

# News

Faculty of Science

## Govan Mbeki Maths Development Centre

### 2019 — A year in Review

**EDITORIAL:** It might be unusual to bring out a newsletter containing information that might be as much as two years old, but the last year has not been a usual one. As a result of the COVID-19 lockdown the work of the Govan Mbeki Mathematics Development Centre (GMMDC) was, firstly, shocked into paralysis and then severely disrupted before we adapted. During most of 2020 it was necessary to focus on a complete re-calibration of the way that the Centre did business, which meant that a lot of the work went on undercover, and there was simply no time to reflect or record the work done in 2019.

Human beings are notoriously adaptable, and life – even under restriction – is returning to a semblance of normality, and so there is now time to look back at the Year Before COVID and record the achievements of that year.

The reason why it might be necessary to create a record of 2019, is because the work that we did in 2019 laid the groundwork for our breakthroughs in 2020. During that tumultuous year, we were called upon – almost catastrophically – to adapt our programmes and projects for conditions of lockdown, quarantine and isolation. We found, to our delight, that our programmes were ideally suited for small adaptations that could turn education on its head and create a landscape for a new way of teaching that could overcome our South African problems of resource-poor schools and poverty-stricken scholars.

In this newsletter, we summarise our achievements and breakthroughs in 2019, in preparation for a report on our adaptations and re-calibration in 2020. We hope you enjoy our trip back in time – to our far-off pre-COVID days!

Hundreds of learners and teachers at under-resourced schools again benefitted

**GMMDC**  
Govan Mbeki Mathematics Development Centre  
*empowering young minds*



Prof Werner Olivier

**DIRECTOR'S MESSAGE:**

The engagement activities of the GMMDC in 2019 were again successful and well received by stakeholders in education. The customised technology-assisted models and programmes were expanded to promote and improve the quality of mathematics and physical sciences teaching and learning in schools. This included new functionalities that were added to our educational apps and agreements with partners in education to expand the centre's national and international footprints.

Hundreds of learners and teachers at under-resourced schools again benefitted from donations used to sponsor projects that were implemented in different provinces.

The centre also made great strides this year to integrate STEAM education activities and its MathArt project has gained strong traction as a national project in schools.

A successful commercialization of the innovative new Gamma teaching device was also concluded with the company GammaTech in 2019. This bears testimony to the potential of the centre's techno-blended approach to address some key challenges in STEM education in a sustainable way. The staff of the GMMDC are proud of their work and centre's achievements in 2019 and look forward to contributing more in the coming years.

The work that we did in 2019 laid the groundwork for our breakthroughs in 2020.



The GMMDC Staff



**MATHEMATICAL ARTISTS:** (back, from left) Paarl Gymnasium's Hano Nieuwoudt, Redhill High's (Johannesburg) Kiara Knopfmacher and Luke Ferreira, Diocesan School for Girls' (Grahamstown) Erin Powers, Framesby High's (Port Elizabeth) Kara van Heerden, Eden College's (Durban) Dorina Cherneva, Sibangani Matsa from the University of Johannesburg's Metropolitan Academy, Beaconsbur High's (East London) Morgan Durrheim and (front, from left) Fish Hoek High's Caitlin Wilde, Sir Pierre van Ryneveld High's (Johannesburg) Busisiwe Mbonani and Eunice Girls' High's (Bloemfontein) Lauren Damstra.

## Annual Math-Art Competition Goes National

2019 Theme: "Maths in Nature" or "Maths in Manmade Designs"

In 2019, for the first time, the annual GMMDC Math-Art competition went national. It had run for the previous three years as a provincial school's competition. The aim of the Math-Art competition is to illustrate the links between maths and creativity, by inviting young people to depict mathematical concepts in visual form. High school pupils could enter artworks in two categories "Maths in Nature" or "Maths in Manmade Designs".

The winners in the competition drew their inspiration from the repeated mathematical patterns evident in ancient Khoi and San cave paintings and traditional Zulu beadwork, as well as the mathematical make-up of well-known manmade landmarks, and even the mathematical mysteries of outer space. Others looked for the maths-art connection in majestic animals, including rhinos and cheetahs. "We were thrilled at the high calibre of the 600 entries we received, although it was a tremendous battle to choose the 12 overall winners," said GMMDC competition coordinator Carine Steyn. All the winners received cash vouchers and book prizes – and Eunice High School in Bloemfontein was recognized for submitting the most entries.

The maths-art link is part of a new global trend called STEAM (Science, Technology, Engineering, Art and Mathematics), which GMMDC is promoting in South African classrooms. The competition also supports the Centre's technology-linked approach to promote the teaching and learning of maths and physical science in high schools across the country.

"We wanted learners to discover the links between maths and art, as this will form a major part of future careers in the Fourth Industrial Revolution," said Steyn.

Let's take a closer look at some of the winners and their Masterpieces...

# Category: Maths in Nature



Left: First in the “Maths in Nature” (Grade 10 to 12) category was **Lauren Damstra** from Eunice Girls High School in Bloemfontein, whose artwork “Infinity” used the vastness of outer space to represent “the terror of things we don’t know”.

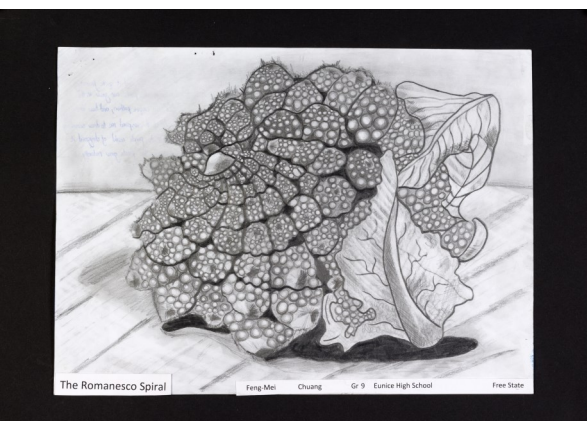
“I chose this topic because it’s something I often think about. The uncertainty of science and maths beyond space deeply unsettles me, but the best we can do is keep progressing and finding new patterns to make what was once scary, normal,” said Lauren.



Placed second was **Kara van Heerden** (left) from Framesby High in Port Elizabeth, with her artwork “The functions of a zebra”, with **Dorina Cherneva** (right) from Eden College in Durban coming third, with her artwork “Tranquility”.



The Grade 8 to 9 winners in the same category were **Luke Ferreira** (left) from Redhill High in Johannesburg, for his exploration of mathematical patterns in cave art, in his artwork “Pale Face”. Placed second and third respectively were Eunice Girls’ High’s **Feng-Mei Chuang** (below left) for “Romanesco Spiral”, and **Erin Powers** (below right) from the Diocesan School for Girls in Grahamstown for “Patterns of the Golden Ratio”.



# Category: Maths in Manmade Designs

Right: First in the Grade 10 to 12 “Maths in Manmade Designs” category was Morgan Durrheim from Beaconshurst High in East London, whose artwork “Hidden Mathematics” showed “many examples of applying mathematics for our own benefit”. Her mixed-media artwork showed famous ancient and modern landmarks, from the Pyramids of Giza to Disneyland’s famous castle.



In second place was Sibangani Matsa (left) from the University of Johannesburg’s Metropolitan Academy, who chose to draw attention to the pending extinction of rhinos through poaching, in his pencil sketch of a rhino constructed out of metal, titled “Same Difference”.

Third place went to Busisiwe Mbonani (right) from Sir Pierre van Ryneveld High (Johannesburg) with her Ndebele-inspired artwork “Ithuthumbo”.



The top three winners in the Grade 8 to 9 “Maths in Manmade Designs” category were Caitlin Wilde (right) from Fish Hoek High School in Cape Town, for her “Heritage Mandala” depicting traditional Zulu patterns, followed by Kiara Knopfmacher (below left) from Redhill High In Johannesburg for the ballet-inspired “Geometrics of Dancing” and Hano Nieuwoudt (below right), from Paarl Gymnasium with “Ngesivinni”, showing the links between the speed of a cheetah and the fighter aircraft jet named after it.



# Incubator Support Programme Success

## Creating brighter futures throughout the Eastern Cape and beyond

During 2019 the GMMDC Incubator Support Programme (ISP) went from strength to strength. Most importantly, it provided lessons for successful adaptation when the education focus shifted to home schooling during the 2020 pandemic.

The Incubator Support Programme comprises an intensive 17-week course, run on Saturdays at a central venue, for selected learners. Trained facilitators provide lessons, tutorials, weekly tests and exam revision, all linked with an offline interactive app called TouchTutor® which is pre-installed onto tablets. Touch Tutor® includes narrated video lessons, Power Point presentations, memos and self-tests, supported by graphics, glossaries, a multi-language dictionary and a built-in calculator. Learners each receive a tablet for use during the course of the academic year.



**Above:** The Nelson Mandela Bay ISP Learner Cohort, along with student teachers and Facilitators at the ETC Conference Centre

“Over the past five years, the ISP has helped thousands of promising Eastern Cape learners improve their marks, and gain access to tertiary education,” said GMMDC director, Prof Werner Olivier.

“We’ve seen a trend of successes over the past five years. Around 50% of all those in our programmes go to university. We’ve had some going into medicine and actuarial sciences. Many go into engineering and the sciences.”

The Centre’s goal going forward would be to scale up across South Africa – and in 2019 they concluded strategic partnerships with the Department of Basic Education in different provinces. They also established maths and science development initiatives with various universities, and with key NGOs focusing on similar outreach programmes.

“Our model has the potential to address some of the challenges for skills development in this country ... As an offline support system, TouchTutor® would also articulate well with the government’s approach to provide web-based digital resources,” said Olivier.

TouchTutor® also includes elements of STEAM education, where Art is added to the traditional Science, Technology, Engineering and Maths (STEM) model, preparing pupils for the creative solutions they will need to make in future careers in the rapidly-evolving Fourth Industrial Revolution.

Neptal Khoza, head of Capitec’s Corporate Social Investment - Capitec Foundation, who provided the donation to make this initiative possible, in 2019, said: “Capitec Foundation has adopted a teacher development approach as part of our strategy. It was therefore fitting that we infuse this into the ISP programme, in partnership with the GMMDC. The aim is to support future teachers with much-needed teaching experience and access to 21 century teaching, whilst assisting high school learners with extra tutorials to help them perform better in maths.”

He said the ISP programme helped learners to “learn for understanding and not just to memorise”.

“The TouchTutor® platform enables learners to access content remotely and enables learners to learn at their own pace.”

**Alongside:** A 4th year Nelson Mandela University Student assisting a small group of learners at an afternoon tutorial session to gain experience.

Back row (from left): **Neptal Khoza** (Head: Corporate Social Investment), **Nkosiphendule Lugongolo** (a Student Teacher Tutor) and **Pauline Mgidlana** (Capitec, Marketing and Communications).

Front : Grade 10 ISP Learners from Khwezi Lomso Comprehensive School.



# 2019 ISP — Word Cloud of Open Responses from the Learner Survey



## Some of the 2019 ISP milestones:

- Of the 330 Grade 12 participating learners, 70 improved their marks by more than 10%.
- 80% of the participants achieved bachelor passes.
- One learner had been failing maths two years earlier, but passed maths after the course with 80%.
- The top-achieving learner got 100% for Mathematics.

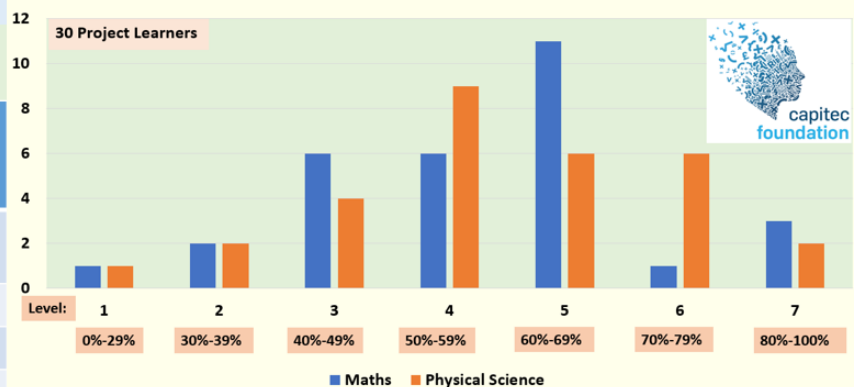
**Maths:** Group Average=58%; Highest mark = 92%

**Science:** Group Average=59%; Highest mark =86%

### Top five improvements in Maths and Science

Maths	Science
19%	30%
17%	23%
16%	20%
15%	18%
14%	16%

Mthatha ISP - Final Gr 11 Maths and Physical Science Results 2019



### Most Improved Grade 11 Learner 2019

Chumu Madiloyi, Ngangelizwe SS (Maths 37%-56%)  
Zolule Filane, Attwell Madala SS (Science 50%-80%)

Average Final Mark of Gr 11 ISP Group	2018	2019	% of Group who have improved	% Learners Improved >5% pts	% Learners Improved >10% pts	Most Improved Learner Gr 11 2018-2019
Maths	54%	58%	70%	53%	37%	Improved by 19%
Science	54%	59%	70%	53%	40%	Improved by 30%

# Cultivating Relationships with Kutlwanong

## Partnerships with Purpose

One of the breakthroughs of 2018 was consolidated in 2019 when the GMMDC entered into a Memorandum of Understanding with the Kutlwanong Centre for Maths, Science and Technology, a national education NGO. Kutlwanong offers annual structured mathematics and science incubation to more than 5 000 learners from under-resourced schools across the country. As part of the collaboration in the STEM education space in 2019, Kutlwanong purchased 300 Gamma devices and the accompanying software to be used by their facilitators in their centres. GMMDC staff held successful training sessions with their Kutlwanong partners in November 2019 at centres in East London, Cape Town and Durban.



Above: Photos from the various training sessions that took place across the country

## GMMDC in the NEWS

The image is a screenshot of a news article from Mail & Guardian, dated 8 Aug 2019. The article is titled 'Programme multiplies pupils' success' and is written by Nicky Willemsse. The main image in the article shows a young girl in a school uniform sitting at a desk, using a laptop. The article text discusses the success of the NCS Mathematics and Physical Science Video series, which has helped many pupils improve their grades. The article also mentions the partnership between GMMDC and Kutlwanong, and the impact of the Gamma devices on the programme. The URL <https://mg.co.za/article/2019-08-08-00-programme-multiplies-pupils-success/> is provided at the bottom of the screenshot.

Above: Mail & Guardian, 8 August 2019: <https://mg.co.za/article/2019-08-08-00-programme-multiplies-pupils-success/>

art for the future

WINNING PIECES



**TOP ENTRIES:** The first-placed artworks in the 'maths in nature' category included 'Pale Face' (grade 8 and 9 category) by Luke Ferreira from Redhill High in Johannesburg, and 'Infinity' (grade 10 to 12 category) by Lauren Damstra from Eunice Girls' High in Bloemfontein. In the 'maths in manmade designs' category, the artworks placed first were 'Heritage Mandela' (grade 8 and 9 category) by Fish Hoek High's Callin Wilde, and 'Hidden Mathematics' (grade 10 to 12 category) by Morgan Durheim from Beaconhurst High in East London.

# High standard for work in maths-art exhibition

High school pupils from across SA won accolades for depicting the links between maths and art in unique and vibrant artworks in the first nationally run mathematical art competition, held in May.

The top 40 entries in the competition, run by Nelson Mandela University's Govan Mbeki Mathematics Development Centre (GMMDC), were exhibited in July at the annual conference of the Bridges Organisation, a leading organisation globally which promotes research and interest in the connections between mathematics and art.

The Bridges Organisation is also spearheading a new global shift in education called STEAM, the acronym standing for Science, Technology, Engineering, Art and Mathematics, which GMMDC is promoting in SA classrooms.

"We were thrilled at the high calibre of the 600 entries we received, although it was a tremendous battle to choose the 12 overall winners," said GMMDC competition coordinator Carine Sleya.

The top-placed winners in the competition drew their inspiration from the repeated mathematical patterns evident in ancient Khoe and San cave paintings and traditional Zulu beadwork, the mathematical make-up of well-known manmade landmarks, and even the mathematical mysteries of outer space. Others looked for the maths-art connection in majestic animals,



**ARTISTIC PUPILS:** Winners in the national mathematical art competition, back, from left, Paarl Gymnasium's Hans Nieuwenhuis, Redhill High in Johannesburg's Klara Knopfmacher and Luke Ferreira, Ditsaan School for Girls in Makhandla's Erin Powers, Framesby High in Port Elizabeth's Kara van Heerden, Eden College in Durban's Dorina Cherneva, Sibangani Matsa from the University of Johannesburg's Metropolitan Academy, Beaconhurst High in East London's Morgan Durheim and, front, from left, Fish Hoek High's Callin Wilde, Sir Pierre van Ryneveld High in Johannesburg's Busistwe Mbonani and Eunice Girls' High in Bloemfontein's Lauren Damstra. Inset: Kara van Heerden of Framesby High's 'The functions of a zebra'.

including rhinos and cheetahs.

The competition was open to all high school pupils, who could enter artworks in two categories: 'maths in nature' or 'maths in manmade designs'. They were adjudicated not only on artistic merit, but on how they represented the links between mathematics and the arts.

All the winners received cash vouchers and book prizes, and Eunice High School in Bloemfontein was recognized for submitting the most entries.

"The competition project adds an innovative educational layer to our centre's technology-blended approach to the teaching and learning

of maths and science," said GMMDC director Prof Werner Olivier.

"It aims to develop creative young minds and also build awareness around the skills challenges they will face in their future careers in the Fourth Industrial Revolution."

## Maths Centre's artworks displayed at Austrian exhibit

Mathematical patterns found in nature provided the inspiration for three unique artworks – created by staff at Nelson Mandela University's Govan Mbeki Mathematics Development Centre (GMMDC) – that were selected for an international exhibition.

The pieces were showcased in Linz, Austria, from July 16 to 20, at the annual conference of the leading global Bridges Organisation, which promotes research and interest in the connections between mathematics and art.

The conference brought together artists, mathematicians, scientists, computer scientists and educators to explore and develop the maths-art connections in their own work.

"Finding the links between maths and art is becoming a central

paradigm in education.

"It aligns with the Fourth Industrial Revolution, which is shaping the world today," said GMMDC director prof Werner Olivier, who created one of the selected pieces with his colleagues Flora Olivier and Arnold Gwaite. Their piece – which uses Shweshwe fabric, cowrie shells and seed-beads to create a fractal pattern (a never-ending pattern) of the African continent in an ancient Roman-Greek mosaic style – was "inspired by the desire to create an original African statement about the historic connections between mathematics and art".

Flora Olivier created the second artwork, which depicts the shape of a fish, constructed using only a ruler and compass.

"It was fun finding creative ways



to deal with the limited degrees of freedom afforded by the two basic construction tools," she said.

The third piece, created by another GMMDC staff member, Victoria Shezi, is a collage of natural

**NUMBER ART:** These three maths-inspired artworks created by staff at Nelson Mandela University's Govan Mbeki Mathematics Development Centre, seated, from left, prof Werner Olivier, Flora Olivier, Arnold Gwaite and, back, Victoria Shezi, were showcased at a mathematical art exhibition in Austria in July.

and manmade objects, arranged in the shape of Africa. Titled Perfection under threat, the piece depicts the beauty, history and resilience of the continent, as well as the destruction of its natural environment.

The Bridges Organisation is spearheading 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. GMMDC is working with the department of basic education and schools across the Eastern Cape, to promote STEAM in South African classrooms.

Each year, GMMDC runs its own math-art competition, open to school pupils across the country.

More than 600 entries were received for the 2019 competition, which closed in May.

"Nelson Mandela University's Faculty of Education remains steadfast in its commitment to making a difference in the communities it serves, using education as a weapon to change the world. Visit <http://education.mandela.ac.za>"

Above: The Herald, 31 July 2019





Twee leerlinge van die Hoërskool D.F. Malherbe in Port Elizabeth, Bjorn Futter (links) en Simoné Gous, kyk na verlede jaar se inskrywings vir die Nelson Mandela-Universiteit se wiskunde-konkopiesie wat vanjaar landwyd aangebied word. Foto: VERSKAF

## Wen met wiskunde en kuns

Die wonder van wiskundige lyne in die ontwerp van objekte omkring ons elke dag. Of 'n minis nou in 'n besige straat tussen wolkekrabbers dwaal of in die veld die skoonheid van 'n enkele blommetjie besonder, wiskundige presisie in lyne, boeke en ontwerp is oral om ons sigbaar.

Om leerlinge aan te moedig om wiskunde in die wêreld om hulle raak te sien, bied die Gou van Mbeki-sentrum vir Wiskunde-ontwikkeling (GMMDC) tans die tweede jaarlikse Wiskunde-Konkopiesie by die Nelson Mandela-Universiteit aan. Om deel te neem moet leerlinge teen 3 Mei 'n kunstewerk, wat deur wiskunde geïnspireer is, inskryf.

Die kompetisie het sy oorsprong in die Oos-Kaap en is verlede jaar vir die eerste keer gehou. Die betrokkenheid van verskeie organisasies het dit moontlik gemaak om dit vanjaar landwyd aan te bied.

Volgens GMMDC se koördineerder van die kompetisie, Carine Steyn, was die kompetisie verlede jaar 'n groot sukses.

"Verlede jaar was die reaksie in die Oos-Kaap so positief dat ons besluit het om die kompetisie na al die ander provinsies uit te brei," sê Steyn.

Leerlinge van graad 8 tot 12 kan tussen twee kategorieë kies. Die een is wiskunde in mensgemaakte ontwerp en die ander is die natuur. Doelname kan enige visuele media, soos fotografie, tekens, skilders, collage of 'n vermening vir hulle inskrywings gebruik.

"In die mensgemaakte-kategorie soek ons na wiskunde in objekte wat mens ontwerp het. Hier kan leerlinge na wiskunde in kuns kyk in alledaagse objekte soos geboue, bruisvoertuie, simbole, versierings en baie meer," sê Steyn.

"In die natuur-kategorie moet die kunstewerke die verhouding tussen wiskunde en die natuur ondersoek, byvoorbeeld die wiskundige patrone in blomme, diere of berge."

Elke deelnemer moet 'n geskrewe verduideliking van die kunstewerk verskaf. Dit moet die skakel tussen die kunstewerk en wiskunde, die wiskundige konsep en die bronse vir die ontwerp omskryf. Kunstewerke moet tweedimensioneel wees en mag in grootte wissel van A4 tot A2 met 'n hoogte van nie meer as 2 cm nie.

Die GMMDC se doelwit met die wiskunde-konkopiesie is om wetenskap, tegnologie, ingenieurswese, kuns en wiskunde (STEM) se gewildheid in die klaskamer te bevorder.

Pryse wat op die spel is, sluit in tabelle en kunstklasse. Die beste inskrywings sal ook by openbare galerye uitgestal word. Die wensters sal op 17 Mei aangekondig word en die prysuitdeling volg op 26 Mei.

Vir meer inligting verlang, e-pos mathart@mandela.ac.za of kyk na "Math-Art Competition 2019" op YouTube.

# Saturday school bright sparks soar

BY HERALD REPORTER - 04 November 2019



Above: Die Burger, 2019

The top Grade 12 pupils in Port Elizabeth's Incubator School Programme are, front from left, first-placed Asisipho Ndinisa and her twin sister, third-placed Siphosethu, both from St Thomas Senior Secondary, and second-placed Stephanie Cronjé from Linkside High. With them are, back from left, head of corporate social investment at Capitec Foundation, Neptal Khoza, science facilitator Luzuko Jama and maths facilitator Ncedile Konzana

Image: Michael Sheehan

Above: The Herald, 4 November 2019:

<https://www.heraldive.co.za/news/2019-11-04-saturday-school-bright-sparks-soar/>

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GMMDC NMU



MobiTutorZA at GMMDC



GeoGebra STEAM at GMMDC



Math Art Competition at GMMDC