

## **Science-on-the highway \_taking science to the people**

Mr Makhwênkwe George Mvalo, Cape Technikon, [mvalo@ctech.ac.za](mailto:mvalo@ctech.ac.za)

### **Paper**

Introduction

Programme description

The Gateway Discovery Centre Trust (GDT) was established as a non- governmental educational organisation in 1992 with the following mission statement:

“To put science and technology into the hands of the people through an exciting range of interactive, educational exhibits thereby affording people, particularly scholars, the opportunity hitherto denied them to experience scientific and technological principles first-hand and to awaken in them the joy of discovery, resulting in enhanced job opportunities and satisfaction, along with personal empowerment and national prosperity”

Founded by educators, scientists and private individuals concerned that South Africa, in an international survey of 41 nations, ranked last in science and maths education (GDT Report, 1999). The latest world competitiveness report put South Africa at position 39 as indicated in Figure 1.

The Gateway Discovery Centre Trust (GDT) known by its operational name, the Discovery Centre originally had a three phase development thrust. The first phase consisted of interactive science and technology exhibits. These mobile interactive exhibits were to visit various high schools in predominantly disadvantaged areas. The organising committee of the GDT will identify a host school and together with science teacher(s) in the school will plan the visit. Other schools in the area will then be identified and invited to the science and technology exhibition. The host school then serve as a “discovery centre” for a period of three to four weeks with the first week allocated to use by the hub school.

The second phase was to take exhibits to predominantly primary schools in disadvantaged areas. This phase came to fruition on 27 November 1998 with the launch of the DiscoveryMobile. The DiscoveryMobile is a customised-science-on-wheels bus. Fitted with 32 interactive science & technology exhibits. Its exterior is also a learning classroom as it covers the four sources of energy, i.e. wind, lightning, solar energy and hydroelectric power.

The third envisaged phase was the establishment of a permanent Science Centre in the city of Cape Town with easy access by rail and bus. The old granary building was identified as a suitable site for the permanent centre. Various factors led to the review of going ahead with this phase including the mooted development of a multimillion rand permanent science centre developed at Century City. This led to a team being nominated to enter into negotiations with the founders of the new permanent science centre. A memorandum of understanding was agreed upon where the Discovery Centre will design and build seven exhibits to be housed on 50 square metres at the MTN ScienCentre. For now it looked that the decision to build a permanent centre in Cape Town has been put in abeyance.

### **Aim of the Discovery Centre**

The aim of the Discovery Centre is to raise awareness and enthuse learners about the practical applications of science and technology. This is done in an informal but fun way through interactive exhibits where learners and educators are encouraged to discover for themselves by pulling, touching, pressing and observing science phenomena thereby becoming discoverers in the scientific process.

It is also anticipated that the learners will continue to take maths and sciences subjects at high school and enrol for science, engineering and technology (SET) at higher education institutions. This in the final analysis will lead to increased human resource base in SET and improved national economic growth and level of international competitiveness.

#### Rationale of the Discovery Centre

The Discovery Centre (DC) is a mobile science centre which unlike conventional science centres not only has it no physical building to house the exhibits but takes the scientific experience to the people. The concept of science centers is a fairly new in South Africa. It has developed over the past few decades (Sarah Howie:1999). With the realisation of the importance of science and technology to the economic development of a country coupled with the low uptake of learners in maths and physical science, the Discovery Centre contributes to encouraging learners to develop interest in these subjects so as to be able to pursue their studies in science engineering and technology (SET).

The concept of interactive science and technology exhibits came about as a result of individuals who wanted to make a contribution to the education of learners who for historical reasons were deprived of opportunities or lacked access to facilities like science laboratories.

The experience of science centres in Europe and America, i.e the Smithsonian Institute, Sudbury Science Museum in, Canada, San Fransisco Exploratorium (famous for its S&T design cookbooks), Questacon, Australia etc led these individuals from diverse backgrounds to establish a mobile science centre that was called the Gateway Discovery Centre Trust which operates as the Discovery Centre.

By now there was overwhelming realisation of the role science and technology play in economic development especially where international competitiveness is concerned. Various reports (i.e. World Competitiveness report, Third International Mathematics and Sciences Study (TIMSS), the then Foundation for Research Develoment's S&T Indicators) over the years belied the fact that South Africa lacked adequately trained science engineering and technology personnel. This was regarded as a shortcoming to the South African science system. A developing country like South Africa that strives to compete on an equal basis with developed countries like, Germany, Britain, Japan, Canada , Nordic countries and America. In an effort to address this the Department of Science and Technology has released a National Strategy on Research and Development which inter alia, looks at the inadequate renewal of the science and technology wiorkforce as well as fragmented governance structures.(DST, 2002:15)

Figure 1

#### World Competitiveness Ratings

Country	2002	2001	2000	1999	1998
USA	1	1	1	1	1
Finland	2	3	4	5	6
Netherlands	4	5	3	4	4
Singapore	5	2	2	2	2
Switzerland	7	10	7	7	9
Germany	15	12	11	12	15
UK	16	19	16	19	13
France	22	25	22	23	22
Malaysia	26	29	27	28	19
Japan	30	26	24	24	20

South Africa	39	42	43	43	42
India	42	41	39	42	38
Argentina	49	43	41	33	30

Source: IMD worlds competitiveness ([www.imd.ch/wyr](http://www.imd.ch/wyr))

It was also realised that for South Africa to be economically successful she needed to invest heavily in the education system especially in maths and physical science in schools.

Integrating the DiscoveryMobile in the school curriculum

### §The Natural Sciences Learning Area

In a recent document, the Natural Sciences Learning Area had been defined as studying "the general principles that attempt to explain how and why something happens or happened with the learners engaging in some of the same practices that scientists did in arriving at these principles, but at levels within their capabilities."(WCED, 2001:)

It goes further saying that the purpose of the learning area is to ensure that all learners:

- § become scientifically literate by the end of Grade 9
- § acquire certain scientific skills, attitudes and values that they will use in all walks of life
- § understand the full implications of scientific activity on humanity

The content of the learning area had been organized around three strands.  
These are:

- v learning science
- v doing science
- v science and society

We aim to address these very principles set out in this document by providing both educators and learners the opportunity to venture beyond the textbook and classroom experience.

We offer a practical, hands-on approach to stimulate and enhance the theories learnt in the classroom. Travelling to schools (both primary and secondary) with inter-active exhibitions underlying the scientific process attains this.

By actively engaging learners in the scientific process of observation, interpretation and verification of information, a positive attitude towards science is instilled. The presentation of scientific knowledge occurs in a relaxed, "fun" environment where the learner discovers the "cause and effect" of certain actions. An assessment process to evaluate the impact this have on the learning process follows this fun experience. Learners are presented with a short test to determine how much of what they had been presented with had positively impacted on them.

Educators are also presented with a questionnaire. Information such as years of teaching experience, years of study in Natural Sciences, highest grade taught, etc. is gathered and stored on a data base. Feedback by way of comments and recommendations from educators is incorporated in ongoing asseement of the impact of teh projetc.

The Discovery Centre continuously interacts with other NCEO's through the PSST (Partners in Support of Science Maths and Technology) programme to ensure that the dire need of educators for support in the teaching of this vital Learning Area is addressed. The Disocvery Centre also serve on the Learning Area Committee of teh provincial department of education so as to keep

abreast of the latest developments in the Learning Area. Some of the developments get communicated to the educators.

#### THE DISCOVERY MOBILE AS AN OBE TOOL

Since the inception of curriculum 2005 we had been exposed to numerous and varied outcomes. Some of these were plainly unattainable and this largely because they were so vague. There had been heated debate and great differences of opinion surrounding most of them. Educators had been demoralized and threatened by them to such an extent that they made little or no attempt to attain them.

As a result the natural sciences outcomes have now been revised to the following three.

the learner is able to demonstrate an understanding of scientific principles, laws and concepts

- the learner is able to carry out scientific activities and to apply scientific principles, laws and concepts

- the learner is able to demonstrate an understanding of the relationship between science and society, and the impact of science on society

The immediate question would be: "To what extent does the Discovery Mobile lend itself to the realizing of these outcomes?"

If we look at the theme Matter and Materials for instance, the Mobile addresses all concepts such as magnetism, phases of water, conduction, density of liquids, etc. [Outcome 1]

In Earth and Beyond, space travel, orbits of satellites, gravitational force, impact on technology (foreign materials brought from space), cellular communication, etc. are addressed. [Outcome 3 largely]

In Life and Living issues such as water conservation, the ozone layer, soil erosion, crop farming, impact of industry on the environment, etc. are addressed. [Outcomes 1 and 3]

In Energy and Change we cover solar energy, wind turbines as an alternative source of generating electricity, hydro electrical power and the conventional ways of generating electricity. [Outcome 2 largely]

While the Discovery Mobile (DM) addresses these themes successfully, the DMO also lends itself perfectly to cross-curricular application as it can be incorporated in the other learning areas with ease.

Examples of these would be for instance:

Language and Literacy: A comprehension exercise can be easily be constructed from the narrative, new terminology and foreign (new) vocabulary, write an essay to describe the visit by the Mobile to the school, write a report on the impact industry has on the environment, etc.

Arts and Culture: Make a sketch of the exhibit you like most. Explain how the San obtained water in the desert. How do different "primitive" tribes view the sun and the moon?

Life Orientation: This could entail a description of practical applications of scientific principles and concepts in the world of work and in every day life, for instance within the home or school environment.

## THE WORKINGS OF THE DISCOVERY MOBILE

### .. Making contact:

We set out to serve a cluster of schools in an area. Using the demarcation of the WCED, these schools are identified. We are currently awaiting the new demarcation pertaining to the newly established EDMC's (Education Development and Management Centres).

As soon as schools had been identified, a six-page facsimile is sent to them. This serves as an introduction from our side, background on the work we are engaged in, and advice on how to maximize our visit and further logistics pertaining to planning.

After this, it is the school's prerogative to take us up on our offer to visit them free of charge. Should they prove themselves to be desirous, we set up a pre-visit for the educators. Most often this is the first time some of them see the Mobile.

### .. The Pre-visit

During the pre-visit the educators are exposed to the Mobile. They spend approximately half an hour in the Mobile familiarizing themselves with the modules (inter-actives) as shown in Figure 3. The aim is for them to identify those inter-actives they can best apply to their curriculum and to devise a strategy on how to implement it on the days of the actual visit (learners aboard). Once this had been attained, they are assisted in developing worksheets for their learners.

The outside of the Mobile is then presented to educators in the form of a narrative by the facilitator. The narrative covers the four natural sources of energy. These are wind, lightning, solar energy and hydro electrical energy.

The graphics and window exhibits as illustrated in Figure 2 enhance the narrative. Technology can also be easily incorporated via the window exhibits. Great detail is given during this presentation and educators are expected to present a similar lesson to their learners on the days of the actual visit. A worksheet with possible lesson plans is handed to the educators to support and guide them in this exercise.

Logistics, such as the time table for the actual visit, where the Mobile will be parked, who is the contact person, what happens on a rainy day, etc. are discussed with the contact person to ensure smooth operation.

### .. The Actual visit

The Discovery Mobile normally arrives at a school before 08h30. The first lesson normally starts about nine o'clock and lasts for about an hour. Big classes are divided into two groups, one inside and the other around the outside with the educator. After half an hour the groups rotate, thus exposing learners to the hands-on and narrative in one hour. The lessons learnt during the narrative are emphasized by the hands-on experience inside the Mobile. This results in initial exposure and immediate consolidation. To further enhance the experience, a worksheet and a short test are handed out which need to be completed by the learners.

### Science Centres and education

Science centres like the Discovery centre have a critical role to play in communication public understanding and awareness of science. They serve a role as places where informal learning takes place in a non-threatening but fun way. Whilst at the same time they serve as a critical educational resource in demonstrating basic (at times advanced) scientific and technological principles and concepts. The latter role becomes more relevant where there are inadequate

resources like science laboratories and adequately trained science educators. Policy makers should begin to realize the immense contribution science centres are playing and how they could be leveraged in an effort of not only raising scientific literacy and technological fluency amongst non-traditional science and technology audiences. The science centres could be mainstreamed into the national education system to play a legitimising role to science and technology educators.

Science Centres are a fairly recent phenomenon in South Africa. How they are able to integrate the curriculum as part of the school visits as well as the dearth of their evaluation are some of the fundamental shortcomings of many a science centre. The problem under investigation relates to how science centres are playing a vital educational role in raising awareness and increased uptake by learners in continued study of maths and science. A number of students study maths and science at high school but few succeed in these subjects. The impact of informal science lessons on learner attitudes towards science and technology still needs to be further investigated.

Funding and evaluation are some of the pressing challenges facing the science centre movement in South Africa. In a Department of Arts, Culture, Science and Technology commissioned report conducted by the Human Sciences Research Council, Sarah Howie concludes: "In general none of the S&T Cens [Science and Technology Centres] appear to have been externally evaluated. In two of the sites visited (Telkom Exploratorium and the Gateway Discovery Centre in the Western Cape), there was an attempt to get some feedback from the visitors to their sites, but on the whole little was done to evaluate S&T Cens" (Howie, 1999:72).

That there has been no evaluation of the more than twenty science centres in the country is indicative of two issues, (a) that many of the science centres most of which do not receive any government funding are on a survival mode and cannot be expected to set aside funds for conducting evaluation let alone external evaluation of their projects, (b) the currency of research evaluation is fairly new in South Africa especially amongst non governmental organisations.

Footnotes: this section is adapted from the paper by Mvalo, M.G. and Africa, F. presented at the Saastec Conference in 2001

References: Department of Science and Technology, 2002, South Africa's National and Development Strategy, Pretoria, South Africa

Howie, S, 1999, Science and technology centres in South Africa, HSRC, Pretoria

Mvalo, M.G. and Africa, F., 2001, Integrating a Mobile Science Centre into the School Curriculum, paper presented at the Southern African Association of Science and technology Centres held in Malelane, Mpumalanga Province, South Africa, 31 October-2 November 2001

Stark, M, 1999 report for the year ending September 1999, Discovery Centre, Cape Town

Stark, M, 2000, The Discovery Mobile: Two years on, A survey conducted by the Discovery Centre, Cape Town

Western Cape Education Department, 2001, Natural Sciences, Resources for Educators, Grade 9, WCED, Cape Town