Using Instant Messaging over GPRS to help with school work

A case study

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***Abstract* —Rural Africa is in need of qualified teachers in mathematics and science for primary and secondary school. Classrooms in rural Africa are often benches under a tree. The teachers themselves often have limited education in mathematics and science. As cellular telephony services pushes deeper into rural Africa, the question we asked was whether various wireless access methods could be used to assist children and teenagers with their mathematics and science education.**

One of the leaders in low cost GPRS communication over cell phones is a South African based company, MXit Lifestyle, boasting over 7 million users using their mobile instant messaging chat client, MXit. According to MXit's demographics, 45% of their users are children and teenagers between the ages of 12 and 18.

***Dr Math* is a project which Meraka Institute initiated in January, 2007. *Dr Math* linked up children and teenagers using MXit on their cell phones to university students (using internet based workstations) in Pretoria who acted as tutors. The tutors would help with mathematics and, depending on the individual tutors, chemistry and physics homework problems. Currently, over 3000 children and teenagers are using this service in Southern Africa.**

MXit, GPRS, math, tutors

I. Introduction

South Africa needs competent mathematicians and scientists in order to compete effectively in the global market. Unfortunately, by many indications, South Africa is doing poorly in mathematics education [1]. Various strategies have been used in order to make mathematics a more interesting and exciting subject for school pupils [2]. The strategies often include math clubs, extra lessons, and one-on-one tutoring.

Teenagers and children of the 2000's, however, are an "electronic generation" [3] growing up with cell phones, Ipods, MP3 players, memory sticks, and data cards. The Japanese have recognized an entirely new subculture, *Oyayubizoku,* which loosely translates "thumb tribe" to describe this generation[4] who can type faster with their thumbs on cell phones than most people can type using all ten fingers on traditional keyboards. Even in Africa, cell phone penetration has been estimated at more than 80% [5] with families and community members sharing cell phones.

Was there a way that we could try to improve the dismal report card that mathematics education was receiving by using cellular technology?

II. Instant Messaging

Instant Messaging is a method of communication where messages are sent between participants immediately. It is similar to email but with instant messaging the conversations go back and forth between participants sentence by sentence with little delay. This is traditionally done on workstations connected to the internet

Mobile Instant Messaging is an implementation of instant messaging over cell phones or in a mobile environment. The conversations will have the immediacy of an SMS or text message on a cell phone but the messages will be carried over a data connection such as GPRS.

Depending on the marketing strategies of cell phone operators in a country, digital data messages may or may not be less expensive then SMS messages. South Africa is fortunate in that all the cell phone operators offer data traffic at a far less price than SMS traffic.

There are a number of free cell phone implementations of Mobile Instant Messaging available to the public. In addition, a number of these implementations are also open source. A quick Google search on the keywords "j2me jabber" or "j2me IM" will yield hundreds of results.

III. MXit

MXit is a South African based company situated in Stellenbosch [6]. It provides a Java application, also called "MXit", which is freely downloadable onto cell phones. The Java application, or client-software, allows participants to communicate with each other via the MXit server in Stellenbosch. This conversation is carried over a cell based

data connection such as GPRS.

The cost of a MXit-based message is minimal compared to the cost of an SMS or text message. Because of the low cost factor, MXit has become an extremely popular method of communication over cell phones especially with children and teenagers who have a limited budget. In addition, MXit has an active marketing campaign and continually upgrades its software so that it is vibrant, exciting and "kewl".

MXit now boasts more than 7 million users [7]. According to MXit's demographic studies, 45% of these users are children and teenagers between the ages of 12 and 18. [8].

IV. Dr Math

Dr Math is a project that Meraka Institute started in January, 2007. *Dr Math* allowes children and teenagers to use MXit on their cell phones and to link up to tutors who will help them with their mathematics homework in the afternoons after school and on Sunday evenings.

When a message is received by our *Dr Math* system, the message will be assigned to a tutor using a load-sharing algorithm. That link between tutor and pupil will remain connected until one or the other logs off our system.

At the onset of our *Dr Math* project, we initially thought we would help pupils at one specific local high school. We were pleasantly surprised to see that the participants were freely sharing *Dr Math's* contact details with their friends. Within a few months we had hundreds of pupils from all over the country posing questions of our tutors. This was all achieved with no formal advertising. By the end of the 2007 academic year, we had over one thousand participants. Within 5 months of the start of the 2008 academic year (at

the time of writing this paper), we had over 2500 participants.

The growth of *Dr Math* by word-of-mouth viral advertising proves to us that children and teenagers will rush at the chance to get quality educational content using GPRS on their cell phones and, specifically, using MXit.

A complete description of the types of mathematical questions posed to the tutors and the types of responses can be found in [9].

V. Architecture

The *Dr Math* software which was developed is a client/ server application written in Java 1.4. The server has the responsibility of communicating with the Mxit server over the internet. The server does the mundane tasks of accepting invitations, automated replies, queuing the questions for the tutors, etc. The client software is a graphic user interface for the human tutors. A diagram of the architecture is found at Figure 1.

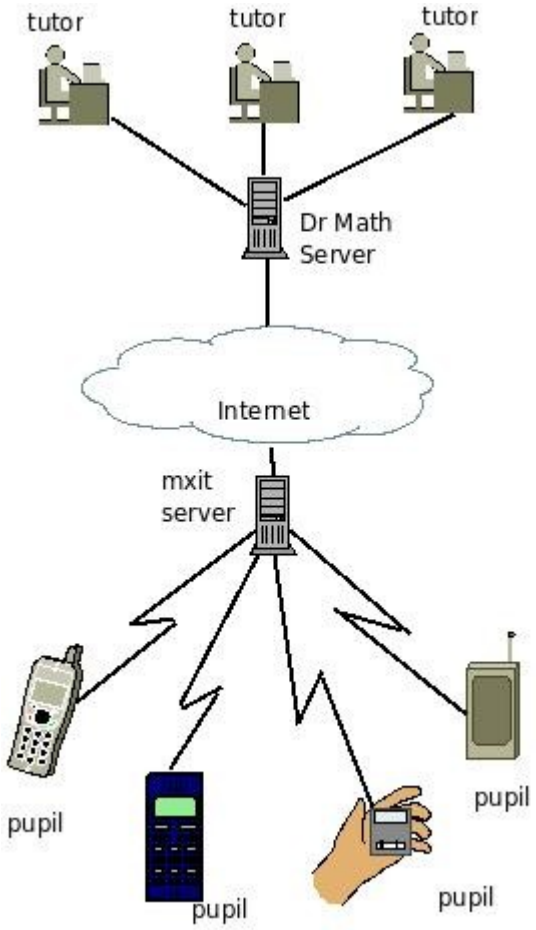

Figure 1.

The questions from the pupils are distributed among the tutors which are logged in to the server at that point. Currently, the server attempts to keep an equal number of pupils assigned to each tutor. In other words, when a new pupil asks for help, that pupil is assigned to the tutor who has the least amount of pupils in his contact list. We may, in future, have to change this. The current rule does not take into account the fact that some pupils ask more questions than other pupils or that some pupils ask more difficult questions than other pupils.

Besides taking care of the communications with MXit, the server also serves out stand alone responses to assist pupils who need help when human tutors are not available. This information includes definitions of mathematical terms (such as *asymptote* and *parabola*) and the definitions of formulae such as trigonometric identities, geometric calculations of area and perimeters, and logarithmic identities.

In view of the fact that we are dealing with children, we also have stand alone competitions where children can compete against each other in mathematical skills such as division, factoring polynomials, and finding the intersection of two straight lines.

VI. Viral advertising

As mentioned earlier, we were pleasantly surprised that *Dr Math* participants shared *Dr Math's* contact details with their friends. This was an aspect of the project where we were completely unprepared. Originally, we had estimated that perhaps thirty to fifty children at one particular high school would use this service. We did not expect that participants would start sharing our contact details with their friends.

Because we did not expect this unsolicited viral advertising, we did not have any facilities in our software to track this phenomenon. If we were to do a similar project again in future, we would definitely add code into the computer programs to try to track and record data on this.

VII. Beyond mathematics

As the pupils learned that *Dr Math* offered good, solid, help with mathematics homework, participants (especially high school participants) started asking for more help facilities in other school subjects.

We received regular requests for help with science homework. In view of the fact that the tutors were engineering students from the University of Pretoria, the tutors themselves took the initiative and started helping the participants with science based questions. When a tutor came on duty, he or she would send out a general messaging such as "I'm here to help with math and physics questions" or "I'm online and can help with math and chemistry questions" depending on the actual knowledge and background of the tutor.

In addition, tutors who were multilingual often fielded questions in Afrikaans. As of the date of writing this paper, we have not yet found any tutors willing yet to field questions in indigenous African languages.

VIII. Beyond school

This technique of helping children and teenagers using MXit over data connections on their cell phones will work in numerous types of environments beyond the school border.

The participants have regularly asked for anonymous counseling. This has been outside the scope of our project; however, MXit has informed us that they are in negotiations with a major counseling organisation to offer this service. [10]

This technique would also be extremely useful in disseminating information about HIV and AIDS. The participant remains anonymous and can ask questions in private.

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IX. Ethics and safety

MXit is occasionally in the news with headlines about children being abducted or teenagers running away with somebody he or she met in a MXit chat room [11][12]. It is important for parents and adults to understand that MXit is merely a mode of communication. Standing alone, MXit itself is neither good or bad. However, because the communication is textual, it is easy for unscrupulous people to pretend to be somebody else and entice innocent children and teenagers into physically meeting up – often with dire consequences.

Children and teenagers must never give out personal details to anybody they meet on MXit.

With that in mind, when participants register with *Dr Math,* the first message they receive back is a warning that they must never divulge personal information and that we record all conversations. *Dr Math* has a code of conduct which all tutors need to sign before they are allowed to enter into conversations with the participants. This code of conduct is basically to ensure that tutors do not attempt to get any personal data from the participants and that the tutors do not attempt to meet up with any of the participants.

All conversations are recorded and the log files are reviewed often to make sure that the tutors are abiding by the code of conduct.

Currently, we manually scan the log files of the recorded conversations looking for inappropriate topics. Perhaps sometime in the future, we will try to automate that process with various HLT (Human Language Technologies) techniques.

X. Other Solutions

We chose to implement our *Dr Math* project using MXit because of MXit's footprint in South Africa. We wanted to leverage the millions of children and teenagers who were already using MXit and entice them to chat about mathematics.

There are other similar implementations you can use.

Jabber is an open source standard for instant messaging and there are a number of open source freely downloadable Jabber servers available. There are scores of free public Jabber servers operating around the world where you can set up free instant messaging accounts without having to go to the effort and expense of running your own server. In addition, there are numerous Jabber cell phone clients which you can easily download onto your cell phone.

Besides Jabber, Google offers a free (but proprietry) solution. Google Talk accounts can be set up for free. There is also a Google mobile chat client which can be freely downloaded onto cell phones.

Both the Google solution and the Jabber solution would be suitable for organisations which do not wish to encourage children and teenagers to use MXit or in

countries where MXit does not have such a large user base.

XI. Conclusions

From our *Dr Math* project, we have learned the following:

- Children and teenagers will rush to get good educational content over their cell phones.
- Children and teenagers will freely share addresses of good educational content with their friends. If the content is good, word-of-mouth viral advertising will be all you need.
- Although we did not obtain any hard data from the children and teenagers due to safety constraints, participants often told the tutors how *Dr Math* had helped them and how they had passed exams and tests.
- Children and teenagers want more educational content available to them over their cell phones. They continually ask our tutors for help in other subjects.
- If an organisation wants to set up something similar to *Dr Math,* there are a number of proprietry solutions available and a number of free open source solutions available.

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