

Mobile Facilitation of Science and Technology awareness for preschool children

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Abstract: *There is an acknowledged international skills shortage in Science and Technology. TekkiTots is an initiative by the Meraka Institute aimed at introducing Science and Technology to preschools. Due to the infrastructure limitations in rural areas we have had to rethink our delivery method of the lesson plans as the reproduction of the lesson plans proved to be challenging. The widespread and ubiquitous nature of Mobile Phones in South Africa led us to convert them to a mobile format for easy distribution, sideloading and access. This paper describes TekkiTots, its initiation, collaborating partners and new direction that have been taken. We report on initial findings and plot a way forward.*

Keywords: Mobile Learning, MobiLED, Design, Mobile Video, Science and Technology, Preschool, education.

1 Introduction

South Africa's shortage of skills is a global problem reflected in a local context (Dobson, Koser, McLaughlin, & Salt, 2001). The Youth into Science Strategy document from the Department of Science and Technology affirms that professions most affected by the skills shortage are engineers, scientists, surveyors, chartered accountants, actuaries, project managers, artisans and Information Technology specialists ("The Youth into Science Strategy", 2006). This is a very complex problem that would need specialised interventions and initiatives at various levels of in the formal and informal sectors. Literature affirms the belief that children learn and establish attitudes long before formal education commences. (Bernstein, 1975; Sammons, Elliot, Sylva, Melhuish, Siraj-Blatchford, & Taggart, 2004; Vygotsky, 1978) Their formal education is, consequently, grounded in previous experiences. This is affirmed by the Harvard University Scientific Council on the Developing Child. They state that the quality of a child's early environment and the availability of appropriate experiences at the right stages of development are crucial in determining the strength or weakness of the brain's architecture, which, in turn, determines how well he or she will be able to think and to regulate emotions. Figure 1 below indicates the rate of return to investment in Human Capital to be the highest in the preschool phase and as such the ideal point to invest with the aim of greatest impact.

Extensive data now indicate that policymakers can achieve greater return on investments in early education for children from families with low income and limited parent education than they can from investments in remedial programs for adults with limited workforce skills. In short, although optimal financial benefits depend on continued investment throughout the middle childhood years, the greatest returns are realized when investments are made in the lives of vulnerable children

well before they begin school.(The Timing and Quality of Early Experiences Combine to Shape Brain Architecture. Working Paper #5, 2007, p.7)

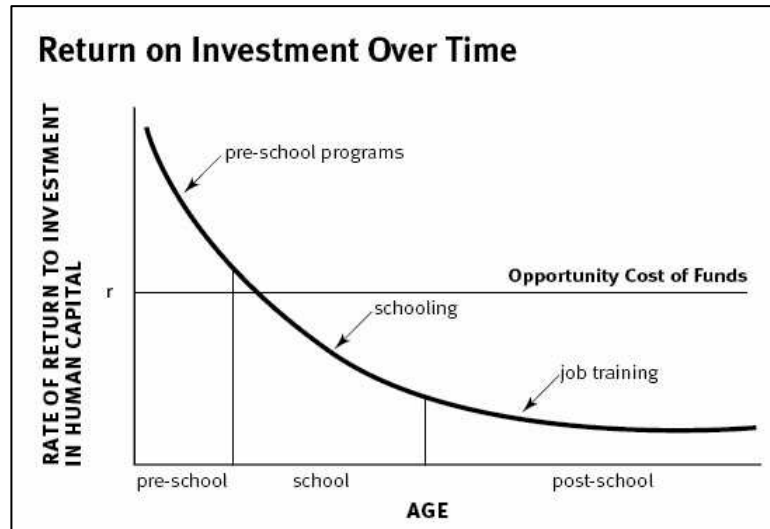


Figure 1: Return on Investment over Time(The Timing and Quality of Early Experiences Combine to Shape Brain Architecture. Working Paper #5, 2007)

An understanding of the preschool environment and the way these children learn, their social context and the direct influence of their parents and teachers have been critical. Vygotsky (1978) argues that as children mature, the way they learn changes. Peel and Prinsloo (2001) describe preschool children as by nature inquisitive, energetic, passionately motivated, risk taking, thinking and doing the impossible, creative, can see the end product, trying over and over again while learning through their mistakes. This makes them an ideal audience for the investigative processes associated with Science and Technology. Their open enquiring minds, however, is strongly contrasted by early childhood teachers that are mostly hesitant about introducing science in their classrooms. Their hesitancy is often “because of their own unpleasant science education experiences (Conezio & French, 2002, p.14)”

2 Aim and challenges

Our aim was to introduce a Science and Technology based intervention that teachers would buy into and that would provide preschoolers with appropriate hands on, positive experiences. A major challenge was to package the content and lesson plans in such a way that it would be easily distributable, shareable, understandable and cost-effective.

The distribution of lesson plans in a mobile format was based on the research done as part of the MobiLED initiative. MobiLED started as MobilED (Mobile Education). A collaboration that began in 2006 between the South African-based Meraka Institute (CSIR), University of Pretoria, Tshwane University of Technology as well as various international partners such as the Media Lab of University of Art and Design Helsinki (Finland), Escola do Futuro Universidad de São Paulo (Brazil) and the WikiMedia Foundation (United States). The initiative aimed to develop, expand and integrate mobile-phone tools, technologies and services into the areas of formal and informal teaching and learning environments. In the absence of desktop computers and ubiquitous internet access, mobile phones have the potential to provide an alternative access and participation mechanisms. Over the past year it has become apparent that many of the initiative's innovations have had a much wider application in the developing world. The concept and MobilED acronym has undergone a change of emphasis to become “Mobile-Led”, pronounced “Mobi-led”.

3 TekkiTots

TekkiTots' first iteration was in 2006, starting as part of *The Young Engineers of Africa (YESA)* research area within the ICT in Education, Youth and Gender research group at The Meraka Institute (CSIR). One school and six children were involved.



Figure 2: Pre-schoolers being assisted by students from the University of Pretoria during the first iteration of TekkiTots (Van Deventer, 2008)

Twenty five lesson plans were developed and evaluated by collecting feedback from children, staff and parents at a preschool in Pretoria, South Africa. The outcome and reflections of each lesson was used to revisit and change that lesson. Those lessons learned were then used to guide the design and content of the following lessons. (Some lessons were discarded) Overwhelming positive responses led to the programme running for a second year at this particular preschool. The table below represents the scaling of the project over the last three years.

Table 1: Scaling of TekkiTots over three years (Van Deventer, 2008)

	Cycle 1 (2006)	Cycle 2 (2007)	Cycle 3 (2008)
Goal	Develop Content	Test method and content with more teachers & children	Streamline the process to minimize input from Meraka and empower students
Schools	1	4	8
Students	1	18	34
Children	6	97	200+

In 2007 the initiative was scaled to four schools and 97 children. This was done by incorporating students from the University of Pretoria's Engineering, Built Environment and IT faculty. As part of a community based module, undergraduate students have to do 80 hours of community service directed at specific community needs. The student volunteers approached various preschools and received basic training, paper based lesson plans and any lesson apparatus needed from the Meraka Institute. The students had to report back on their experiences as well as the usability of the content. The feedback from the preschool community as a whole was very positive however internally we started to question the viability of the distribution mechanism.

The iteration in 2008 was distributed more widely with the initiative being implemented in 8 schools using 34 students from the University of Pretoria and reaching in excess of 200 preschool children. The lesson content was further refined. Meraka Institute printed all the lessons and supplied them to the students. Cost and time became serious issues as students misplaced their copies of the lessons. Feedback from the community of students, preschools and children were

positive and a model was published on the implementation of preschool science using the students of the University of Pretoria (Van Deventer, 2008).

We were planning to scale the project further in 2009. One of the implications being that lesson plans as well as lesson guides and best practice would have to be either published online or in book format. Both of these would exclude a large section of the population. This is either due to the cost of published material or the lack of physical amenities to access, download and print the lesson material. To reach the largest audience it was decided to produce mobile videos of the lessons for teachers to download from a WAP site, sideload from a colleague or Bluetooth site and share from their mobile phones.

4 Mobile video

In 2001 the amount of Mobile Phones surpassed the amount of fixed line phones with most of the growth in the mobile market taking place in so-called developing countries (Feldmann, 2003). In South Africa the uptake of Mobile phones have been phenomenal, no doubt partially due to the availability of prepaid subscriptions (Esselaar, Gillwald, & Stork, 2007) on the one hand and on the other the challenges of connectivity and infrastructure that make up the realities of Africa (Abungu, 2002; Akinboade & Lalthapersad-Pillay, 2005; Traxler, 2007). According to the International Telecommunications Union, the African growth rate has been the highest of any region over the past 5 years, averaging close to 60% year on year with a recorded figure of 76 million users on the African continent at the end of 2004 (ITU Report, 2006). The total number of mobile phone subscribers on the African continent was expected to reach 316 million mark by the end of 2008, this figure represents a penetration of 34% (Engineering News, 2008).

Michael Minges, head of ITU's Market, Economics and Finance Unit states:

Mobile technology is the Information Society in Africa, it is a technology that has permeated more widely than any other into new areas, and we must examine how we can utilize this technology going forward (Minges, 2004)

Traxler (2007) affirms that "(In Africa Mobile learning is partly a way of dealing with the challenges of poor connectivity, mains electricity, and PC availability on the one hand, and on the other hand, has been stimulated by the enormous spread of mobile phones..." Joel Selanikio (2008) calls the spread of personally-financed wirelessly-connected "the silent computer revolution" He questions the initiatives aiming at supplying laptops to schoolteachers and calls for a rethink of strategy to rather utilise "the computer they already have in their pocket (Selanikio, 2008)"

In South-African context mobile phones not only provide mobility, but also empower the user with ability. This ability refers to the user's capacity to connect to the information society as a contributor and user which is a primary advantage in the areas where other means of access are not available as a result of various infrastructure and physical realities (Botha, Batchelor, van der Berg, & Islas Sedano, 2008). Through the development, implementations and evaluation of the Mobile Videos as learning objects to enable teachers to independently implement TekkiTots preschool science, we intended to make explicit the implicit decisions associated with the design and integration process.

Mobile Video

The videos are essentially about enabling the facilitator to teach and structure the lessons in such a way that the children will construct basic knowledge, encourage the development of the fundamentally needed skills and nurture a positive attitude towards Science and Technology in a hands-on practical manner. To embed effective practice a collaborative design methodology was followed. We approached a school in Centurion, Pretoria, known for their innovative practice and high standard of teaching to evaluate and give feedback on each video. The preschool has 9

teachers; 2 teaching Grade 000 (3 turning 4 year old), 3 teaching Grade 00 (4 turning 5 year old) and four teaching the Grade 0 (5 turning 6 year old).








<p>Teacher prepares the indicator solution at the start of lesson</p> <p>Instruction to Teacher.</p>	 <p>Suggested Chemicals/Materials used in preparation. No specialised Chemicals/Materials are used and most are readily available.</p>	 <p>Suggested preparation of indicator.</p>
<p>Prepare enough solution: each child to get a sample</p> <p>Teaching strategy incorporated in the lesson.</p>	 <p>Solutions to be tested by the children. A suggestion to accommodate each individual pupil is given visually.</p>	 <p>The Teacher is shown how the students would do the experiment as well as the outcome.</p>
 <p>Children doing the activity on Acids and Bases.</p>	 <p>This activity was prepared by the teacher using the mobile video as guide.</p>	 <p>Teacher helping students with the Acids and Basis activities,</p>

Figure 3: Screenshots of Video on Acids and Bases

The Mobile videos would be implemented in Grade 0 initially and depending on the suitability of the content possibly in Grade 00 and Grade 000. With reference to this paper the teachers teaching in Grade 0 evaluated the videos which were then edited and the feedback was incorporated into the design of subsequent videos.

The mobile videos are there to serve as a guide to the best practice models on introducing Science and Technology into preschools. These models were established through the three years of implementation. The mobile videos further serves as a guide to the level of content preschool children can cope with when they are encouraged, challenged, guided and supported.

The mobile videos are further supported by a “**how to use**“ guide. This guide gives the structure of the lessons and suggests some guidelines as to the general structure and flow of lessons. Examples of suggestions given include:

- Proper preparation entails testing the experiment beforehand and building the simple products yourself before expecting the child to do it.
- Each child should always have his/her own practical material
- Start by emphasising that the lesson is about Science and Technology. This will help the children to give some meaning to Science and Technology.
- Explain class rules during the first lesson.
- If you want to get the attention of a large group start clapping your hands and ask them to join in.
- Focus children’s attention by touching your head, shoulders etc. before you speak to the children. Instruct them to copy you.
- Science and Technology involves logical thinking processes. It is a good idea to follow these processes when presenting the lesson material as a simple scientific experiment has the following components:
 - Purpose (what are we going to do today – maybe a little background information if needed)
 - Hypothesis (what do you think will happen?)
 - Materials (what are we going to use today?)
 - Method (how are we going to do it?)
 - Observation (what do we see, hear, feel, smell?)
 - Conclusion (at this age the conclusion takes the format of a summary of the lesson by the presenter)
- Test the product (does it work/is the child happy with the product?)

Due to the inherent limitations of the Mobile Phone space is at a premium and the lesson plans have had to be reduced to the essential. As such clear concise statements were used to convey each lesson. The following themes are covered:

- Sound
- Electricity
- Colour
- Shapes and Structures
- Acid, base and indicators
- Measurements (weight)
- Data handling

The screenshots below are from the mobile video on *Sound and Vibration*. Some examples of children’s observations and interactions are included in the figure.



The Mobile Videos are licensed under the creative commons licence.



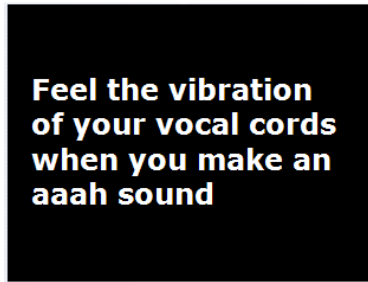
Contributors on the MobiLED Mobile Video's.



Verdana 18pt in White Bold on a black background gave us the best readability on the largest range of phones.



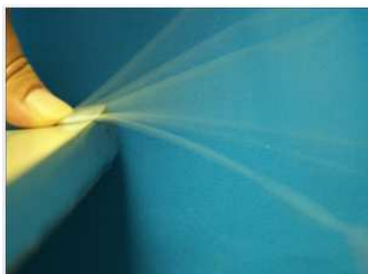
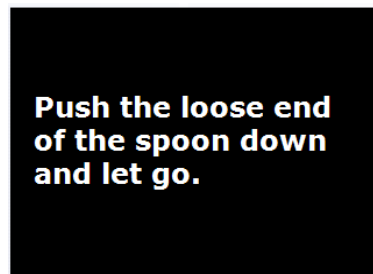
No specialised equipment is used and most are readily available.



A fuss is made about new "big" words. Facilitators repeat the words a few times and combine the repetition of words with rhythmic movements. Combine lesson material with poems or songs.



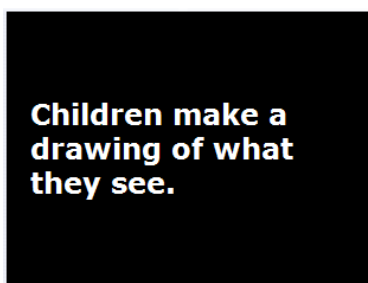
Simple demonstrations are suggested and demonstrated where applicable.



Child doing experiment from instruction by teacher.



Child doing experiment from instruction by teacher.



Children are encouraged to make drawings of what they observed.



Example for the facilitator.

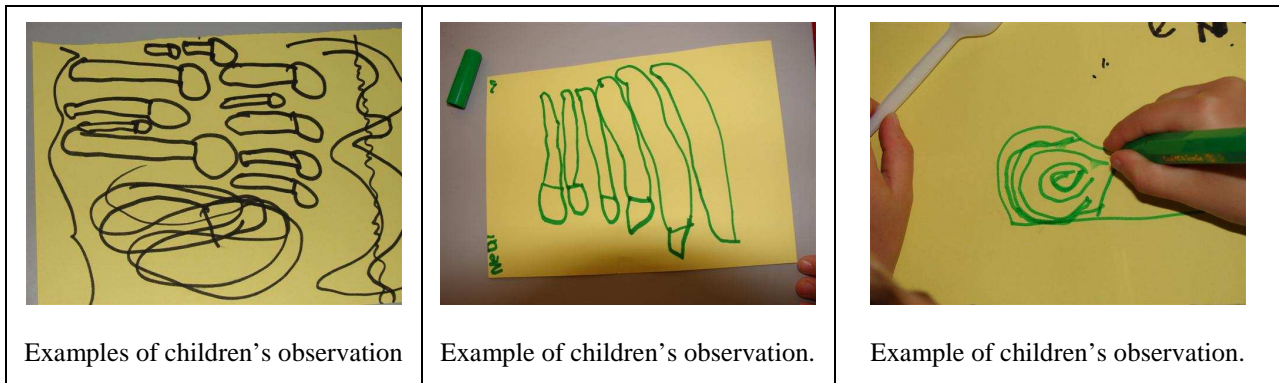


Figure 4: Screenshots of Mobile Video on *Sound and Vibration*

Feedback from Teachers

The feedback from teachers are grouped under common headings and briefly discussed below:

- **Technology related**

The teachers all used their own phones. They indicated that they didn't mind this in the least and actually preferred it as they were comfortable with their own technology. The mobile videos were sideloaded to one of the teacher's phones and they then distributed it amongst themselves. Initially not all the teachers knew how to work with the Bluetooth functionality on the phone. This was however never considered a barrier as another teacher volunteered to help and assured all concerned that it was easy.

The music didn't play on one of the teachers phones. The rest however indicated that they liked sound and preferred it to a silence. To accommodate this we used the sound as an enhancement rather than a necessity.

- **Design related**

In the first videos we experimented with different colour schemes, fonts and font sizes. We found that 18pt Verdana Bold, white on a black background, gave us the best readability over the largest range of phones.

It was indicated that we should limit the amount of text per slide. We found it best to put only one concept per slide.

Text should only be used to enhance an image. Additional concepts should be placed on consequent slides.

With some of the phones we tested, the mobile phone did not pause the video but rather stopped it. This resulted in teachers having to view the video multiple times from the start. Feedback was that we should put the apparatus needed right in the beginning to accommodate these phones.

- **Lesson related**

It was felt that it would be helpful to make a mobile video that shows how these lessons could be used. To accommodate this, the '**how to**' mobile video was made.

Some teaching strategies were incorporated to help novice teachers to facilitate large class groups.

5 Conclusion

We have investigated the use of Mobile Video's as a way to support and encourage preschool teachers to integrate Science and Technology into their curriculum. Mobile technology as a medium has been chosen because of the high penetration of the devices into all spheres of the South African community. The initial pilot has affirmed that teachers were comfortable and proficient users, they were able to access and use the lesson plans in ways that benefitted the children in their care, giving them the self-confidence and tools to extend their practice to include Science and Technology.

Investing in the youth of today for a future of tomorrow is a strategy that is a long term venture and does not show impact over the short term. The feedback from the parent, teacher and student community, however, has been overwhelmingly positive. The Department of Education has expressed an interest and these videos will be made available through the Thutong Portal (The South African Department of Education Web space) after final evaluation and editing.

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