatives have been undertaken to provide schools with computer labs and infrastructure in order to reach these goals, with varying degrees of success. In the meanwhile, the ICT landscape in South Africa and worldwide has changed dramatically with the advent of the cell phone and its almost ubiquitous penetration into all levels of society, especially amongst the youth. Indigenous services that utilise this new ICT platform have emerged, that specifically target the youth and address very South-African issues, such as affordability. One such platform is MXit, a mobile instant messaging platform that enables real time text-based chatting between users at a fraction of the price of an SMS. This paper discusses the innovative use of MXit as a teaching and learning platform by the Meraka Institute and others and suggests a pragmatic framework for integrating cell phones as ICT tools into the education system in South Africa.

Keywords: mobile, cell phone, mlearning, digital divide, services, mobile instant messaging

1. Introduction

Worldwide, the introduction of ICT into schools often started with the rationale that learners needed to learn how to use ICT and to develop 21st century skills. The focus is now changing to ICT becoming a tool for teaching and learning. ICT is also seen as having a transformational effect [1]. This is illustrated quite well within the South African context, by the definition of e-Education by government [2]:

> *"In the South African context, the concept of e-Education revolves around the use of ICTs to accelerate the achievement on national education goals. E-Education is about connecting learners and teachers to each other and to professional support services, and providing platforms for learning. E-Education will connect learners and teachers to better information, ideas and one another via effective combinations of pedagogy and technology in support of educational reform. It supports larger systematic, pedagogical, curricular and assessment reforms that will facilitate improved education and improved use of educational resources such as ICT."*

These aspirations are laudable, but unfortunately the wide, practical implementation of e-Education has been a failure. South Africa has a host of dispersed and uncoordinated programmes and projects that promote e-Education in schools [3]. One of the few successes is the Khanya project, driven by the Western Cape Education department. It has a decentralised approach where local communities contribute to the establishment of

technology facilities in schools on the premise that education is a shared responsibility by the state, local community, and parents [3]. Gauteng Online is a project started in 2001, driven by the Gauteng Department of Education. After spending R1 billion, the project failed after 5 years [4]. A further R2 billion has been invested and the project re-tendered in an attempt to salvage it.

Issues that are prevalent in failed e-Education projects in South Africa include [2]:

- Lack of ICT-literacy at a general level amongst teachers.
- Stringent & structured forms of teaching with little/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.

Even with success stories like Khanya, it is not clear whether ICT is making a positive impact on the teaching and learning process. The project utilises a computer lab approach, which can be an issue when many schools have a student-teacher ratio as high as 80:1. This presents as many challenges as opportunities as there may only be a computer lab of 10-20 computers for the entire school [5]. 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 ICTs into teaching and learning practice. The conclusion from research into these models done in the developed world is that the "effect of these computer labs on education is almost negligible" [6].

Whilst the focus in the education sector has been in using "traditional" ICTs such as computer labs to support teaching and learning, a worldwide ICT revolution has taken place. According to the International Telecommunications Union, mobile cellular has been the most rapidly adopted technology in history. Today it is the most popular and widespread personal technology on the planet, with an estimated 4.6 billion subscriptions globally by the end of 2009 [7]. Africa is the region with the highest mobile growth rate. By the end of 2008, Africa had 246 million mobile subscriptions and mobile penetration had risen from just 5% in 2003 to well over 30 per cent today [7].

Many new mobile-based businesses have started to emerge to provide contextualised services that can reach the masses in South Africa and Africa. One such business is MXit Lifestyle (Pty) Ltd, a Stellenbosch-based company, which provides MXit, a free instant messaging and mobile social networking application for both mobile phones and PCs. It allows members to chat to other MXit users anywhere in the world. It also allows users to send text messages to and from cell phones and PCs using GPRS or 3G instead of using standard SMS technology, which is expensive. MXit currently has 17 million subscribers, of which 45% are teenagers [12]. According to a new study, South African teens use mobile instant messaging application MXit for social networking more than any other application, including Google and Facebook [13].

The cell phone is playing a major role in the stimulation of the information society and the move towards digital inclusion in Africa. It is the most prevalent and accessible ICT device in South Africa today, particularly amongst the youth. The cell phone can be looked at as the "PC of Africa" and is being used in ways that the developed world cannot yet envisage [9]. Today's cell phones are programmable, powerful, and capable of accessing the internet. Lacking a traditional PC, many young Africans are turning to their cell phones to connect with people, information and services [11], thus already developing 21st century skills.

There is an opportunity at this early stage of ICT implementation in schools to implement strategies for ICT integration that use the technology already in the hands of South African learners and to look at new and innovative solutions from a South African perspective, whilst still applying best practice from the developed world. This paper discusses the potential use of MXit as a teaching and learning platform by looking at case studies and pilots by the Meraka Institute and others, according to a research framework

that was developed by the Meraka Institute to guide technology research, development and innovation in particular application domains. It suggests a pragmatic framework for integrating cell phones as ICT tools into the education system in South Africa.

2. Objectives

The research has 5 key scientific, technical and developmental objectives:

1. Explore, understand and utilise the use of cell phone technology by the youth in South Africa, so that concepts and ideas support practise as much as possible.
2. Develop research-based models and scenarios of how cell phones could be used for teaching, learning and the empowerment of learners, both for formal and informal education.
3. Develop concepts, prototypes, tools and platforms that will facilitate and support the models and scenarios developed.
4. Test, evaluate and disseminate the research findings on a wide scale.
5. Ensure that research outputs are applied or "packaged" as much as possible, whether through policy or via the technology transfer of the tools and platforms developed. Sustainability and contextualisation within South Africa are of paramount importance.

3. Methodology

A research framework for the integration of cell phones into the school system was developed and is shown in *Figure 1* below [9].

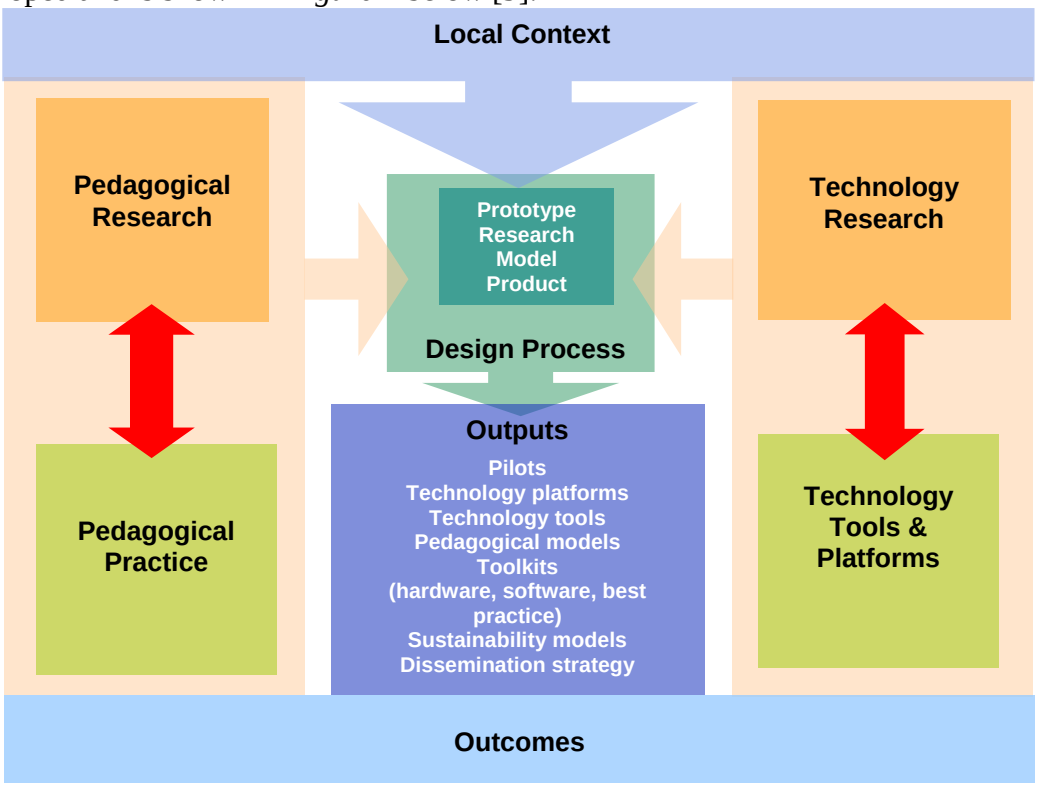

Figure 1: MobiLED research framework v2.0

Each intervention needs to ground in the local context. Central to the intervention is the design process, which is fed by both the appropriate pedagogical models (educational research) and pedagogical practise (i.e. teaching) and the potential of the technology itself. The potential of the technology consists of new technological research combined with the development of new technological platforms and tools. The initiative takes into account that on it's own, the cell phone would not necessarily be a useful pedagogical tool, but with the

addition of other technologies it could be made more viable. Standard technology should be expanded to support educationally-appropriate interventions [9] where appropriate.

In order to come up with a potential approach for integrating cell phones as ICT tools into the education system in South Africa, the research framework (see *Figure 1*) was applied to guide the thinking.

4. Local Context

Although South Africa is a country where there are pockets of first world environments, it is still largely a developing country with the typical problems and issues experienced in such contexts. It is an environment where affordability, accessibility, limited electricity supply and lack of infrastructure has led to a general lack of ICT-literacy amongst the majority of people [18]. According to the National Education Infrastructure Management System (NEIMS) survey in 2007, of 28 742 schools, 72 percent had electricity, 40 percent had landline telephones, 23 percent had computer centres & 13 percent had Internet access.

The context for education in South Africa has many additional challenges [3]:

- Illiteracy rates remain as high as 24% of adults over 15 years of age.
- There remains a shortage of qualified teachers; one-third of teachers teaching mathematics and science were not qualified. Of 50 countries studied in the Trends in International Mathematics and Science Study (TIMMS), 2003, South African Grade 8s featured at the bottom of the scale in mathematics and science.
- The majority of schools remain under-resourced, under-supplied, and over-crowded.

There are also reports of HIV/AIDS having a serious effect on teachers, both with regard to absenteeism due to illness and deaths from the disease. A national Department of Health report shows prevalence of HIV/AIDS at 15.5-18.4% amongst all people aged 15-49 years old [14]. The implication of crime both within schools and targeted at schools is also a major concern. There has been a steady increase in burglary-related crime [16] which has a direct effect on schools, since there are many reports of computer labs being setup in schools, only to have the computers stolen within a couple of days.

The technology context in South Africa is mobile, with cell phones the de facto technology in the hands of most South Africans. Mobile penetration in South Africa is currently at more than 100% [18]. Mobile technology has permeated into all levels of society – into rural areas, classrooms and boardrooms. The ubiquitous and personal nature of the technology has changed the way people interact and act around many social and economic issues [18].

In South Africa there has been a reaction of school administrations into banning the use of cell phones on school premises and during school time [14]. The technology is labelled as disruptive and is often at the short end of press led moral panic. This has however not curbed the uptake amongst learners from as young as 6. Research by Tino Kreutzer [11] has shown that the uptake amongst youth in urban low-income areas in the Western Cape is nearly ubiquitous, other studies confirm these findings [19].

In our research into the context of cell phone usage amongst learners in South Africa, we found that nearly all learners with access to mobile phones that can connect to the internet are doing so on their own accord, often using the internet for research purposes, to download ringtones, wallpapers or music [14]. A high percentage use MXit to “chat” at a fraction of the price of calls and SMS. Most of the learners use prepaid airtime and frequently own more than one SIM card. Learners that did not own a phone often owned a SIM card that they used in shared phones, family phones or friends’ phones. All the learners admitted to being exceedingly frugal with their airtime and they meticulously kept

track of their expenditure, preferring free services such as *"please call me"*[1], and sideloading [2] via Bluetooth. The learners considered themselves proficient users who could utilise the capabilities of their technology [14]. Most indicated that their internet access setup, the installing, downloading of programmes and files were done by a friend and that is how they learned to do it. This was a skill and knowledge that they were very willing to share and demonstrate. The learners commented that there were very few user related issues that their support base couldn't solve [14].

5. Pedagogical Research

In order to use technology effectively, technological applications must be underpinned by learning theories and pedagogical principles. Without a good understanding of how learning occurs, it is difficult to determine how technology could be used effectively to support the earning process. The mobile learning projects also included team members who were studying for both masters and PhD degrees in educational technology. Some of the principles investigated were [22]:

- Bringing real-world problems in the classroom;
- Computer simulation;
- Inquiry-based learning;
- Accessing information resources;
- Supporting the reflective process;
- Cognitive tutoring;
- Supporting communication; and
- Supporting the social process and community-building.

6. Pedagogical Practice

With regard to teachers, many do not have access to computers, either at school or at home and there is a lack of computer literacy skills [20]. Most researchers agree that the successful use of computers in the classroom is dependent on positive attitudes towards computers [21]. If teachers do not feel comfortable with the technology, it becomes very difficult to utilise the technology as part of the teaching and learning process. As soon as there is a level of comfort with the technology, the teacher is able to focus and innovate with regard to the pedagogical practises.

It was decided very early on in Meraka's mobile learning research activities, to work very closely with schools, to the extent that the teachers were part of the project team and were active contributors. A design research approach was followed, where various iterations of technology integration into teaching practice was tested, with the results feeding into new iterations. In some cases ideas which seemed to have merit in theory just proved impossible to implement in practice.

7. Technology Research

Since the Meraka Institute is a technology research, development and innovation institute, the focus was on looking at how advanced engineering and computer science research

[1] *"Please Call Me"* messages are a popular cultural form of mobile communication in South African society. These messages evolved from the practice of "beeping," or calling someone and hanging up after a ring or two. Beeps, also known as missed calls or flashes, are a signal for the recipient to call someone back when the caller is low on airtime. Carriers started providing PCM messages free of charge after they found that the networks were getting inundated by millions of beeps a day. http://mobileactive.org/please-call-me-messages-hiv-info-mobile-social-marketing-south-africa

[2] *Sideloading* is a term used in reference to the process of transferring data between a mobile device and a computer or between two mobile devices.

outputs could be included into technology interventions. An example of where this worked exceedingly well was in the development of the MobilED audio-wiki, where text-to-speech resources in South African English was incorporated, based on outputs from the human language technology research group.

8. Technology Tools and Platforms

The basic technology components that were used for mobile learning by the Meraka institute over the past four years include:

1. Various types of cell phone, from basic, voice-and-SMS-only models through to feature phones and smart phones;
2. GSM/GPRS/3G/Bluetooth communication channels;
3. Wikipedia: The Free Encyclopedia;
4. Social Software: MediaWiki, blogs; instant messaging via Google Talk and MXit;
5. Open Source Language technologies: Speech interfaces, audio usage, etc;
6. Cell phone development frameworks (such as J2ME); and
7. Open Source telephony and software frameworks and platforms (such as Mobicents).

9. Design Process

The challenge in the design process is to integrate the various technology and pedagogy perspectives and learning within a very specific South African context to come up with a very pragmatic intervention that can have impact in the South African education system.

From a high level **context** perspective, the solution should be affordable, accessible, not be too dependable on electricity supply and not need specialist skills to operate. It should provide the opportunity for learners to learn, independent of teacher presence. It should be as "theft-proof" as possible. It should provide access to information and content. It should enable learners to develop 21st century skills and teachers to use the technology as a tool to support teaching and learning.

From a **pedagogical research** perspective, it should enable modern aspects of learning theories, especially where it pertains to the use of technology to support learning. The solution should support **pedagogical practice** in that the teacher is able to concentrate on how to use the technology for teaching and learning, rather than grappling with the technology itself. The solution needs to consist of a **technology tool or platform** which incorporates the latest **technology research** principles.

The most obvious solution, based on the various needs and perspectives is to use the cell phone. The challenge is to remove the levels of complexity inherent in the development of solutions on cell phones, especially when looking at application development on these devices. An option is to look at those cell phone services or environments which have done this, such as the mobile web, and mobile instant messaging systems such as MXit.

The popularity of MXit amongst teenagers in South Africa [11] and the fact that the environment itself is inherently collaborative and supports social networking, makes MXit a very attractive option as an education platform component. MXit have recently made their API available which enables 3rd parties to provide services via the MXit platform [23]. Since the service is text-based (although newer versions do support graphics on high end phones), data costs are kept to a minimum. Since it is also possible to zero-base specific IP addresses (e.g. an educational content repository), it offers scalability and sustainability with regard to data access costs.

10. Outputs and Outcomes

The Meraka Institute has pioneered a mobile tutoring platform to support learners with their mathematics homework, using MXit. The service is known as *Dr Maths.* Learners are able to have a one-to-one conversation with a tutor who supports them in solving mathematical queries (e.g. maths homework assignments) in real-time. The service can be likened to a text-based call centre, where individual users are assigned to tutors, based on tutor availability.

Various preloaded modules are also available that enable access to Dr Maths when tutors are not available. These modules include mathematical quizzes, drill-and-practice exercises, lookups (e.g. definitions and formulas) and text-based mathematical adventure games. A new addition enables learners to use Wikipedia to look up information, whilst still in the MXit environment.

Dr Maths was initially developed as a standalone service, which consisted of software, hardware and a tutor component. Over the past 6 months, Meraka has developed a generic set of tools that enables anyone to set-up a similar service to Dr Maths. The toolset is known as "C3TO" (Chat Call Centre Tutor Online). This could enable a teacher (or learner!) to easily create content that is made available via MXit.

Other examples of the use of Mxit as an interactive content platform, in addition to its social networking and mobile instant messaging capabilities, include the "Bsmrt initiative" and the "ImfundoYami/Yethu" pilot undertaken in South Africa by Nokia and other partners.

Since cell phones are still seen as disruptive by teachers, an intervention is necessary in order to educate teachers on the potential use of cell phones in the classroom. A "MobiKIT" has been developed which is intended to support the integration of mobile phones into a school environment to support teaching and learning. The aim of this kit is to:

- Educate learners, teachers, parents, school management and administration with regard to the possibilities of mobile phone technology as a learning support tool;
- Provide best practise principles and examples regarding the governance of mobile phones in a school environment; and
- Integrate "mobile and online safety" learning outcomes into the life skills curriculum in schools.

MobiKIT will consist of content to support the above, and also a portable physical kit that will contain 5-10 cell phones, plugs and chargers that a teacher can take into the classroom. The MobiKIT will be trialed in the Nokia Mobile Maths project due to be launched in South Africa in February 2010.

The following diagram (Figure 2) is an attempt to encapsulate the Meraka Institute's learning over the past 4 years into a very pragmatic, practical solution for integrating cell phones into schools in South Africa in the short term, using MXit as an educational platform. Aspects of this model were successfully applied in the Nokia "ImfundoYami/ Yethu" Mobile Mathematics pilot in 2009, where Meraka was a partner and will be implemented in the Dr LOLS project.

Longer and medium term solutions would entail the expansion of the use of MXit to other technologies (such as the mobile web, mobile applications specific to education and other standard mobile services, such as SMS, USSD, Bluetooth and MMS).

The framework will be discussed by referring to case & future studies as applicable.

1. *Use of MXit's content and service API to deliver various activities to learners.*
   The decision was made to use MXit, rather than a mobile web browser platform, because of the large MXit youth usage base. The fact that it is a social media tool, with inherent peer-to-peer based interaction capabilities, also makes it a potentially strong collaborative learning platform. It is intuitively easy, for example, to flip from a drill-

and-practise quiz to get help from a friend, teacher or tutor who is online at the same time, then flip back to your quiz.

2. *Expansion to other services as needed.*
   This will expand the framework to make provision for other mobile technology applications and services in the future.
3. *Use of mobile tutoring to supplement school learning activities in various subjects.*
   Dr Maths tutors were made available at set times to support learners. This is important in a context where there is a shortage of skilled teachers in certain subjects.

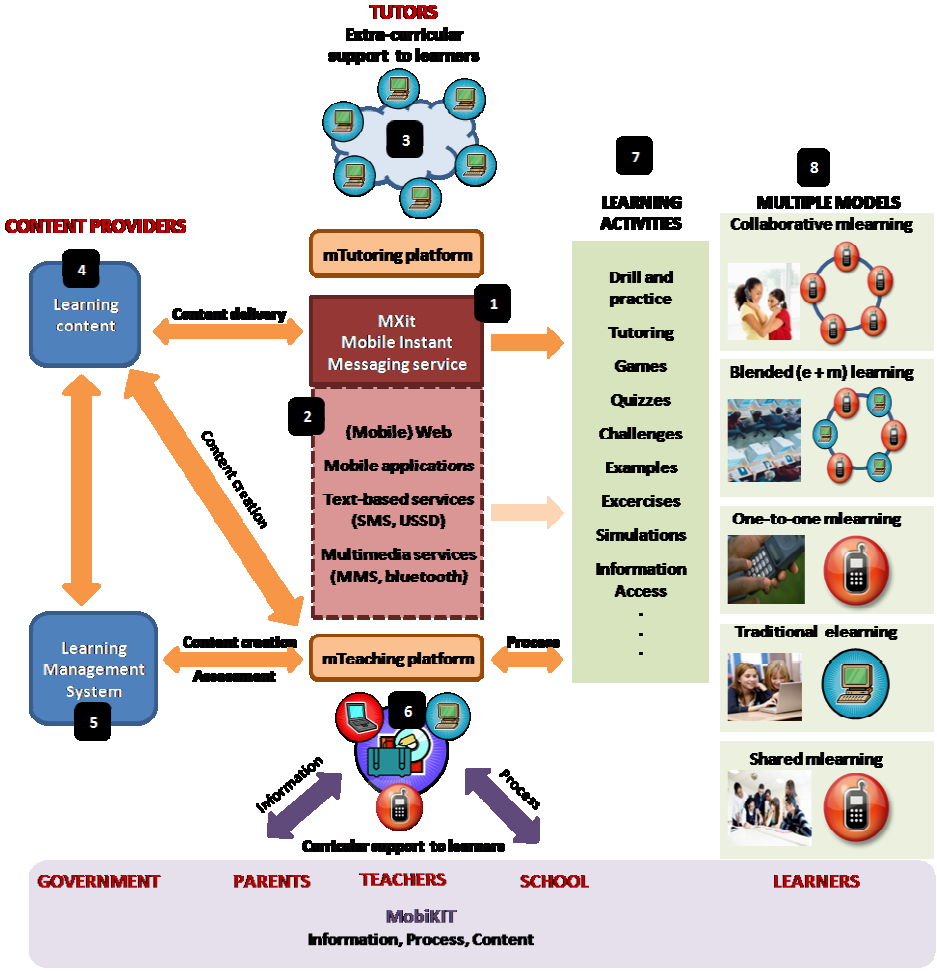

Figure 2: Framework for integrating ICT (with the focus on mobile) into South African schools

4. *Learning content to be provided by various content providers (including teachers themselves). Content to be made available via MXit service (via the standard API).*
   Mathematics curriculum-based content in the form of multiple-choice questions was provided by an external content provider. A future model needs to include the ability for teachers and others to provide content via the platform as well.
5. *Optional use of standard learning management systems (e.g. Moodle, LAMS) to manager content and learning environment.*
   Moodle was used as the learning management system for the project. This enabled teachers to view the activity of the learners and to assess their progress.
6. *Teachers to have the ability to use cell phones, laptops or PCs to manage content, assessment and the learning process.*

Teachers used laptops to interact with the system. The fact that many teachers are not computer literate needs to be taken into account in future so that they have the option to use cell phones via a lightweight management system.

The MobiKIT to be used to support the teacher, parents, school and learners in terms of information and process in the use of cell phones to support education.

The MobiKIT was used very successfully in the project. Sessions were presented at the schools before the project commenced, posters were given to schools and information brochures were provided for learners and parents. The success of this approach can be illustrated by the fact that not one of the learners in the pilot used a vulgar MXit nickname (as is often the norm as experienced by Dr Maths).

7. *Various learning activities to be made available to learners ("drill and practice", exercises, tutoring.)*

   The learners were given curriculum-based drill and practice multiple choice mathematical exercises. The C3TO toolset can now expand this into others, such as user-generated quizzes, games, competitions and Wikipedia lookups.

8. *Multiple learning models to be utilised in the learning process (e.g. shared phone models, blended models in using computer labs and cell phones, etc.)*

   A cell phone per learner was used in the project, but there were cases of teachers innovating and developing shared phone models. The follow-on Mobile Maths project in 2010 will also utilise shared class phones. The option of linking cell phones to existing computer labs and exploring the possibilities is something Meraka will be researching during 2010.

11. Conclusion

The framework outlined is one that can easily be implemented in schools in South Africa, provided schools are prepared to be innovative in embracing cell phone technology as a potential tool in the learning process, rather than banning it. The MobiKIT is an important addition to schools grappling with how to manage cell phones in schools and how to prepare their learners for the 21st century digital world. Over the next 6 months, the C3TO toolset will be expanded and made available to anyone wanting to provide mobile tutoring and support services, content, games and information via mobile instant messaging platforms, both in the education arena and others.

It is important that Africa innovates according to its own context and needs and does not just blindly follow examples from the developed world. Mobile learning with a specific African flavour, utilising African technology has the potential to be exported to the rest of the world.

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