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TITLE: Girl Learners Using Mobile Phones in the Classroom for Mathematical Education

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ABSTRACT

The UN defines South Africa as a middle−income country, yet there are concerns about quality of education, especially in poorer areas. This concern, linked with unemployment figures of between 27 and 40% (over 5 million people) makes quality access and engagement with education a priority so that women may benefit from full access to employment. The South African National Department of Education published the e-Education white paper in 2004, but the challenge remains in the implementation of these strategies. The main question revolves around the value of ICTs demonstrated through teacher and learner improvements.

Mobile phones as an ICT tool are becoming more frequent and pervasive. While there is gender parity in education in South Africa, this is skewed by subject matter, with the gender ratio of girls accessing mathematics and science at higher education levels becoming progressively lower than boys. This impacts on later employment positions, status and achievement. In addition, performance in mathematics and science at the secondary level are poor and has been prioritized by government. This situation is compounded by a lack of qualified mathematics and science teachers.

Twenty girl learners were selected to participate in this project: a partnership between Nokia Mobile and Mindset Learn. This pilot project has provided each girl with a Mobile phone with Mindset mathematics content loaded on. This content is freely accessible and is curriculum aligned. The project has analysed how the phones are used in relation to both content and technology in general and has measured the impact these phones have had on girl learners' educational attainment, perceptions of technology and new learning that has taken place. Implications for mobile phones in the classroom are discussed.

INTRODUCTION

Open and distance learning has its core objective to "widen access to learning" by reaching a diverse and disparate group of learners, some in the schooling system and some who have been marginalized. This paper presents the use of mobile phones as an avenue to access this range of learner in an open and accessible manner. It also synchronises the schooling system with an educational resource that becomes movable – or mobile. It also provides an avenue to target a group of learners who have been marginalized within and outside the schooling system in South Africa: girl learners. This paper will outline an investigation that will take place over this year (2008) to uncover the impact that mobile phones with open relevant, high-quality digital content have on girl learners' performance and attitudes towards learning. The project is thus innovative in two ways:

- Using mobile phones as a learning device in a developing country

- Creating open content that is not merely a miniaturization of video content or paper content. One size does not fit all. The content has been designed for mobile phones.

Gender and education

Educationally, mobile phones are devices that have an inherent collaborative possibility to them. Adolescents swap content, sms and converse with each other cheaply, and Bluetooth content. The content and games that Mindset has developed have been designed specifically to work with the collaborative and sharing nature of mobile devices. As this is a pilot project, the area of mathematics has been targeted (a ntional priority area in South Africa).

Mathematics is essential to many strategic occupational areas that South Africa needs to develop to remain competitive in a global economy. Areas such as science, engineering, accounting, financial services, architecture, and research, all require a firm base in mathematics.

While there is gender parity in primary level education in South Africa, this is skewed by subject matter at a secondary level, with the gender ratio of girls accessing mathematics and science at higher education levels becoming progressively lower than boys. In the past, Grade 12 results and the profile of subjects taken by learners at school have shown that girls have not taken mathematics and science for a variety of reasons. These may include access to qualified teachers, resources at schools, and perceptions of gender specific subjects to take, for example. This means that women have had limited access to both opportunities at a tertiary level and in the job market. Thus women become disempowered financially, socially and psychologically. This impacts on later employment positions, status and achievement. In addition, performance in mathematics and science at the secondary level are poor and has been prioritized by government. This situation is compounded by a lack of qualified mathematics and science teachers.

The National department of Education in South Africa has prioritized Mathematics as one of the key areas to develop. Learners' performance in Mathematics has been exceptionally and consistently poor in the past few years. In addition, The Minister of Education, Naledi Pandor has on many occasions stressed the development of female learners as a priority. Isaacs (2007) has noted that there is gender parity in South African schools, but Huyer (2003) notes that other forms of literacy also need attention in order for girls to have access to science and technology:

- Functional literacy – common channels of communication with information in everyday sources such as books, newspapers and pamphlets.
- Functional technological literacy – literacy that is necessary to use one's mobile phone, the internet, a computer, and the implications of using it.
- Scientific literacy – this includes a general understanding of science to be able to speak about policies (for example, where energy comes from, why natural resources are precious, how, why and where to build roads? etc).

In order for girls to partake in an equal fashion in society, this functional and scientific literacy is essential. Even in countries where women appear to hold occupations within a technological sector, one often finds these to be of a more clerical nature (Huyer, 2003). The World Bank (2002) in a report on gender argued that societies that discriminate by gender do not combat poverty as effectively, if at all, than those who are less discriminatory. If a woman is educated she can contribute towards the economy in a meaningful manner.

Huyer (2003) in her paper on gender and ICT development, recommends that both the support and encouragement for girls and women at every level of science and technology is imperative. This is especially true past the primary school levels and into high school where domestic pressures, and levels of encouragement for education in general, and mathematics and science in particular, starts to decline. Greater access to ICTs is also necessary, as is the demystification and normalization of all types of technology.

Isaacs (2007) notes:

> "*As for the integration of gender equality and women's/girls' empowerment in the ICT for education sphere, a recent study outlined by James (2006) suggests that there are limited targeted interventions that promote girls and women in particular. A number of programmes have tended to incorporate gender equality considerations in their project design but there are limited studies that demonstrate the effects of such an approach. The study calls on focused interventions in promoting girls in maths, science, and technology programmes and ICT careers*" (pg. 25).

In terms of gender issues and the use of mobile phones as learning devices, the Mindset project aims to enhance and develop girl learners' mathematical skills and to have an ultimate impact on the MDGs and EFA goals:

1. Eradication of poverty – education is a means of developing the economic power for girls, especially in areas where they have been under-represented. Girls need to be empowered in more than the basic education that is provided, but also in the areas that they have been implicitly or explicitly marginalized from (mathematics and science especially). This access to education provides girl learners with an opportunity to be competitive in a scarce skills market.
2. Combat HIV and AIDS, Malaria and other diseases – in this sense education and access to technology provides another means of accessing facilities. However, using mobile phones in this fashion also creates a sense of personal responsibility for one's own learning. With large numbers of teachers falling ill, absenteeism, low morale and emotional trauma affecting the learning process, learners need to be taught how to learn not what to learn.
3. Equitable access to education – the reach of mobile phones within South Africa is starting to reach saturation point (as evidenced by the South African mobile phone organisations' expansion into the rest of Africa). Mobile telephony has a greater reach than television and is second only to the radio. Poor infrastructure and diverse populations have actually encouraged the use of mobile phones in Africa. By providing open content that is freely available to these devices one is able to reach larger numbers of learners. Even if an adolescent does not have a phone, they generally know someone who has a phone that they are able to use.
4. Eliminating gender disparity in high and primary schools – using ICTs and innovative use of these needs to be accessible for both genders and/or empowering of girls. Mobile phones in South Africa appear to be utlised by both genders equitably (but no clear research on this is evident). If mobile phones are a means of accessing girls in a technological fashion, they become 'gateway' devices to other technology.

The mobile phone project:

Mindset Network and Nokia partnered to provide mobile content on 20 Nokia 6300 mobile phones to girls in a disadvantaged area of the North West Province in South Africa. The girls are in Grade 10 and are all taking mathematics as a subject. 20 girls will receive mobile phones with content and games loaded on them, while 20 specifically matched control girls from the same school will not. The school will have the Mindset datacast solution installed as standard and all learners will have access to this. The Mindset datacast solution is the normally available mathematics, science, IT and English high

school level content that is broadcast into the schools for the educators to use as they require it. The system has forwards, backwards and pause functions available. Topics may be chosen as they are needed for the lessons.

The girls who receive the mobile phones will have the following loaded onto the phones:

1. Mathematical content for grade 10. This content has been adapted from the curriculum-aligned videos that Mindset has produced for the Grade 10 mathematics level. Short episodes with key points of explanation and illustration have been created from these. The girls will be able to select the topics they require explanation on.
2. Mobi-sodes. Short episodes will be created with cartoon characters illustrating key mathematical points, such as the effect of changing values on the x or y axis, the Cartesian plane etc. These characters have been created and tested on users and have been found to have exceptionally high ecological validity (thus leading to suggestions for further and additional use of the characters).
3. Mathematical games. Two games have been designed and created using software creation organisations in South Africa:
    a. Fashion Empire – In this game the mathematical concepts are implicit and not directly obvious to the girls. The game was set in a fashion setting to create a successful business, but has the potential to be placed within other arenas such as Soccer Empire or Baking Empire. There are smaller games within the Fashion game that need to be played in order to build the empire. These include reading graph forecasts of trends and seasonal changes, three dimensional problem solving in the box stacking warehouse, designing the clothes and the patterns on the clothes using geometrical shapes and colours, dealing with a bank by borrowing money and interest rates, selling the clothes to buyers, hiring and firing staff. This game also extends the purely mathematical aspects of the game to include social responsibility – there is a portion where one's actions create a 'reputation' within the game and one may lose or gain points by acting ethically.
    b. "Mathstermind" – this is an overt mathematical problem solving game where a progressively more difficult equation is provided, and the object of the game is to attempt numbers and functions to solve the equation. Clues and small teaching sessions inherent in the game allow the user to progress and learn as they move higher in the game.

User testing on both games has been incredibly successful with the Grade 10 users seeing the games as problems and puzzles to solve to get to higher levels - the levels are challenging enough o keep them motivated but not too hard to make them frustrated. In addition, user testing observations have noted that the users seek out mathematical methodologies for the purpose of solving the puzzle.

The purpose of designing and developing this project was to pilot test content for mobile phones in a disadvantaged school and to assess the impact on learners, with specific reference to girl learners. The type of questions that this project and the research attached to this project seeks to answer include:

- Is it a technology-driven fad or a genuine enhancement to school teaching in this context?
- Does it offer value for open and extension schooling?
- Do the girls demonstrate a change in mathematical performance?
- Do they play the games, watch the episodes and use the videos? In what way, how, with whom and where?
- Is there a change in attitudes towards learning?

- Is there a change in thinking style and problem solving techniques?
- Have they spontaneously used collaborative learning?
- Has their attitude towards technology been altered?

A results framework for the research is presented below.

Methodology to be employed:

Table 1. Results Framework Template

Name of project	**Short description of the project (according to relevant evaluation criteria)**	**Objectives for the project**	**Impact goals for the project (*these are the expected outputs from the Mindset interventions*)**	
			Intermediate	***Long term***
Empowering girl learners with curriculum aligned maths content on a mobile phone platform	Effectiveness: Do project aims (gender empowerment, educational efficacy and mobile phone technology empowerment) result in a positive change for the learners, educators and wider community of learning? A secondary, non-direct effect of the project is the empowerment of educators in using the Mindset datacast system. Efficiency: Monitoring process (project manager). Impact: There is a priority to empower girls in the area of maths and technology. In addition, mobile phones as a new technology platform for curriculum and learning needs to be evaluated. Relevance: The Department of Education has identified maths as a priority area for secondary schooling, especially for girls who have been marginalised in this area. In addition, e-Learning has been prioritised and the Mindset Schooling platforms of datacast and mobile phones are examples of this. Sustainability: This project is a pilot test to determine the efficacy and impact of using mobile phones in	1. Increase knowledge of girl learners in the priority area of maths content at a Grade 10 level. 2. increase knowledge of all learners in the priority area of maths content at a Grade 10 level 2. Empower girl learners in the use of mobile phones as a window/gateway into technology access and expertise 3. Pilot test the Mindset maths Grade 10 content on a mobile phone platform 4. Empower educators in an alternative pedagogy in providing curriculum-aligned content	Greater knowledge in the area of maths at Grade 10 A significantly greater improvement in maths performance if girl learners with access to mobile phone Mindset content Greater self-efficacy in accessing technology platforms such as mobile phones. Empowerment of educators in using the Mindset datacast system	Improvement in educational attainment of Girl learners Improvement in educational attainment of learners Build capacity in ICT in South Africa Change pedagogic practice

	education as well as the empowerment of girl learners. Long term impact will determine the sustainability of the project. In addition, Mindset content is easy to access and mobile phones have the most penetration of the technology platforms thus providing a model of sustainability for future roll-out.			

The project starts in June 2008 and continues to November 2008. Assessment and evaluation of the process and the final outcome will be undertaken and reported on at the end of the year and the beginning of next year.

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