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Mobile Instant Messaging (MIM) Applications to Assist Learning in South Africa

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Abstract

A typical problem experienced by Computer Application Technology (CAT) learners in mainly township and rural schools is that they do not have access to textbooks out of the classroom. The most common scenario is that these learners have access to textbooks during lessons, but then the books are left behind in class to be shared with other learners. This problem is made worse by the fact that these learners usually also have very little access to computers. Similar problems are experienced regarding the teaching of Mathematics.

This paper mainly reports on a mobile instant messaging application that was developed at the Nelson Mandela Metropolitan University, aimed at assisting CAT learners with a glossary of terms related to computers and related technologies. Furthermore, other mobile applications, developed at NMMU to assist learners, are discussed. The paper highlights, from the different usage data, the popularity and effectiveness of such applications. After investigating the issues that need to be addressed for such applications to be really effective and useful, suggestions for future work are made.

Keywords: Mxit; Mobile; Cell Phone; mLearning; Mobile Instant Messaging.

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Introduction

It is a generally known fact that learners in schools from mainly poorer and rural communities in South Africa have to overcome various challenges during their schooling careers. Of these challenges, the huge problem of good Mathematics education receives the highest media attention. The authors became aware of the fact that, in addition to Mathematics, many learners doing Computer Application Technology (CAT) as a subject do not have regular access to computers as well as to textbooks. Furthermore, interaction with

school learners via the instant messaging platform Mxit (http://dev.mxit.com/) highlighted a great need for study and career guidance, especially for learners in rural and disadvantaged areas.

Since the turn of the century instant messaging (IM) has become a preferred on-line activity mainly for teenagers, prompting several studies related to the use of IM in the learning environment. Kinzie, Whitaker, and Hofer (2005) from the University of Virginia investigated the use of IM in the classroom. Although they found that students were comfortable with the use of this technology, they could not conclude that it contributed to the learning process. Contreras-Castillo, Perez-Fragosa, and Favela (2006) found in a study conducted in Mexico than an IM system was a useful communication tool in a learning environment, with most of the communication taking place between students, rather than between teachers and their students.

Mxit is a popular IM service in South Africa, popular amongst young people, and since the penetration of smart phones, mainly used in less affluent communities. The aim of this paper is to present different Mxit applications developed by the Department of Computing Sciences, Nelson Mandela Metropolitan University (NMMU), and the results and impact of these applications on the target sample users. The purpose of the research surrounding each of these applications was to determine the viability of using a mobile instant messaging as a platform for education. Case studies presented in this article where research results are discussed, have obtained the necessary ethical clearance and have followed appropriate research strategies.

A general background is provided before different case studies in South Africa as well as at the NMMU are discussed where Mxit is used to address the educational needs of young people. The following sections then discuss new projects in the Department of Computing Sciences which address the issues relating to Mathematics, CAT, and career guidance.

Background

A goal of the South African government is for South Africa to become an active participant in the global information society (Gudmundsdottir, 2008). The vision is that quality information and communication technology (ICT) services should benefit learners in school and also the local population (Department of Education [DoE], 2004, p. 6).

Computer Applications Technology (CAT) is a subject that is offered in approximately 1,600 South African secondary schools for learners from Grade 10 to Grade 12. CAT teaches the effective use of ICT in different sectors of society through the use of end-user computer applications such as word processors, spreadsheet, and database programs (DoE, 2008, p. 9). CAT learners require prolonged exposure to computers and end-user applications to become ICT literate and to develop 21st century skills. However, sporadic use of computer technology, due to the limited number of computers, affordability, limited electricity supply, and lack of infrastructure has led to a general lack of ICT literacy (Ford & Botha, 2010). This situation is worsened by the shortage of qualified teachers, and under-resourced and under-supplied schools. CAT learners in rural and township schools lack sufficient access to computer technology and resources, especially after school hours (Ford & Botha, 2010).

The studies done by the Centre for Development and Enterprise (an independent policy research and advocacy organisation in South Africa) found a strong correlation between socio-economic factors and the mathematics performance of learners. The studies found that less affluent schools, generally, did not produce good results for mathematics when compared with more affluent schools. The pass rate is very poor. Only 75% of South African schools are producing passes, but these are very few. These poor results

were attributed to the shortage of teachers in these areas and consequently, teachers have less contact with learners who do not have adequate access to educational resources (Centre for Development and Enterprise, 2010).

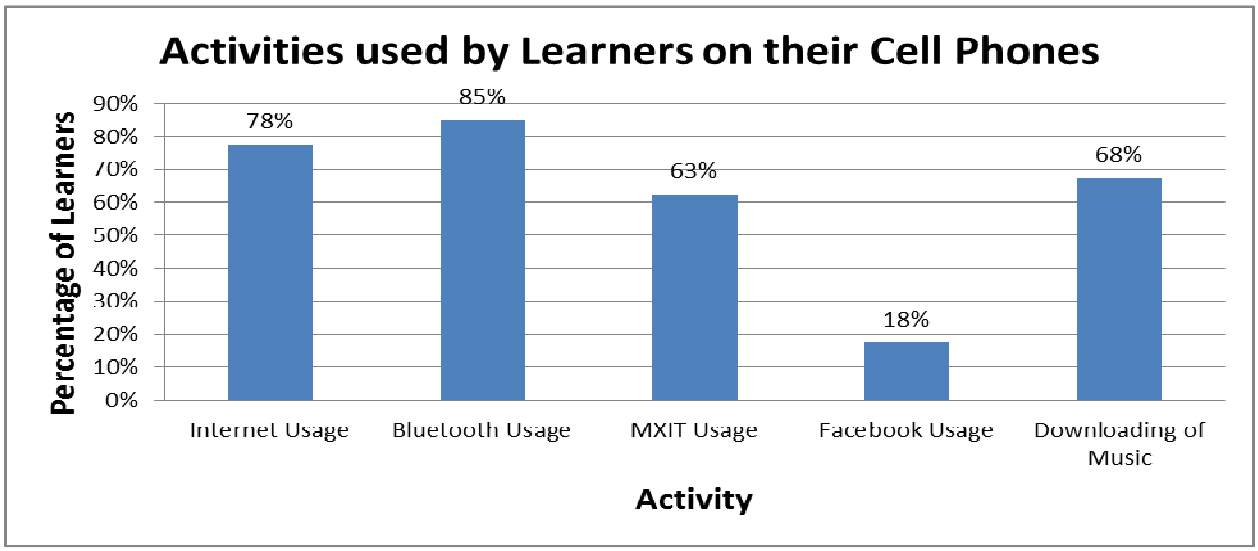
It is estimated that 95% of the South African population have mobile phones (Nitsckie & Parker, 2009). The mobile phone is considered more accessible than the landline telephone (Bhavnani, Chiu, Janakiram, Silarszky, & Bhatia, 2008). Mobile phones now have access to the latest internet tools including social networking and instant messaging. The costs of instant messages are far less than the cost of SMS messages. Mxit is a popular South African instant messaging service with around 10 million users per day (Knott-Craig, 2012), of which the majority are in the age group 13–24 years. The Mxit service is easy to use and its low costs make it a popular social networking tool for South African youth (Nitsckie & Parker, 2009). This mobile instant messaging (MIM) application service is the ideal platform to bring computer application technology information and access to South African school learners.

Surveys conducted by Kreutzer (2009) and Foster (2009) confirmed that learners in socio-disadvantaged schools mainly make use of feature phones. Although these phones are regarded as “low-end” mobile phones with fewer features when compared with smart phones, it must be noted that these phones do provide internet access. This makes Mxit accessible to these phones.

As a follow up to the above-mentioned surveys, Joubert (2010) conducted a survey amongst Grade 12 learners participating in workshops presented by the NMMU Govan Mbeki Mathematics Development Unit (GMMDU). One hundred and twenty surveys were handed out of which 35 were returned fully completed.

Image 1

Activities on cell phones (Joubert, 2010)



Ninety-one percent of the phones belonging to these learners had capabilities which allowed them access to the internet. The fact that learners possess phones with internet access does not imply they made use of that capability. Consequently the survey also enquired about the internet activities of cell phone users. Image 1 provides the results. For this paper it is important to note that 78% had access the internet, and 63% made use of Mxit. A further question in the survey tested whether learners would be open to receiving mathematics content on their mobile phones. On this question 85% of the learners responded positively, indicating a general acceptance of using their phones for educational purposes.

Before discussing different educational Mxit applications developed at NMMU, the next section will give an overview of two of the most effective applications that have been produced in South Africa.

South African Case Studies

Because Mxit is such a popular social networking tool in South Africa, various projects have been launched to make effective use of this tool to the benefit of society. This section reports on the Dr Math project initiated by Meraka Institute as well as the use of the JamiiX platform to provide guidance regarding drug abuse and HIV.

Dr Math

Butgereit et al. (2010) recognise the fact that on the one hand, 93% of South African first year university students have insufficient mathematics knowledge, while 97% of all South African teenagers have cell phones. Meraka Institute in Pretoria consequently initiated the Dr Math project in 2007, allowing teenagers to have access to math tutoring using Mxit on their cell phones. Initially users would only interact with tutors from the University of Pretoria. This proved to be very popular, with 4,500 pupils making use of the tool within the first two years of launching it. Tutors would interact with approximately 100 pupils per hour. The following is a verbatim example of a conversation a learner had with a tutor (Butgereit et al., 2010):

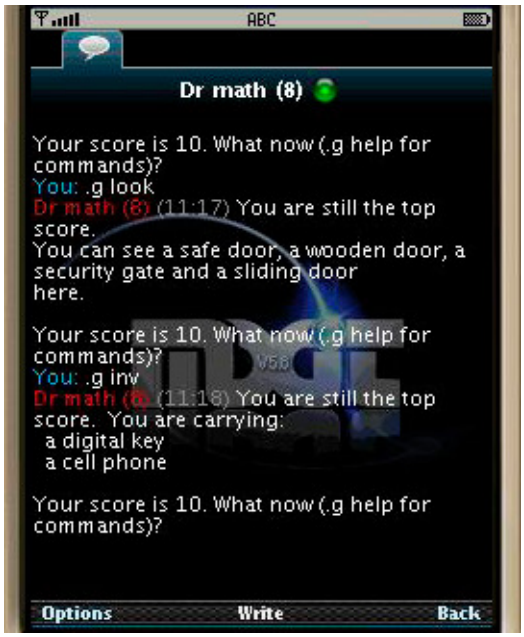
> Learner: May i ask a question about applying there?
> Academic: I have 5 minutes. Ask.
> Learner: If u wr0te BCom(c0mputer science) nd if u want BSc . . . hw cn I change?
> Academic: Give me your ID, full names and cell phone number. I will find out for you.

The Dr Math service has been extended to include various automated competitions and games (Butgereit, 2009). The first of these was an Arithmetic competition where pupils were tested on problems in Addition ranging from 1+1 to 12+12. A Top Score was kept, which resulted in learners regularly returning to defend their Top Score title. Some participants ended up doing hundreds of calculations.

Another game in Dr Math was a text-based adventure game which was based on a plot with a mathematical twist (Image 2). It was soon realised that competition was important to keep the attention of participants. Many played for nearly an hour while doing various mathematical calculations.

Image 2

Dr Math text-based adventure game (Butgereit, 2009)



An underlying concern regarding the Dr Math application is related to the fact that tutors are used to interacting with the learners. From literature it is clear that the tutors are trained before becoming involved. It is, however, not clear whether it is possible to monitor the answers that are provided. The section discussing applications developed at NMMU will acknowledge the importance of the gaming element and attempt to address the above-mentioned concern.

Drug Advice Support (DAS)

Nitsckie and Parker (2009) highlight the fact that the increased use of alcohol and drugs in South Africa has increased the demands on abuse treatment and counselling facilities. Access to these services, especially for socio-economically disadvantaged communities is often very limited.

The Drug Advice Support (DAS) platform, a project of the Athlone Living Lab, was born out of the above-mentioned need. A community-based organisation (Impact Direct Ministries) in Athlone, an impoverished suburb of Cape Town, decided to use technology to provide this support. From that endeavour, the Athlone Living Lab was founded as the result of collaboration between Impact Direct Ministries, Cape Peninsula University of Technology, and the Bridgetown community in Athlone.

DAS conducted its services using instant messaging via the Jabber IM platform. People seeking advice were able to communicate with advisors who were not necessarily in the same location or even in the same time zone. The following advantages of the system were identified:

- **Productivity**. Incoming conversations can be distributed evenly and shared between advisors, allowing advisors to have multiple conversations.
- **Convenience**. DAS is a web application, thus advisors need not be in the same location. The only requirement is a computer connected to the internet.

- **Archiving**. All messages and conversations are archived in a database which allows an advisor to view a full history.

DAS showed that instant messaging was a very effective way of communicating with people, especially those from disadvantaged communities who do not have easy access to traditional communication platforms. A total of 16,609 conversations between persons in need and advisors took place over a period of 186 hours. Five advisors could effectively manage 178 conversations during a two-hour session.

In an extension of this project, Cell-Life and LifeLine worked together to provide HIV counselling. Although calls to the National AIDS Helpline (NAHL) are free from a landline, this does not apply to mobile phones. Many people, therefore, either experience problems because they cannot afford airtime or they are forced to phone from public phones where it is difficult to have confidential conversations. Mxit made HIV counselling available not only at affordable costs, but anonymous conversations could take place from, for example, the privacy of a bedroom. The result was that conversations were much more open and to the point when compared to calls made from a fixed-line telephone (Cell-Life, 2011). It is further interesting to note that the number of hoax calls (up to 80% on the telephone service) was reduced greatly on the Mxit platform (Nitsckie & Parker, 2009).

Applications developed at Nelson Mandela Metropolitan University

The following section will discuss various applications in the NMMU Department of Computing Sciences which address the needs of learners regarding study guidance, CAT, and Mathematics.

Study Guidance via Mxit

Because the NMMU is situated in the Eastern Cape which is one of the poorest provinces in South Africa, it has to make provision regarding study guidance for school learners from townships and rural areas who do not have regular access to the traditional means of communicating with the university (for example, phoning or sending emails). During March 2011 the Department of Computing Sciences assisted a group of students who went into the rural Transkei to inform learners about aspects related to studying at NMMU. After returning, the authors realised that follow up communication would often take place by making use of SMS or Mxit. This highlighted the fact that by using Mxit as a communication tool, the university could become much more accessible to learners who do not have easy access to phones or email. Consequently two interventions were launched to address this need, namely, one-on-one interaction via JamiiX, and using a mobile information portal.

One-on-One Interaction via JamiiX

Through collaboration with RLabs in Cape Town *(*www.rlabs.org*)*, the use of JamiiX (Erasmus, 2010) was obtained. JamiiX is a web service product developed from a refinement of the Drug Advice Support platform reported above. During the NMMU Open Day in May 2011, learners were encouraged to add NMMU as a contact on Mxit (or Google Talk) and interact with the Department of Computing Sciences via JamiiX. Consequently, sessions were arranged where learners could interact via these platforms with either academics or staff from the university marketing department.

Short conversations with learners often resulted in the learners providing details, and the responsible academic following up their query with SMS notification to the learner. Within the first five months after the launch of this service in May 2011, 347 subscribers engaged in 1,000 conversations with 4,773 messages being sent. Typical issues covered during these conversations are:

- Subjects needed at school to qualify for certain degrees and diplomas
- Information about different degrees or diplomas
- Costs and duration of studies
- Practical information regarding applying or changing on application.

Whenever a postal address was requested to follow up on a conversation, learners were always from the target group (township or rural communities). Learners would also often comment during conversations that they were very thankful to have this medium since they actually had no other way of communicating with the university. One learner summed it up by concluding a conversation with the following comment: "Thank you for this, because phoning is so difficult!"

Although JamiiX proved to be a very popular way of interacting with learners who did not have an easier means of interacting with the university, the following needs were noted:

- Many questions regarding specific degrees or programs were asked via JamiiX which the staff member from Computing Sciences could not answer. Consequently some learners could not be assisted.
- It became very time consuming to be available on a regular basis for learners to interact and discuss their problems, which made this mode of communication difficult to sustain within the department.
- A definite pattern of frequently asked questions began to develop and it became cumbersome to give similar answers repeatedly.
- While using the JamiiX communication platform, some learners merely wanted to have informal conversations which had nothing to do with the subject matter.

All of this pointed to the obvious need of an information portal accessible via Mxit which could address many of these issues. The development of this portal will be discussed in the next section.

Using a Mobile Information Portal

JamiiX provided a system of communication between learners and academics. While the JamiiX platform allowed for an effective form of communication between learners and advisors, it created some challenges, which were highlighted in the previous section.

The science.nmmu Mxit application (Ngundu, 2012) was developed to address the problems of redundancy, informal conversations and 24/7 response system availability. The application provides quick and easily accessible information to learners and makes it easier for academics to publish the content that they want learners to access via the Mxit platform. The learners have access to this information at any time of day.

The information for the science.nmmu Mxit application requires the academic to provide information that is accessed by learners. A Windows-based desktop application was developed to provide the academic with an easy-to-use content management system which could be used to create menu items and pages that did not need programming knowledge. The menu items and pages form the information architecture of the Mxit application. Learners are able to access the answers (stored in a SQL server 2008 database) for the typical questions that they would want answers for, including the following:

- What subjects are needed at school to qualify for certain degrees or diplomas?
- What different degrees or diplomas are offered in the NMMU Science Department?
- What are the costs and duration of various science courses?
- What are the requirements for courses or degrees?

Image 3 shows the main screen for the Windows-based desktop application where the academic can manage menu items and various pages of information. On the Mxit platform, the learners are able to view the information they require about Science academic programmes at NMMU. This one-way information sourcing reduces the opportunity of informal conversations between a learner and an academic. The science.nmmu Mxit application makes it easier for the learners to access information that would otherwise have been on the Department of Computer Science website. When web pages are viewed from a mobile phone they are sometimes not quite visible, and it is usually difficult to navigate the website via a mobile browser. By using a Mxit application, information is clearly visible and navigation is easier because of the text -based interface and there are few or no images.

Image 3

Desktop interface for the academic (Ngundu, 2012)

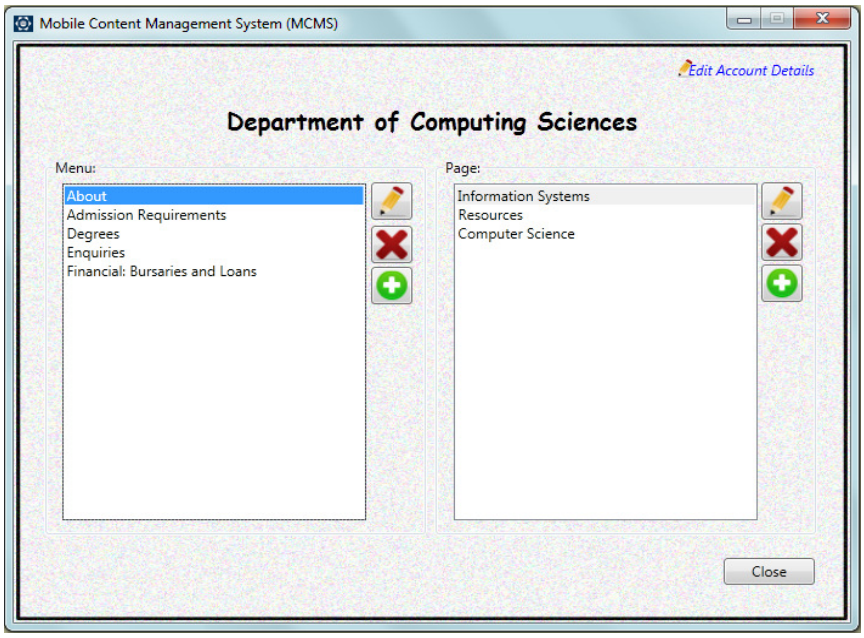


Image 4 shows the result of a learner's request for information about what Information Systems entails. Users are provided with a short description of the topic selected. The topics and associated descriptions are derived from data entered by academics using the desktop interface (Image 3).

Image 4

Information delivered on the Mxit platform (Ngundu, 2012)

A study was done with eight learner participants who were tasked to populate a portal about sciences at NMMU. The following individual tasks were given to each participant (the average satisfaction rating per task is provided):

- Log in as system administrator (92.19%)
- Create an account (78.06%)
- Edit account details as system administrator (90.63%)
- Log in as content administrator (92.19%)
- Add a page (87.50%)
- Edit a page (76.56%)
- Move a page to another menu (54.69%)
- Edit account details as a content administrator.

The results of the study showed that the content management system had a System Usability Scale (SUS) score of 75 which showed that the system was usable, efficient and effective. Sauro (2011) considers that satisfaction ratings of higher than 68 are above average.

An additional evaluation was conducted of the Mxit application, determining whether eight participants were able to view the content that had been stored using the content management system. A 100% success rate was achieved by all eight participants (Ngundu, 2012).

Mxit Support for Computer Application Technology (CAT)

The Department of Computing Sciences launched a CAT application on Mxit in order to provide explanations of computing-related terms that learners would encounter in the CAT subject at school level. A user can send a word or term to the application using an application on a mobile phone and receive an automated response providing a description of the term. The database is continuously updated manually

by including descriptions of requested terms that could not be found and that were relevant. In addition to the glossary, a menu is also made available to users to provide general information on computing careers as well as on the Department of Computing Sciences.

Usage Data

The usage data of the application was collected over a 6-month period (March–August 2011). It includes the user's Mxit ID which is a unique alphanumeric identification for users on the Mxit system, the term sent by the user, and the date and time at which the term was sent. It must be noted that, with this application, there is no data available on the demographics of the users. These would include the age, geographic location, and whether the user is actually a CAT learner.

Table 1

Career information

Job Title	No. of Requests
Games Programmer	4,169
Computer Programmer	2,408
Software Engineer	2,304
Business Analyst	1,935
Computer Auditor	1,778
Web Developer	1,610
Total	14,204

Usage patterns varied greatly from day to day, but the general trend was that 75–250 different users interacted per day, requesting 400–900 different terms. In total 34,749 terms were requested by 6,877 registered users over a five-month period. An additional menu option was provided to users regarding information on computing careers and the Department of Computing Sciences at NMMU. An important observation that must be made from usage data of this component (Tables 1 and 2) is that 23,483 requests out of the total of 34,749 requests (68%) were made regarding the menu options related to job descriptions and information about the Department of Computing Sciences.

Table 2

Information about the Department of Computer Sciences

Category	No. of Requests
Degrees Offered	2,609
Undergraduate Subjects	1,823
Research Areas	1,751
Staff	1,349
Contact Details	938
Postgraduate Subjects	809
Total	9,279

Since all interactions were logged, it was possible to have a breakdown of when, during a 24-hour period, terms were requested. This gave a very good indication of when Mxit users were active. As would be expected, since the typical users were expected to be learners, usage increased from around 3:00 p.m. (after school). Other usage patterns are interesting to observe:

- The maximum usage was just after 11:00 p.m. which is probably not too surprising, assuming that the users are teenagers.
- There was considerable activity during school hours (8:00 a.m. to 2:00 p.m.).
- There was never a time during a 24-hour day when there was not activity. This included the early hours of the morning.

The usage data results were encouraging and improvements to the application were considered, based on these results. Version 2 of the CAT application provided users with more functionality to assist their understanding and learning of the CAT-related content.

Version 2 of the CAT Application

The development group decided to expand the functionality of the application to improve its usefulness for CAT learners, and the following functions were added:

- Random facts related to computers were provided to users.
- Solutions to common problems that could be experienced when working with computers could be requested from different categories.
- Users' knowledge of computers and computer-related topics was tested by making use of a quiz.

In Version 1 of the CAT application, users had to submit a word for which they required a definition. Users thus had to initiate interaction with the application. The random facts function was included as a way of encouraging interaction with the application without the users having to send a word or term with which they required assistance.

Providing solutions to common problems was an idea that originated from the CAT examination paper to assess CAT learners' subject knowledge. Learners were required to troubleshoot computer-related problems. The application could allow users who were CAT learners to prepare for assessment examinations.

The quiz component consisted of a test of 10 randomly selected multiple-choice questions from the database. The previous best result of a user was recorded. Users (Ngundu, 2012) were provided with feedback at the end of the quiz indicating which questions were answered correctly. Users were also provided with an explanation of the correct response.

Version 2 immediately proved to be very popular with 200,000 requests within the first six weeks after the launch. The quiz proved to be the most popular of the different components, confirming the importance of building some competitive format into any educational application. An encouraging confirmation of the usefulness of the application was the fact that usage doubled during the two days before the two matriculation CAT exam papers were written in November 2011. This is proof that the targeted group (CAT learners) was reached through the application.

Toolbarz Application

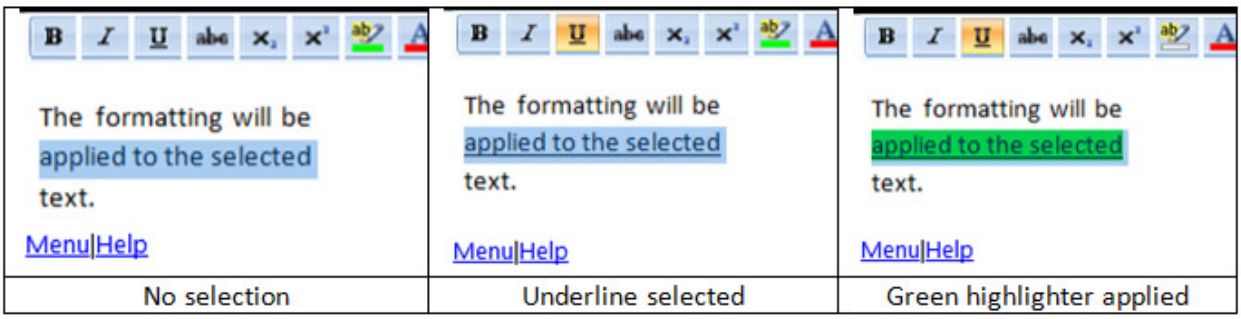
Mxit applications can display images to users if the user device is able to display images. In-line images are used in the CAT application to improve user understanding of the description provided for a word or term. In addition to in-line images, Mxit also supports the use of image strips in tables allowing developers to implement the look and feel of a graphical user interface.

Image strips consisting of a number of tiles containing images for a blank cell, a highlighted cell, and a selected cell, for example, can be registered. Image strips can also be set to different layers. This allows the Mxit application to support games such as chess or tic-tac-toe where users are presented with a board and are able to click on different areas of the board to make a move.

The image strip functionality was used to develop an application that could simulate the use of standard toolbar buttons specifically found in word processing or spreadsheet software applications. Users can select between standard, paragraph, and shape toolbars. Image 5 indicates the use of the image strip in a table to simulate the application of formatting to selected text. The first sub-image (left) indicates no formatting, the middle indicates that underlining has been applied while the last sub-image (right) indicates that underlining and highlighting have been applied. The text provided is an image which is changed based on the buttons selected on the toolbar. Image strip tiles are changed to indicate which buttons have been selected.

Image 5

Toolbarz application interface for the standard toolbar



The purpose of the application is to allow users who do not have access to a computer to become familiar with the use of a toolbar and standard formatting options. The aim is that users who are learning to use a computer and office suite software are able to focus on learning other aspects of the application software without being hindered by a lack of skills related to the use of the toolbar.

The number of users of the Toolbarz application is not as high as the number of users using the CAT application. The purpose of the application may be too simple for users who are able to use the toolbar functionality. The use of the image, together with the tables to implement an interface, creates the possibility of developing more interactive interfaces that could support user understanding of computer-related application software.

Mathematics Support via Mxit

The department launched two projects with the aim of addressing the challenges regarding mathematics education. Mentalmaths is a compilation of games aimed at stimulating an interest in the subject, while Mathwars combines the gaming aspect with content directly linked to the Grades 10–12 curriculum.

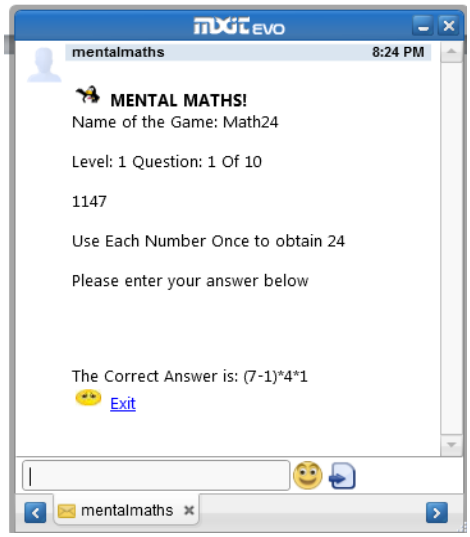
Mentalmaths

This project expanded on the functionalities of the arithmetic competition offered in Dr Math. A set of mathematical games collectively named Mentalmaths was developed that could be accessed by learners over Mxit (Kyazze, 2012). The usage data is stored in a remote database and accessed over the web by the educators of the participating learners. In addition to basic addition, subtraction, division, and multiplication table games, the following games were also implemented:

- Math 24: A learner is presented with four numbers and is tasked to obtain the value 24 by making use of each given number once and the arithmetic operations of addition, subtraction, multiplication and division (Image 6).
- Numbers: A learner is presented with six randomly selected numbers from the *High* and *Low* groups. High contains 100, 75, 50 and 25 while Low contains each of 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10. A random total is given and the learner is tasked to compute the total by making use of the given numbers.

Image 6

Self-Assessment feature (Kyazze, 2012)



The following are specific features of Mentalmaths which need to be noted:

- Hall of fame: Learners can compare their performance against the overall best for each game.
- Viewing of the correct answer to a question: Learners are able to view the correct answer to a problem when they get it wrong; this facilitates the learning process.
- Time-based competition: Learners actively compete to have the best finish time for a given level.
- Educator access to learner data: Educators can view data about their learners through a web interface.

An evaluation study was conducted to determine the effectiveness and usability of the mobile application. Twelve learners (chosen randomly) participated in the study. This was because the games are meant to be simple and intuitive for any learner to use. The positive aspects about the games identified by the participants were:

- Self-assessment: Test participants liked viewing the correct answer to a problem they had failed.
- Simple interface: Most participants commented positively on the simple layout of the game interface.
- Variety of games: The participants liked having a wide selection of math games.

The System Usability Scale (SUS) questionnaire was used to determine user satisfaction (Bangor, Kortum, & Miller, 2008). The overall system usability score was 76.8%. This implies that the participants viewed the application positively. Design improvements, however, should be made to ensure that the score is above 80% because this is the point at which users are more likely to recommend the games to their friends

(Sauro, 2011). The learnability score achieved was 72.9%, which shows that users found the application easy to learn.

Mathwars

The Mathwars Mxit application was initially developed and deployed specifically to support the improvement of mathematics literacy and problem-solving skills. The first version of the application implemented multiple-choice questions sourced from previous Mathematics Olympiad questions organised by the Association for Mathematics Education of South Africa (AMESA).

The questions were graded into different levels of difficulty based on the school level academic grade for which they were intended (South African Mathematics Olympiad, 2012). Users of the application start at Level 1 and progress up the levels to more difficult questions if a minimum number of tests have been completed, and if their average is above a certain threshold value. The 10 questions presented to users are randomly selected. Based on the user's average, the question set consists of a combination of questions from the current level of the user as well as questions from the previous level if the user's average is less than 50% or from the next level if the user's average is above 65%.

During the first four months after its launch, 210 users registered to use the application. Table 3 provides a summary of the usage of the application. None of the users have progressed further than Level 4. Level 4 questions are sourced from Grade 4, First Round, Olympiad question papers, whereas 80,4% of the users indicated that their school academic grade level lay in the range, Grades 8–12. Level 1 consists of basic addition and subtraction (for example, 7 + 2), while Level 2 questions include the addition and subtraction of larger values (for example, 52 + 27).

Table 3

Mathwars usage

Level	No. of users	Mean no. of tests	Min. no. of tests	Max. no. of tests	Mean level average
1	107	2	0	15	52%
2	46	10	2	36	39%
3	53	36	4	217	35%
4	5	50	10	136	53%

The usage data indicated that users at Level 1 did not actively participate in the use of the application, while users who progressed to higher levels were inclined to complete more tests. The average score at each of the levels was also a problem because users needed an average of approximately 60% to continue to the next level. The threshold value to determine progression to the next level, as well as the minimum number of tests that require completion, has been adapted to make it easier for users to progress.

The results may indicate that the poor performance of users is because of their knowledge and understanding of Mathematics content. Level 1 and Level 2 evaluate numeracy skills. However, the remaining levels evaluate problem-solving and logical skills because Olympiad questions have been used. The questions are in no way based on current Mathematics subject content for the respective grade levels.

The Mathwars application will be used to promote enthusiasm amongst school learners to participate in the official Mathematics Olympiads. Further functionalities that will be added to the Mathwars application include access to mathematical subject content as well as assessment of this content by using a quiz interface. Quiz tournaments and functionality to challenge other users will also be implemented in future to encourage users to participate actively in the quiz component provided, and to leverage the social aspect of the Mxit platform.

Conclusions

The work reported on has confirmed the fact that instant messaging (and in our scenario, Mxit) is a medium of communication that typically reaches the socioeconomically disadvantaged parts of our society because it remains the most cost-effective instant messaging system (Chigona, Radic, & Mpazanje, 2012). With the development of smart phones and consequently other instant messaging possibilities such as Blackberry Messenger and WhatsApp, Mxit is becoming less popular in more affluent communities where smart phone penetration is more prevalent. It is, however, still a medium that cannot be ignored for institutions that typically need to reach township and rural communities.

The use of the Mxit platform to support the Dr Math application and enable drug advice support, has highlighted the fact that mobile instant messaging still has a role to play in social upliftment. The use of instant text messaging to converse with Mathematics tutors or drug advisors where users can remain anonymous and communicate freely with facilitators is an advantage of using the Mxit platform to support these applications.

The implementation of simple text-based message-driven applications that can run on the Mxit platform with support for images and links has also proven to be an opportunity to develop applications to support education and social upliftment. The applications developed and implemented in the Department of Computing Sciences, NMMU, have explored different ways of leveraging the functionality provided by the Mxit platform. The applications are aimed at providing users with specialised subject knowledge as well as to allow users to assess their knowledge of subject content, specifically Mathematics and CAT subject knowledge, by using multiple-choice test assessment. Different methods of encouraging active participation have been explored and implemented. Usage data collected has indicated interesting usage patterns regarding, for example, the time of the day Mxit users are most active.

The authors believe that the usage data reported in this paper confirms that instant messaging can go a long way to address the problem of CAT learners who have limited access to computers as well as to text books. It also shows that there is great potential in expanding this application into other school subjects.

Future work on the Mathwars application will include promoting social interaction specifically in respect to the quiz component. Further data collection and analysis of user patterns regarding the viewing of question solutions and the time taken to complete tests will be conducted. User surveys to gather qualitative feedback from users regarding their usage of the applications would also assist the analysis of application usage. It is hoped the qualitative and quantitative collection and analysis of the usage data will provide insight into the use of the quiz as a learning tool for users.

References

Bangor, A., Kortum, P.T., & Miller, J.T. (2008). An empirical evaluation of the system usability scale. *International Journal of Human-Computer Interaction*, *24*(6), 574–594.

Bhavnani, A., Chiu, R. W. W., Janakiram, S., Silarszky, P., & Bhatia, D. (2008). The role of mobile phones in sustainable rural poverty reduction. *ICT Policy Division Global Information and Communications*

Department (GICT). Retrieved from http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/The_Role_of_Mobile_Phones_in_Sustainable_Rural_Poverty_Reduction_June_2008.pdf

Butgereit, L. (2009, May). *How Dr Math reaches pupils with competitions and computer games by using MXit*. Paper presented at IST-Africa Conference, Kampala, Uganda.

Butgereit, L., Leonard, B., Le Roux, C., Rama, H., De Sousa, M., & Naidoo, T. (2010, May). Dr Math gets MUDDY: The "Dirt" on how to attract teenagers to Mathematics and Science by using multi-user dungeon games over Mxit on cell phones. Paper presented at IST-Africa Conference, Durban, South Africa.

Cell-Life. (2011). RedChatZone: HIV counselling via mobile instant messaging chat. Retrieved 30 September, 2011, from http://www.cell-life.org/home/123-c4h-case-study-using-Mxit-for-hiv-counselling

Centre for Development and Enterprise. (2010). The maths and science performance of South Africa's public schools: Some lessons from the past decade. Retrieved from http://www.cde.org.za/images/pdf/Maths%20and%20science%20performance.pdf

Chigona, W., Radic, M., & Mpazanje, F. (2012). Uses and gratifications of mobile instant messaging amongst the South African youth. In A. Koch & P.A. van Brakel (Eds.), *Proceedings of the 14th Annual Conference on World Wide Web Applications* (pp. 4–16). Retrieved from http://www.zaw3.co.za/index.php/ZA-WWW/2012/paper/viewFile/598/219

Contreras-Castillo, J., Perez-Fragoso, C., & Favela, J. (2006). Assessing the use of instant messaging in online learning environments. *Interactive Learning Environments, 14*(3), 205–218.

Department of Education. (2008). *National Curriculum Statement Grades 10–12 (General): Learning programme guidelines, Computer Applications Technology*. Retrieved from http://www.education.gov.za/LinkClick.aspx?fileticket=0rI5T6iNUxU%3d&tabid=247&mid=595

Department of Education. (2004). *Draft whitepaper on e-Education: Transforming learning and teaching through ICT*. Retrieved from http://www.info.gov.za/whitepapers/2003/e-education.pdf

Erasmus, J. (2010). JamiiX: from the Cape Flats to the world. Retrieved from http://www.mediaclubsouthafrica.com/themedia/1781-jamiix-040610

Ford, M., & Botha, A. (2010). A pragmatic framework for integrating ICT into education in South Africa. In P. Cunningham & M. Cunningham (Eds.), *IST-Africa 2010 Conference Proceedings* (pp. 10–20). Retrieved from: http://hdl.handle.net/10204/4098

Foster, G. (2009). *A survey on mobile phone usage*. (Unpublished raw data). Nelson Mandela Metropolitan University, Missionvale Campus, Port Elizabeth.

Gudmundsdottir, G.B. (2008). Digital competence and the language issues in South African classrooms. Retrieved 30 January, 2013, from http://www.openroad.net.au/conferences/2008/papers/gudmundsdottir.pdf

Joubert, J. (2010, October). *Influencing factors of a M-Learning application*. Paper presented at South African Institute for Computer Scientists and Information Technologists Masters & Doctoral Symposium, Bela-Bela.

Kinzie, M.B., Whitaker, S.W., & Hofer, M.J. (2005). Instructional uses of instant messaging (IM) during classroom lectures. *Educational Technology & Society*, *8*(2), 150–160.

Knott-Craig, A. (2012). *Mobinomics: Mxit and Africa's mobile revolution*. Johannesburg: Bookstorm.

Kreutzer, T. (2009). Assessing cell phone usage in a South African township school. *International Journal of Education and Development using ICT*, *5*(5), 43–57.

Kyazze, M. (2012). *Mobile self-assessment of arithmetic skills.* (Unpublished Honours treatise). Nelson Mandela Metropolitan University, Port Elizabeth.

Ngundu, T.H. (2012). *Mobile content management system*. (Unpublished Honours treatise). Nelson Mandela Metropolitan University, Port Elizabeth.

Nitsckie, W.B., & Parker, M.B. (2009). Mobile instant messaging: "Help at the fingertips of addicts". In P.A. van Brakel (Ed.), *Proceedings of the 11th Annual Conference on World Wide Web Applications* (pp. 4–18). Retrieved from http://www.zaw3.co.za/index.php/ZA-WWW/2009/paper/viewFile/62/27

South African Mathematics Olympiad. (2012). Retrieved from http://www.samf.ac.za/QuestionPapers.aspx

Sauro, J. (2011). Measuring usability with the System Usability Scale (SUS). Retrieved from http://www.measuringusability.com/sus.php