NELSON MANDELA UNIVERSITY

July—December 2017

Faculty of Science
News

Govan Mbeki Mathematics Development Centre
empowering young minds

Govan Mbeki Maths Development Centre

Editorial - Centre Upgrade

The application of the Govan Mbeki Mathematics Development Unit (GMMDU) to be upgraded to an Engagement Centre at the Nelson Mandela University was approved in 2017. This was in recognition of the contributions the entity has made to strategic aspects of the scholarship of engagement at this institution since its formation in 2008.

The GMMDC (as it is now called) has a broad engagement mandate through teaching and learning, community service and outreach, professional/discipline-based development, project based research and scholarship in education.

Successful focus areas of the entity include, amongst others, the generation of innovative offline educational platforms and digital teaching and learning (T&L) resources to improve the quality of teaching and learning of mathematics and physical sciences in secondary schools and TVET colleges. The scale of engagement activities of the GMMDC that are linked to professional development of educators and learner incubation for access and success at Higher Education has grown rapidly over the past few years. Currently the GMMDC supports more than 300 in-services educators via structured professional network programmes each year. More than 1000 selected learners with potential from more than eighty schools participate in structured Tablet-assisted incubation programmes on Saturdays each year and similar off-line Tablet-assisted support platforms are in place at schools across the Eastern Cape to support thousands of other learners. The engagement goals and activities of the GMMDC fall squarely within the scope of the Vision 20-20 goals of the Nelson Mandala University and is supported by a network of national and provincial stakeholder organizations including the DBE and the private sector. The GMMDC is 100% self-funded and attracts 3rd-stream project funding of over R10 million per annum.

Success! Among the top achievements are the most improved Maths learner in the ISP from 40% - 80% and most improved Physical Science learner in the ISP from 18% - 60%

***TAPS participants**, Chloe and Courtney Koeberg matriculated from St Thomas High School in 2017. They achieved 11 subject distinctions between them, each averaging 84% . Both are registered at Nelson Mandela University for BCom Accounting and hope to follow careers as Chartered Accountants.*

*Siyamthanda Kalawe, who matriculated from Richard Varha High School in King Williams Town in 2017, scored Level 7s in all her subjects. Here she is seen with two other high performing students from the **OMEFP**, Mihlali Blekiwe and Solomzi Gladile and GMMDC's Arnold Gwaze.*

STEAM activities become part of development agenda

The GeoGebra Conference in June 2017 represents a turning point of sorts for the Govan Mbeki Maths Development Centre (GMMDC).

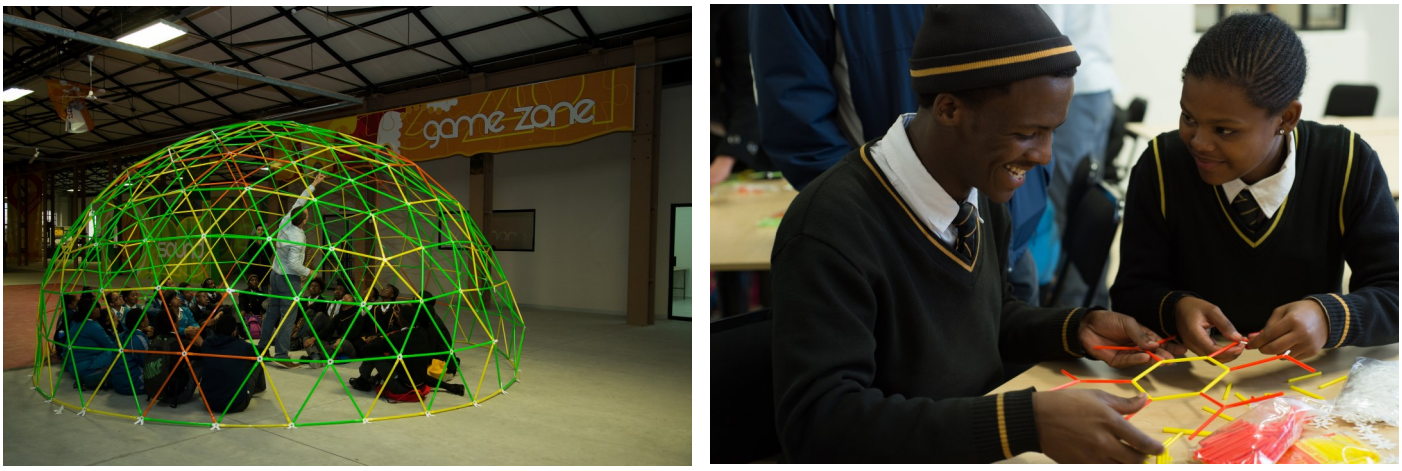
Dr. Kristóf Fenyvesi, from the University of Jyväskylä, Finland, conducted an Experience Workshop with the GMMDC, linking Mathematics and the Arts in the construction of a Geodesic Dome using materials from the 4Dframe educational modelling kit. These Experience Workshops are part of the larger STEAM (Science, Technology, Engineering, Arts and Mathematics) movement that wants to promote more inquiry-based, cooperative and experience-orientated learning and critical thinking.

The hope is to move learners away from shallow, rote and formulaic learning that stumbles at the first hurdle, towards a much deeper, more active and attentive, engagement with learning experiences that build inquiring mindsets, develop problem-solving, embrace collaboration with peers, and thoughtful risk taking.

The GMMDC has resolved to begin incorporating the principles of STEAM in its engagement with educators and learners. The first small steps were taken at the GeoGebra Conference, involving learners from various Uitenhage schools to first build a larger geodesic dome, and then translating that experience into building models of C60 buckyballs (Westminster fullerenes) and nanotubes – relating these shapes which they learn about in the Physical Sciences curriculum, to everyday life in terms of soccer balls and basketball nets. A further small step was taken when the GMMDC met in Bedford with educators collaborating in its ISP (Incubator School Programme) there.

The Physical Sciences educators were tasked with exploring the structure various substance through building 3-d models thereof. These included graphene (a 1-dimensional layer of carbon atoms linked in a hexagonal structure), diamond (a 3-dimensional structure wherein each carbon atom is linked to 4 others), and other more complex structures. Educators (and learners consequently too) would only have known of these structures in theory (via textbook diagrams). Converting that theoretical knowledge into a 3-dimensional model proved quite challenging and rewarding for some.

With the new ISP programme for 2018, the intent is to engage in some STEAM activities with the learners.



Dr Kristóf Fenyvesi with learners who took part in the construction of a geodesic dome (left) and smaller models of C60 buckyballs (right), at the NMB Science and Technology Centre in Uitenhage

Spring Schools for ISP Centres

The GMMDC held successful Spring Schools at five ISP centres (Mthatha, Queenstown, King Williams Town, Bedford/Somerset East and Port Elizabeth) in the Eastern Cape during the 2017 October school holidays.

A total of 250 Grade 12 ISP learners attended the 4-day Spring School Sessions which were sponsored by the Capitec Foundation, Old Mutual Foundation, Telkom Foundation and the Cookhouse Windfarm Trust.

The programme focused on the final examination preparation for Mathematics and Physical Sciences for Grade 12. Each daily session comprised of 3 hours of Mathematics and 3 hours of Physical Sciences support which were facilitated and presented by experienced and dedicated Mathematics and Physical Sciences Educators.

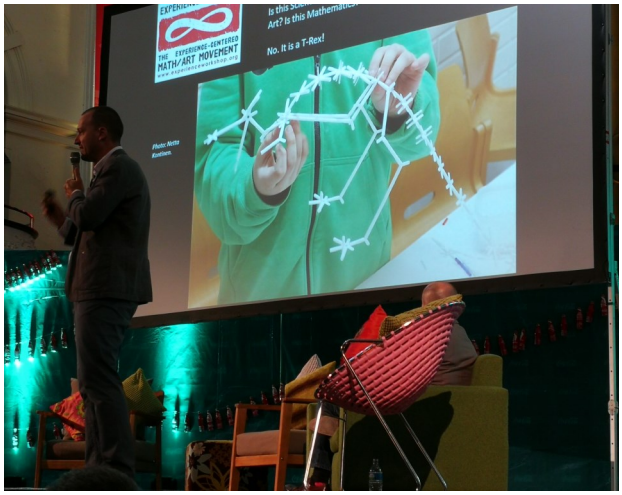
Learners were provided with specially prepared Examination Preparation support materials to further supplement the support material available on their TouchTutor® tablets. The learners also wrote mock examination question papers during these sessions and feedback on their performance in these papers were provided to the learners.

OPEN Design Cape Town Festival

In the words of the Open Design Cape Town Festival organiser, “Design is the unifying thread that links innovation, education and community as the building blocks of a sustainable, inclusive, prosperous society.”

The Festival brought these concepts together in a 12-day programme of inspiration, discussion and discovery in the form of seminars, displays and interactive workshops in Cape Town’s City Hall in August 2017.

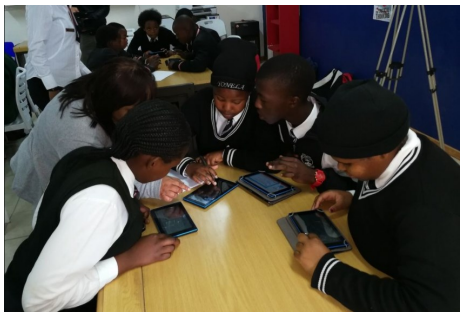
Prof Werner Olivier and Dr Philip Collett from the GMMDC gave presentations on innovative design aspects of the TouchTutor packages developed by the GMMDC. They also participated in an International STEAM Symposium entitled Building a new Future! which included a panel discussion to explore and respond to questions on priorities and strategies in promoting design thinking and creativity across the curriculum.



STEAM activities and the Bridges Maths, Science, Art and Design Festival presentation

High-tech Financial Literacy Support via Tablets in Queenstown

SETTING a budget, monitoring cash flow and learning how to grow your money are all valuable life skills. Although they do not form a core part of classroom curricula, a lot can be gained by using aspects of the financial mathematics component of the CAPS school syllabus to engage practical aspects of managing personal budgeting and finance. To plug the gap, Capitec Foundation in partnership with the GMMDC, has recently implemented a financial literacy support project for Grade 10 &11 learners in the Queenstown. Teachers from project schools also participated in this 2-day event which took place at Get Ahead College during the September school holiday period. The purpose of this intervention was to educate learners about the importance of mathematics as part of basic personal financial management skills. The learners were already part of a Capitec-sponsored Maths and Science Saturday Incubator School Programme in Queenstown. All the learners who were in the ISP programme already had tablets pre-installed with the TouchTutor® package. To support the financial literacy project an interactive financial literacy programme, developed by Capitec, was also added to these tablets. The learners worked in teams, putting together a budget for their own businesses, with prizes awarded to the most financially-savvy group. Learners loved the project activities which were facilitated by experts from CAPITEC. They also expressed appreciation for the important life skills that they gained through this project. The GMMDC plans to extend this pilot project to more development nodes in 2018.



Financial Literacy activities: tablet-based assistance with personal budgeting

GMMDC in the News

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Science, maths project brings results

Herald Reporter

IMPROVEMENTS in the marks of pupils participating in a technology-linked maths and science programme, run at 18 under-resourced high schools in the Bhisho area over the past three years, have led to a R4-million, two-year extension of the project.

The June exam marks of participating Grade 11 and 12 pupils, compared to their December last year marks, showed that half the pupils had improved by 10%, while some 20% of Grade 11s and nearly 10% of Grade 12s had improved by as much as 30%.

The top-achieving Grade 11 pupil shot up by 80%, and the top Grade 12 pupil by 60%.

The Old Mutual Education Flagship Programme's (OMEFP's) maths and science development project, launched at the start of 2015, is geared towards 21st century pupils.

It uses an innovative teaching and learning model, packaged at TouchTutor, that was developed by the Govan Mbeki Mathematics Development Centre (GMMDC) at Nelson Mandela University.

"This project has afforded us the opportunity to test, refine and demonstrate the impact of a technology-blended model in a rural context," GMMDC head Professor Werner Olivier said.

He previously tested the model in an urban context, with similar improved results.

The project, which runs in close collaboration with the provincial Department of Basic Education, focuses on improving Grade 8 to 12 teachers' skills and Grade 10 to 12 pupils' achievements.

To do this, a laptop-based model for teachers – for use as a classroom resource – and a tablet- and desktop-based model for pupils for use after school hours as an offline tutor are used.

Offline and curriculum-aligned, TouchTutor makes use of video content lessons, animated PowerPoint lessons, open-source GeoGebra software, self-tests, language support and various other digital support material, to enhance understanding in maths and science.

The project took the form of a centralised Incubator School Programme, run on Saturdays for 120 pupils with potential from the 18 different project schools, as well as Tablet-assisted After-school Peer Support maths sessions for 200 pupils from 10 of the schools.

"We invest in education so as to effect societal change," Old Mutual senior project manager Kanyisa Diamond said.

The extension of the project, which has cost R6-million to date, was announced at the project's end-of-year certification function at the Steve Biko Centre in King William's Town.

"Over the next two years, we are hoping to boost the impact of the programme even more by adding science, technology, engineering, arts and mathematics activities as well as a mobile app for inter-school maths competition purposes and free maths curriculum support," Olivier said.

Linking maths and art

Teachers, pupils to experience subjects' connections

FROM the perfect symmetry of a snowflake to the intricate patterns on a puff adder's skin to spiral galaxies in space, nature is filled with mathematically precise patterns.

These patterns extend to the world of art, including colourful fashion designs, architecture, African and Islamic art, and much more.

There is a connection between maths and art. And while there is a global push for maths-, science- and technology-related education, there is a new shift that is including art in the mix.

STEAM education – the acronym for Science, Technology, Engineering, Art and Mathematics, and a variation on the better-known STEM – was introduced to South African teachers and pupils in July by Nelson Mandela University's Govan Mbeki Mathematics Development Centre (GMMDC), at its fourth annual GeoGebra Conference.

GMMDC is home to one of 187 global institutes for GeoGebra, which is free, open-source maths software used in millions of maths and science classrooms across the globe, to enable teachers and pupils to visualise and experiment with geometry, algebra, tables, graphing, calculus and statistics. However, this year's conference will also demonstrate the link between GeoGebra and art.

"STEAM education is a much more practical, relevant and career-linked way of teaching maths and science," GMMDC head Prof Werner Olivier said.

International guest speaker at the conference – which was attended by 70 teachers and TVET college lecturers from across the province – was Finnish STEAM researcher Kristof Fenyvesi, vice-president of the world's largest maths, art and education community, called the Bridges Organisation.

Fenyvesi also ran his international "Experience Workshop" at the Uitenhage Science Centre, giving 30 pupils from under-resourced schools a practical taste of how art and maths connect, as they built giant soccer balls and 3m-high by 5m wide igloo-like domes using GeoGebra to understand the structures.

"The Experience Workshop gave the pupils the opportunity to learn mathematics through art, and to do art through mathematics," Olivier said.

AT THE CORE: Prof Werner Olivier is head of Nelson Mandela University's Govan Mbeki Mathematics Development Centre, which is hosting the GeoGebra Conference

The same practical maths-art activities were included in the GeoGebra Conference, which took place at Nelson Mandela University, and was themed "Steaming ahead: Promoting creative cross-curricular collaboration with GeoGebra".

Olivier said: "A GeoGebra community has been established across the world by teachers, pupils and lecturers, as they continue to develop GeoGebra resources. There are about 800 000 GeoGebra apps and files which people can download for free to bring the maths and science curricula to life."

He said in addition to "popularising" the study of maths and science, GeoGebra had also built strong links with major organisations, such as Google, Microsoft Office and the Bridges Organisation. As part of a formal research project in collaboration with the International GeoGebra Institute (based in Cambridge, England) and several national role-players – including Get Ahead College in Queenstown, which is aiming to set up a STEAM centre – GMMDC is also working towards developing resources for the world's first master's degree in maths and art, which will be available at Johannes Kepler University in Linz, Austria.

The GeoGebra conference tied in with the GMMDC's hi-tech approach to maths and science. The Centre has developed a curriculum-aligned teaching and learning model for high school pupils and teachers, which is available on tablet, laptop or desktop computer,

> *While there is a global push for maths, science and technology-related education, there is a new shift that is including art in the mix*

and includes video lessons, animated PowerPoint presentations, self-tests and many other resources, including GeoGebra.

GMMDC uses the model to boost teachers' skills and help pupils improve their knowledge and performance in maths and science, through Saturday incubator schools and technology-assisted peer support (TAPS).

GMMDC will also introduce STEAM at the Open Design Festival this month.

Art of puzzling out maths connection

ON THE BALL: This team of Somerset East and Bedford maths teachers, from left, Ernest Boakye, Ayanda Nyatela, Gideon Williams, Nozekelo Nzuta, Neil Bennett and TB Kula were the first to complete their soccer ball sculpture

Workshop helps teachers, pupils master molecule sculpture software

Herald Reporter

ALTHOUGH maths and art seem worlds apart, they are more connected than you think.

Nature is full of mathematically precise patterns – just think of a snowflake or a zebra's pelt – while architecture and fashion rely on mathematics in their designs.

Members of the Department of Basic Education, along with principals, teachers and pupils from eight schools in the Somerset East and Bedford area, experienced the maths-art connection first-hand during a workshop run by Nelson Mandela University's Govan Mbeki Mathematics Development Centre.

The workshop showed participants how to use open-sourced maths software called GeoGebra to develop sculptures of giant molecules, soccer balls and igloo-like domes.

"The workshop gave the 40 participants the opportunity to learn mathematics through art and do art through mathematics," Dr Phil Collett, project leader at GMMDC, which hosts one of GeoGebra's 187 global institutes, said.

"GeoGebra is already used in maths and science classrooms across the world to help teachers and pupils visualise and experiment with geometry, algebra, tables and so on.

"Linking GeoGebra with art adds a very practical, real-world dimension."

The workshop tied neatly into the new global shift towards STEAM education, the acronym for Science, Technology, Engineering, Art and Mathematics, and a variation on the better-known STEM education.

The workshop was run to prepare participants for next year, when hundreds of pupils in the area (who are attending GMMDC's mathematics and science incubation programme) will be exposed to STEAM activities, using a technology-linked teaching and learning approach, which includes the use of GeoGebra, to boost their knowledge and progress in maths and science.

The pupils were selected from four schools in Somerset East and four in and around Bedford to attend the incubation programme, which is sponsored in that area by the Cookhouse Wind Farm Trust Initiative, a 20-year project geared towards building up critical skills for the job market in the region.

The Department of Basic Education's Nomtembeko Tom (second from left) and maths teachers (from left) MC Gobane, Zingiswa Somson and Thobeka Makana use open-sourced maths software called GeoGebra to build a soccer ball sculpture. PHOTOS: SUPPLIED

Art + maths = connections for teachers and learners

REPORTER

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Hi-tech approach getting results

Herald Reporter

Maths, science marks soar

PUPILS from 10 under-resourced schools in Nelson Mandela Bay are celebrating improved results in maths and science, thanks to a technology-linked maths and science support programme, run by the Telkom Foundation in partnership with Nelson Mandela University.

The top-performing school in this year's Integrated Maths and Science Development Programme was Khwezi Lomso Comprehensive School, while the top pupils were St Thomas High Grade 12 twins Courtney and Chloe Koeberg (who attained 87% and 83%, respectively), and Cillie High Grade 11 pupil Valerie van Vuuren (83%).

Their results in the curriculum-aligned programme were well above the national average for maths and science in this country, which last year were 51.1% and 62%, respectively.

The three-year R3-million project, which started last year, is sponsored by the Telkom Foundation – Telkom's Corporate Social Investment (CSI) arm – and run in partnership with Nelson Mandela University's Govan Mbeki Mathematics Development Centre (GMMDC).

The 10 participating schools include Cillie, Douglas Mbopa, Gelvandale, Khwezi Lomso, Ndyebo, Ndzondelelo, St Thomas and Woolhope in Port Elizabeth, and Solomon Mahlangu and Uitenhage High in Uitenhage.

"The Telkom Foundation is focussed on basic education to enable the youth to participate in the economy through the ICT sector," Telkom Foundation senior manager: Corporate Social Investment Nathi Kunene said.

"Through partnerships such as this one, which help to adequately prepare pupils in maths and science to access careers in ICT, the Foundation is able to deliver on its mandate."

The innovative project has three legs, including Tablet-assisted After-school Peer Support (TAPS) run at all 10 schools for 110 selected Grade 11 and 12 pupils; an Incubator School Programme (ISP) run on Saturdays for 64 Grade 11 and 12 pupils from the Telkom Foundation schools and additional pupils from 20 other schools in the Bay; as well as laptop-based skills training via a Professional Learning Network (PLN) programme for 20 teachers at the 10 schools.

Each of the 10 schools have also received a resource centre, with sponsored desktop computers.

At the project's core is GMMDC's pioneering technology-linked teaching and learning model, which is available on tablet and desktop computers for the TAPS and ISP pupils, and laptops for teachers. The curriculum-aligned maths and science support package is called the Integrated TouchTutorR Support Programme (ITSP).

It was developed by GMMDC head Professor Werner Olivier, who chose a hi-tech approach to get pupils and teachers excited about maths and science, and to overcome some of the challenges facing many South African classrooms.

"Our aim is to nurture learners who show potential, and enable them to access higher education – and succeed at their studies. At the same time, we are helping teachers to deliver the mathematics and science curricula more effectively," Olivier said.

TouchTutorR includes video lessons, animated PowerPoint presentations, digital interactive mathematics software such as GeoGebra, self-assessment and feedback, interactive language support (in six indigenous languages), past matric papers with memorandums and more – to give academically-talented pupils a chance to improve their results.

It is aimed at schools where there are many challenges, such as a lack of resources, large numbers of pupils in the classroom, a lack of staff capacity or teachers themselves who struggle with core areas of the curriculum.