

“Dr Math Rocks!: Using Instant Messaging to Help Pupils with Mathematics Homework”

Abstract: Mathematics education in South Africa needs help. This paper describes a project where school aged pupils could get help with their mathematics homework using MXit, South Africa's most popular instant messaging system, on their cell phones in the afternoons after school. Tutors from a local university acted as tutors using internet based workstations. Pupils used MXit on their cell phones using GPRS to connect to the internet and, eventually, to the tutors.

Keywords: mathematics, education, instant messaging, IM, MXit, GPRS

1. Introduction

Children and teenagers now grow up in a digital age of cell phones, Ipods, MP3 players, computers, and GPSs [1]. Even youngsters in extremely rural areas of Africa will have access to a cell phone through family members and neighbours.

With cell phone penetration in Africa being near 84% [2], we wondered whether it would be possible to reach children and teenagers with good educational content via their cell phones in a manner that they would find interesting and exciting. This paper describes a project in which school pupils in South Africa could reach a tutor in mathematics in the afternoons after school to help them with their mathematics homework using MXit on their cell phone.

MXit is the most popular instant messaging system in South Africa with nearly 5 million users registered on their system. Approximately 45% of these users are in the 12-18 age group [3]. Our project allows school learners to use MXit on their cell phone and chat with a tutor to discuss mathematics homework problems. During periods of time when human tutors were not available, pupils could still access our system and get predefined mathematical information such as definitions and formulae.

(Please note that in the transcripts of conversations with pupils, we have changed the pupils' aliases or nick names.)

2. Objectives

South Africa has much room for improvement in mathematics education in primary and secondary schools. Much has been written previously about the state of mathematics education in South Africa and in Africa in general [4][5]. The objective of this project was (and still is) to see if we could help improve the situation as it currently stands by using a medium of communication which teenagers and children love – MXit.

The actual mathematical education aspect of this project was more fully described in the paper “Math on MXit: The Medium is the Message” [6] which was presented at the 13th Annual National Congress of the Association of Mathematics Education of South Africa. Although we will cover some aspects of mathematics education in this paper, this

paper will deal with the more technical ICT issues of the project such as open source software projects, instant messaging public servers, mobile software, and Java development.

3. Instant Messaging and MXit

Instant Messaging is a type of communication which, in many ways, is very similar to email. The primary difference between instant messaging and email is that instant messaging sends the messages immediately between the people having the conversation. Email, on the other hand, may be delayed and only arrive a few hours later. Instant Messaging can be used on both traditional computer workstations and on cell phones.

Instant Messaging is also similar to SMS (Small Message System) on cell phones (often called Text messages in many English speaking countries). The primary difference between SMS and Instant Messages, however, is the cost factor. In South Africa, SMS messages cost anywhere from between 20 South African cents up to 80 South African cents where as Instant Messaging messages cost between 1 and 3 South African cents.

MXit Lifestyle (Pty) Ltd is a South African company based in Stellenbosch, South Africa. They originally started with an open source Instant Messaging software application called Jabber [7]. Jabber itself uses an extremely verbose XML protocol. MXit made certain modifications to the Jabber protocol so that it was more suitable to cell phone communication using GPRS (General Packet Radio System) by primarily changing the message format so that the messages were much shorter in length.

It is extremely quick and easy for teenagers (or anybody for that matter) to get connected to MXit. They just have to access MXit's website [8] using the browser on a WAP enabled phone, download a small piece of software, and register with MXit using that software. The entire procedure takes normally less than 2 minutes and teenagers are quickly "MXiting" each other.

We originally "advertised" our "Dr Math" service on the first day of school, 2007, at one high school in North West province of South Africa. The advertisements were small A4 posters which were printed on colour printers. We handed the posters to the mathematics teachers of the highschool and attached the posters to physical bulletin boards in the surrounding town. Teenagers flock to MXit and our first "customers" accessed our mathematics tutoring service on the same day we started advertising.

Within weeks, we found that teenagers had told their friends about our "Dr Math" service and those friends had told other friends.

Rogue: cul. I just gave ur jabber id 2 a friend

Grapefruit: Haha:D um i just gave your ID to my girlfriend:D did you get that?:D

glamouras: and i was waiting all day 4 u my friend gave me ur contact do u mine
me given my friend

Tracy: OK CAN U INVITE MY FRIEND SHE NEEDS HELP SHE NOT RITE
IN DA HEAD WHEN IT COMES 2 MATH

Smeagle: Can i give your number to a friend? He struggles with maths.

Within six months, we had teenagers from coastal areas using our service. By the end of 2007 school year, we had nearly 1000 participants on our system. All of this was accomplished primarily by word of mouth advertising although a few months into the project we did get some press coverage in a national Sunday newspaper.

4. Methodology

Our “Dr Math” project took advantage of the fact that teenagers (and even pre-teens) are already on MXit chatting with each other. We just wanted to entice them to chat to our tutors about mathematics and their mathematics homework.

When the project was in its infancy stage, we managed with just one tutor – the author of this paper. The original idea of the project was to offer tutoring for one hour in the afternoons 4 days per week. Soon, however, it was obvious that we needed many more tutors and many more hours.

A local university had a “community service” requirement for their engineering department. Engineering students needed to complete 40 hours of community service in order to graduate. We managed to attract 18 students from the University of Pretoria to act as tutors during the course of 2007. We eventually were able to offer our tutoring services Monday – Thursday from 14:00 to 20:00 and on Sunday evening from 18:00 to 20:00.

One of our primary concerns on this project was the safety of all the participants – both the pupils and the tutors. We developed a code of conduct which the tutors needed to sign before they could act as a tutor for us. That code of conduct was intended to stop tutors and pupils from physically meeting. Tutors were prohibited from giving out any personal information about themselves. They were also prohibited from asking for any personal information from the pupils (except for asking what grade the pupil was in).

Our code of conduct included:

1. I will not contact any learner who joins the “Math on MXit” program outside the “Math on MXit” program.
2. I will not give any of the cell phone numbers which I have access to to anybody outside of the “Math on MXit” program
3. I will not ask any personal questions of any of the participants of “Math on MXit.” The one acceptable exception to this rule is “What grade r u in?” in order to judge the level of your response to the participant.
4. I will not answer any personal questions of any of the participants of “Math on MXit”
5. I will maintain the log files of all conversations and will not tamper with them in any way.
6. I will limit my conversations to topics of mathematics, science, and school work.
7. I will not discuss sex, drugs, or any illegal activities with any of the participants of “Math on MXit”
8. I will encourage participants to further study any subjects in which mathematics is important including science, geography, accounting, and computer studies.
9. I will encourage participants to use their cell phone as a research tool (and not just a convenience) by informing them about cell phone browsers and cell phone based calculators.

Obviously a code of conduct is ineffective without effective monitoring. We recorded all conversations between the tutors and pupils. These conversations were then

reviewed daily by a third person on the project. Conversations were logged and retrievable by tutor name and by participant alias.

5. Technology Description

The technology we used changed along the course of the project. We had 3 major configurations which we used.

1. When our project started, MXit communicated with various open Jabber servers. At that point, we merely created an account at a public Jabber server and were chatting with MXit participants within minutes. At that point in time, we used open source Gaim Instant Messaging client software. After a number of months, however, MXit made a policy decision to no longer communicate with public Jabber servers [9] and we had to change our technology.
2. For the second incarnation of “Dr Math”, we created an account at Google. MXit does communicate with Google mail accounts. Again, this required no software development on our part. We used the Google web interface. However, after operating for a few weeks or so using this, it was clear that messages were not reliably being transmitted between MXit and Google. That problem has subsequently been corrected but, by that time, we had advanced to configuration #3 of our project.
3. For our third and final incarnation of “Dr Math”, we wrote a specific program that would communicate with MXit's Jabber server using their modified protocol. We did this development in Java 1.4 as a client/server application which would allow multiple tutors to handle multiple of cell numbers. Originally tutors needed to come into our offices in Pretoria to take part in our project, but we also eventually came up with a web interface so tutors could access our project from home.

Once we were in stage 3 of our development, we were free to add many features which would make the lives of the tutors easier. These features included:

1. Bulk messaging where the tutor could send out a message to all participants. When our tutors first logged in, they would usually send a bulk message out to all participants who were online at the time to encourage them to tackle some mathematics homework. Messages such as “Let's chat some maths” or “Let's tackle some math homework” brought lots of responses.
2. Auto-answer where the tutor could set up an automatic answer such as “I've just gone to get a cup of tea. Be right back.”
3. “Bots” which could give out standard definitions and formula or respond to fixed commands. We eventually had 3 different automated “bots” which could feed out these replies. Two of the “bots” operated in two different human languages. These are:
 1. Calculators
Although most cell phones come with a calculator, participants were reluctant to exit from the MXit program on their cell phones to access their own calculator. In addition, few cell phones actually had scientific calculators with trigonometric functions on them. So we provided a calculator service which participants could reach from within MXit
 2. Definitions

The definitions “bot” supplied standard definitions of mathematical terms such as parabola, tangent, and perpendicular. We provided this “both” in both English and Afrikaans.

3. Formulae

The formulae “bot” supplied mathematical formulae for well know problems such as area of a circle, perimeter of a rectangle, and Pythagorean Theorem. This “bot” was also provided in both English and Afrikaans.

6. Alternate Solutions

The reason we used MXit for this project was because South African pupils are already using MXit to communicate with their friends. There are, however, a number of similar configurations which do not use MXit. This would be appropriate for schools and organisations outside of South Africa where MXit does not have such a strong presence. They would also be appropriate for organisations which do not wish to recommend that participants use MXit.

We will describe three different solutions. All three of these solutions, however, do require that GPRS is available on the cell network.

1. Google

Google allows participants to create an email and instant messaging account. The instant messaging account can be accessed through Google's web interface or it can be accessed through various open source instant messaging client software applications such as Gaim or Pidgin. Google also provides free of charge a mobile chat program which can be downloaded onto a cell phone.

The only real drawback of this configuration is that the pupils will have to have access to a traditional internet workstation in order to set up their Google account prior to actually accessing their account on their cell phone.

Once the accounts are set up on the internet workstation and the appropriate Google software downloaded onto the participants' cell phones, then the teacher could continue to use the internet workstation with the Google web interface and the pupils could use the cell phone software.

2. Public Jabber

There are numerous open public Jabber servers which allow people to create instant messaging accounts. The accounts usually can not be created using a web interface and can not be created using just a cell phone. Open Source software such as Gaim or Pidgin can be used to create the accounts on the many Jabber servers using a traditional workstation connected to the internet. Cell phone software to communicate with Jabber servers can be easily found by searching on the keywords “j2me jabber client”.

3. Private Jabber

The third option is to host your own Jabber server. Jabber is open source and there are a number of implementations of it which you can download free of charge and host on your own computer. By hosting your own Jabber server, you can have some additional features. For example, you could pre-create the accounts for your pupils so that pupils did not need to access a traditional internet workstation to create their accounts. This would allow you to limit your service to just pupils in your school or your organisation. It would also give you much easier access to the log files of all the conversations.

7. Developments

After the initial novelty of the system wore off the pupils, they responded with good questions about mathematics. We eventually had pupils from as young as Grade 4 using our services. We covered a wide range of topics from addition and multiplication tables up through trigonometry. As mentioned before, the specific aspects of mathematics education can be more fully obtained in the AMESA paper[6].

Participants accessed us from all over:

thusi: Hi

Dr.math: hello, thusi, r u still in class?

thusi: no watin 4 a taxi

Dr.math: so how's math class going?

thusi: its not okay

Dr.math: do u have time to chat now? how can I help?

thusi: i need help with factorisin brackets

Dr.math: give me an example and we can work thru it while ur waiting for the taxi

Lex: Maybe later. Currently in the bath

Dr Math: with your phone???? aren't you afraid of getting it wet

Lex: npe i hv craze skills haha. I even go on MXit on the back of my friends bike

Participants developed a friendly virtual relationship with “Dr Math” and often virtually “dropped by” to say “hi” after class. Participants would share successes on their mathematics tests and exams. Sadly, a few also shared their failures but our tutors would use those situations as opportunities to really engage the pupil on studying mathematics with more passion and care.

Another interesting development of the project was the number of participants who specifically asked for anonymous personal counselling. This was completely outside the scope of our project and in these cases we referred them to the telephone hotline of ChildLine. However, the techniques and software which we used on our “Dr Math” project could easily be used by a counselling service to help teenagers using MXit as a medium.

8. Results

The participants loved “Dr Math”. They seem genuinely grateful for help with their mathematics homework. They think “Dr Math” is kewl!

Tracy: OK TANK U FOR THE HELP U ARE THE BEST

Gemini: i think what u trying 2 do is gr8.

Tash: u r a star in the making

Angelcakes: wow! U mus g0 make a plan by ur big boss en tel hm 2
speak 2 l0wveld highs principel en tel hm dat we need fns
2 beta 0ur educati0n ne

Quintin: U guys r dam clever!

Slipknot: cool you rock man thanks 4 the chat

Bullet-proof. Thnx 4 pr0viding the service

Js\$ic: kwl tnx again!:-)

Participants commented favourably about “Dr Math” in the various MXit forums.

9. Business Benefits

The costs of running our “Dr Math” project were minimal especially in view of the fact that our tutors were volunteers from a local university. Our primary actual cost was our connectivity to the internet. The participants covered their own costs for their cell phones and their own MXit connectivity costs (which were minimal).

We found that one tutor could easily handle up to around 30 participants at any one time. Even if there was a bit of time delay from the tutor in answering a question from the participant, it is important to realise that the participants were also chatting with their friends while they were waiting for a response from “Dr Math.”

It would be possible to run similar configurations in three different sizes:

1. Small classroom sized configurations could be set up by an individual teacher using a Google account. The teacher could log in from home for an hour on a personal dial up connection and easily help 30 participants without any additional software having to be installed. The pupils could use either MXit or use a Google account which they would set up on a traditional internet connection and download Google's mobile cell software.
2. School wide implementations could be configured using a private Jabber server. The school would be able to restrict who accesses the Jabber server. This would also be suitable for situations where parents and teachers were not comfortable recommended MXit to their children and pupils.
3. Nation wide implementations (such as our “Dr Math”) could be set up on different subject matters (participants always ask for a “Dr Science”). Extremely heavy usage does require some additional software which we wrote for this project.

10. Conclusions

Instant Messaging, and specifically MXit, can be used to deliver good education content to teenagers and pre-teens. Teenagers are attracted to technology and actively engage adults using Instant Messaging to discuss educational topics. In fact, teenagers have specifically asked for additional educational content specifically science topics. There have also been many requests for anonymous counselling services.

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