meraka INSTITUTE
African Advanced Institute for Information & Communications Technology

Young Engineers of South Africa
A brief overview

Prepared by: Ron Beyers
rbeyers@csir.co.za
0833108843

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Project Executive Summary

1. YOUNG ENGINEERS OF SOUTH AFRICA PROGRAMME

In keeping with the South African Government's intense drive to harness and improve the skills of South Africans to ensure accelerated economic growth, the Young Engineers of South Africa (YESA) programme was established by the Meraka Institute to contribute to the pipeline of science, engineering and technology (SET) graduates and postgraduates, in response to an ever increasing shortage of skills in this area. This was affirmed by Deputy President Phumzile Mlambo-Ngcuka's address during the launch of the Joint Initiative on Priority Skills Acquisition (Jipsa), when she announced that professional skills in engineering, science, finance and management, as well as technical and artisan skills, were critically needed as the South African economy move into higher gear. She said, "Nothing short of a skills revolution by a nation united will extricate us from the crisis we face." In just two years, with limited resources and capacity, approximately 400 learners have been subjected to the R&D and pilot phases of the YESA initiative. The feedback from learners has been extremely positive, and the response for additional sessions has been overwhelming. Current stakeholders in the initiative include, inter alia, the CSIR, Department of Science and Technology, Department of Education, Depart of Communications (FET Colleges), Advanced Manufacturing Technology Strategy's (AMTS) Fab Lab Initiative, and a growing number of schools.

The Accelerated and Shared Growth Initiative for South Africa (Asgi-SA) has identified the shortage of skilled labour as one of the six constraints to its goal of boosting economic growth to 6%, and the government has acknowledged that the single greatest impediment to its public infrastructure programmes - as well as private investment programmes - is the country's shortage of skills. As South Africa moves more towards a knowledge economy there is an increased need for innovation and associated production, infrastructure development and maintenance. The time is now right to make a long-term investment in the future generation by introducing interventions that will contribute positively to the nurturing of future graduates with the right knowledge, skills, attitudes and values.

YESA presents a number of interventions to address the issues of skills development and growing the SET pipeline, ranging from Grade R to Grade 12. The pilot studies have revealed results indicating the need to share these stimulating learning experiences on a massive scale with the youth of South Africa. Building capacity is a key component for expansion of such activities as extra mural clubs, camps and competitions to provide many more learners with hands-on opportunities to experience the wonders of modern technologies which have the potential to ultimately translate into meaningful career changing opportunities.

At the same time, these YESA interventions nurture key 21st century skills including creativity and innovation, specifically targeting previously disadvantaged communities including learners with disabilities, blacks and young women. The existing national education curriculum is supplemented through a broad range of activities where participants are challenged to apply their knowledge in order to solve real-world problems with the potential of stimulating black inventors in particular. Current interventions include:

- TekkiTot Programme – Preschool intervention aimed at instilling a love of the subject through basic science and technology experiments.
- TekkiKids – Advantaged schools are twinned with disadvantaged schools as a cross cultural experience where Lego acts as the medium of instruction and learners are introduced to the world of computer programming (Grades 4-7).
- Fab Kids – Access to a high-tech rapid prototyping environment provides for an opportunity to apply creative and innovative skills to solving challenges while working in teams. (All grades)
- Hub Schools – Connected learning communities need to be supported from a central hub which can provide access to shared resources through the application of the principles of digital inclusion and digital manufacturing.
- Fab Teachers – Learners need to be supported when they return to the vacuum of a traditional school environment in order to create more sustained interventions for learners to extend themselves.

A number of different interventions are being investigated in order to address identified gaps in the skills database. These include aspects of robotics and digital image manipulation. There is also a feasibility study being conducted into the establishment of a South African School of Space and Aeronautical Technologies as a 'call to action' to provide more learners with access to a 'space camp' type of learning environment. The later project is in response to one of the grand challenges of the Department of Science and Technology's 10 Year Strategic Plan. If South Africa is to stand any chance of having an Africanaut as part of NASA's planned trip to Mars in 2020, we must start preparing the youth as soon as possible.

e-Education plays a key role as the foundation stone of most interventions though the focus is much higher up the technological ladder spawning high-level skills needed in the economy. Computer literacy is assumed where the emphasis is on utilizing technology as an enabling environment and learners are encouraged to operate outside the box of traditional education.

In summary, YESA can play a key role in the Accelerated and Shared Growth Initiative for South Africa (AsgiSA) and Joint Initiative on Priority Skills Acquisition (Jipsa) in addressing the shortage of skills in key sectors of the economy, needed to meet South Africa's Millennium Development Goals. In order for YESA to achieve maximum potential and impact, it must receive national support and be elevated beyond the pilot and incubation phase within the Meraka Institute.

1.1. Additional Information

A significant amount of time over the past year has been spent on formulating an exit strategy for YESA from Meraka. At this stage the plan is to extend the contract of Ron Beyers for a further 12 months to ensure that the project translates into a viable national delivery vehicle for the growing number of interventions that are associated with the organization. A key factor is the identification of gaps in the skills continuum which can be addressed by new or existing interventions building on the strengths of partnerships with key stakeholders. Donors, private and public sectors will be targeted in an attempt to secure project and institutional funding needed to develop a strong YESA team to drive the process forward. YESA is well positioned to make a significant contribution to the Youth into Science Strategy.

2. Fab Kids Project

Please refer to The Fab Kids Project Preliminary Results April 2007.pdf for further details on the Fab Kids project. In total 457 learners have had a Fab Kids experience since the inception of the intervention. Open Source Software is being used in this project in the form of Open Office Draw as the main interface between the learner's designs and the laser cutter.

There are discussions underway to integrate the concept of Fab Kids into the FET College programme in association with the Department of Communications and AMTS.

3. Fab Teacher Pilot Project

Due to the national strikes in 2007 this project was not able to be launched. There was however one informal session where a group of teachers from the North West Province in association with Philemon Kotsokoane, together with two staff from Meraka who participated in a mock up exercise. From this limited experience the results of the intervention are looking promising.

There is a certain degree of reluctance on the part of schools to release teachers to participate in the project. However, this matter has been elevated to the district level and a closer relation with the Tshwane South District is being pursued to resolve this matter at the district level. The project has received clearance from the Tshwane University of Technology's Ethics Committee.

Based on the general acceptance that technological capability is central to contemporary society, many advanced and developing countries have introduced technology education into the school curriculum. There is considerable debate as to whether technology is a discipline in its own right, whether it should be taught as part of science, or spread across the curriculum. In many countries the implementation of technology as a subject has been undermined by a shortage of resources and teachers, inadequate support, and confusion about its philosophical underpinnings. Currently Technology as a learning area is embedded in the National Curriculum Statements and is being taught in all schools across the country.

Academic subjects on the one hand tend to provide mental gymnastics and caters for the academically inclined. On the other hand the more technical subjects cater for the development of essential psychomotor skills and between the two this makes

provision for matriculants to enter the job markets with a broad range of skills. Technology Education as a GET learning area has the potential to link the mind and the hand in a unique marriage of thinking and applying knowledge and skills acquired which should be tempered with experience.

The sad state of affairs in many schools is that the subject of Technology Education, and many other subjects for that matter, is taught from a textbook perspective through pure information transfer depriving learners of the opportunity to exercise their minds and their hands in order to work to their own specifications. It is not necessarily a lack of resources that induces teachers to treat Technology Education as an academic exercise but more an ignorance of the potential of the subject and the application of the design processes which are inherent in the Revised National Curriculum Statements.

The recently introduce Fab Kids project which is run at the Innovation Hub's Fab Lab has revealed that all learners, no matter what their school background are able to make use of this type of environment. In essence the Fab Kids are exposed to a high-tech rapid-prototyping environment in order to complete predefined challenges in teams.

The dilemma that has arisen is that Fab Kids are exposed to powerful learning experiences leaving them on a 'creative and innovative high' but returning to the vacuum of the information transfer environment of the classroom. There are no mechanisms to continue to support them let alone nurture a spirit of enquiry, creativity and innovation needed to nurture future Scientist, Engineers and Technologists.

There is a need to expose teachers to a new pedagogical approach of facilitating the introduction of new technologies into the learning process. Ultimately the Fab Teacher experience will have very little to do with the technologies as the emphasis is on the design process which has the potential to be transferred to other learning situations which may or may not involve technology.

3.1. Fab Teachers Broad Developmental Objectives

The Fab Teacher Project has four key scientific, technical and developmental objectives:

1. Explore and comprehend the nature of the Fab Teacher experience.
2. Understand the pedagogy of facilitating learning in a high tech rapid prototyping environment.
3. Evaluating the concept with teachers in the Tshwane area.
4. Develop a model for the replication of Fab Schools facilities across the country which can empower learners, teachers and the broader community.

3.1. Fab Teachers Project Purpose

The project aims to contribute to the scientific and technical know-how about how teachers are able to facilitate the introduction of a variety of technologies into the learning process. The concepts of innovation and creativity will form an integral component of solving challenges which require lateral thinking, problem solving and more importantly team-work. These are important skills that need to be experienced

first-hand for teachers in order to expose their learners to similar experiences. This may or may not include the Fab Kids who have had exposure to the Fab Labs.

The program for a single day intervention will include the following:

- Teachers being introduced to the concept of Fab Teachers in conjunction with Fab Kids. The emphasis will be on the facilitation of the learning experience emphasizing the need to provide support to learners by applying the design process. It must also be emphasized that the process also highlights the need for stimulating creativity and innovation which can be transferred to other situations that may not involve the introduction of technology, namely highlighting the process and not the product.
- Fab teachers will be given the option of completing their own challenges. This will also entail a detailed analysis of how and why these steps are essential. Should no challenge emerge from the group one will be provided for the day's activities.
- The Fab Teacher group will be divided up into groups of 3-4 with each member adopting a different role based on the same roles as the Fab Kids.
- On completion of the challenge there will be a debriefing of the design process and how this can be transferred to other learning areas.

3.3. Fab Teachers Project Beneficiaries

The project beneficiaries include:

- Primarily teachers in the fields of Technology Education, Science, Mathematics and IT related fields
- E-Learning support staff in the various educational departments
- Team building exercises for school management teams

3.4. Fab Teachers Project Research

It is proposed that the research will be conducted in six to eight sessions involving approximately 70-80 teachers from the Tshwane area including both junior and senior schools and all schools can participate.

3.5. Fab Teacher research responsibilities

The research group will consist of a facilitator who is an ex-teacher together with staff from the Fab Lab and Meraka Institute.

The studies are as follows:

1. A literature survey of similar initiatives
2. Group dynamics. Where possible, the data will be largely in the form of videos recordings and some classroom observations.

4. Digital Kids Concept Document

Two schools were approached at the start of this year to participate in the project. Both have indicated a willingness to participate.

Gatang Comprehensive in Mamelodi is due to start before the end of March with assistance from Leslie Hlengani as part of the Dinaledi School and Ulwazi Projects. This project has the potential to supplement the good work being done in this school where learners are using cell phones to video experiments which are then shared amongst the community of learners. The project has received clearance from the Tshwane University of Technology's Ethics Committee.

The Net Generation have grown up in a digital world and are more at home with a digital representation of reality and have a strong affinity to express themselves digitally. They have grown up in a digital world having the ability to adapt and explore technologies to suite their own needs.

This intervention will encourage learners to express themselves in a variety of different formats ranging from digital photography, capturing and editing of video material, creation of animations, compilation of pod casts and other MMS media. The focus of the project will be the generation of learning material for other learners and educators to have access to a more informative learning environment by sharing this material. It is envisaged that a variety of hardware and software will be used with an emphasis on Open Source where possible.

There is a gap in the Young Engineers of South Africa (YESA – www.yesa.org.za) continuum to provide a forum for the development of skills across a broad range of digital media. These include:

- Digital photography
- 3D Graphics
- Animations
- Pod casting
- Voice casting
- Digital music
- Video productions

The aim is to provide the learners with an additional set of skills to be able to express themselves in a format that they are comfortable with. The focus of the work will be mainly on the development of educational material to supplement their deeper understanding of some of the underlying educational processes, especially in the sciences.

It is possible to 'look into the minds' of the learners through the animations that they create in order to identify whether they have grasped the fundamentals of a concept or not. Learners may be able to reproduce two dimensional drawings from memory without having assembled all the components needed to comprehend the underlying concepts. This may satisfy the requirements for a traditional mode of teaching where marks are allocated to the drawing without any insight into the processes behind the drawing. The generation of animations may provide educators with an opportunity to identify whether an individual may or may not have understood the work comprehensively.

A variety of software will be used to teach the concepts associated with each of the different aspects which will range across a range of software platforms, depending on the available technologies in the schools. The types of software that will be used is dependent upon the skills available but may include:

- Apple i-Life

- Movie Maker for video editing
- Cinema 4D for animations
- Gif Animators to merge individual pictures into a gif animation
- Paint brush
- Gimp

4.1. Digital Kids Broad Developmental Objectives

The Digital Kids Project has four key scientific, technical and developmental objectives:

- Introduce the concept of a Technology Club at schools which can facilitate a range of activities associated with YESA.
- Develop a model of how Digital Kids Clubs could operate in more schools to be used for teaching, learning and empowerment of learners.
- Share the information gathered from the pilot project with other schools.
- Evaluate the concept with at least three schools in the Tshwane area.

4.2. Digital Kids Project Purpose

The purpose of the project is to introduce multimedia authoring tools through a Technology Club environment at a school level. Learners will be introduced to a variety of software tools with the view to generating educational material to be used in the classroom.

The main activities for the project will initially involve up to four afternoon workshops for each of the groups. The types of activities that they will be exposed to will include:

- Demonstration of the capabilities of a particular piece of software
- Basic training
- Setting of a task to see if the learners are capable of applying their skills

4.3. Digital Kids Project Beneficiaries

The project beneficiaries include:

- The learners themselves, their parents, teachers and communities;
- Educational technology and developmental research community who will be informed of the outcomes through various publications.

4.4. Digital Kids Project Research

It is proposed that the research will be conducted in three participating schools in the Tshwane area –

- Irene Primary
- St Mary's DSG – Junior and Senior School
- Gatang Comprehensive

4.5. Digital Kids research responsibilities

The research group will consist of a facilitator with additional staff from the Meraka Institute. Where possible students from the University of Pretoria in association with Dr Martina Jordaan will be included in project as part of their social outreach project.

The studies are as follows:

1. A literature survey about the current use of multimedia authoring tools in other countries.
2. Promoting creativity through exposing learners to a variety of software tools.

4.6. Digital Kids Lesson Plan

Material for this project will be developed in association with the schools as the project progresses. Initially the work will be kept at an elementary level in order to meet the needs of the learners but this will be ramped up with time.

5. Ulwazi project

Work on this project is progressing well. Although the project was presented to the Mpumalanga Education Department in May 2007 the network will only be available by April 2008. Most of the delays were as a result of obtaining permission from the various land owners to attach radio equipment needed to establish the backbone of the network. The project has the potential to provide a radio grid over the whole of the Mpumalanga province. Lessons learnt with this project will be shared with all other provinces including EduNet.

The initial phase of the project has been encapsulated in a journal Article about to be published in the South African Journal of Higher Education.

A working committee under the Chairperson, Ken Mohan from Mpumalanga has been constituted. This committee has taken ownership of the project and will work closely with the Mpumalanga Education Department together with district officials and other stakeholders such a Wireless Africa, Digital Doorways, Motorola, Edge Interactive and Smart to facilitate an interesting educational project.

The second phase of the Ulwazi project is aimed at providing a demonstrator which will investigate a number of key concepts embedded in a living laboratory. This phase will focus on the development of a much larger INTER-SCHOOL broadband network sponsored by Motorola which will provide connectivity between four centres which are separated over a distance of 100 km. A radio corridor will extend the original network to include the:

- Meraka building on the CSIR campus in Pretoria
- Original Ulwazi project between Mamelodi (4 schools) and St Alban's College
- Bronkhorstspruit (2 Dinaledi schools)
- Middelburg (2 Dinaledi schools)
- Witbank(6 Dinaledi schools)
- HP i-Community
- NEPAD e-Schools (Lomahasha) near the Swaziland border

The information gathered from this project is aimed at addressing a key element of the White paper on e-Education, namely:-

“The Telecommunications Act 103 of 1996 and amended in 2001, makes provision for the development of a network for education (EduNet) that will connect all schools to each other and to the Internet through multi-media laboratories. The Department of Education, in collaboration with the Department of Communications, will initiate the development of a national education network with other relevant government departments. The education network will be designed to serve the goal of universal access for every e-school. The education network will provide high-speed access for learning, teaching and administrative use.”

6. Fab Kids/Teachers Technology Transfer strategy

The first draft of the YESA business plan is being compiled. The main thrust of the process is to constitute YESA as a national delivery vehicle that focuses on the identification of talent while nurturing 21st century skills with an emphasis on creativity and innovation. This will make a significant difference to the SET pipeline in the long term especially with the potential of capping a YEAS experience with a Space Camp for learners with sought after skills and encouraging them to pursue careers in SET.