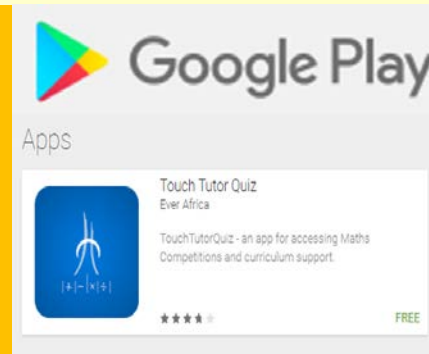




An Offline Techno-Blended Model for Enriching Mathematics Teaching and Learning in South African Schools

***by
WA Olivier
Nelson Mandela University***



**Govan Mbeki Mathematics
Development Centre**

 *empowering young minds*

NELSON MANDELA
UNIVERSITY

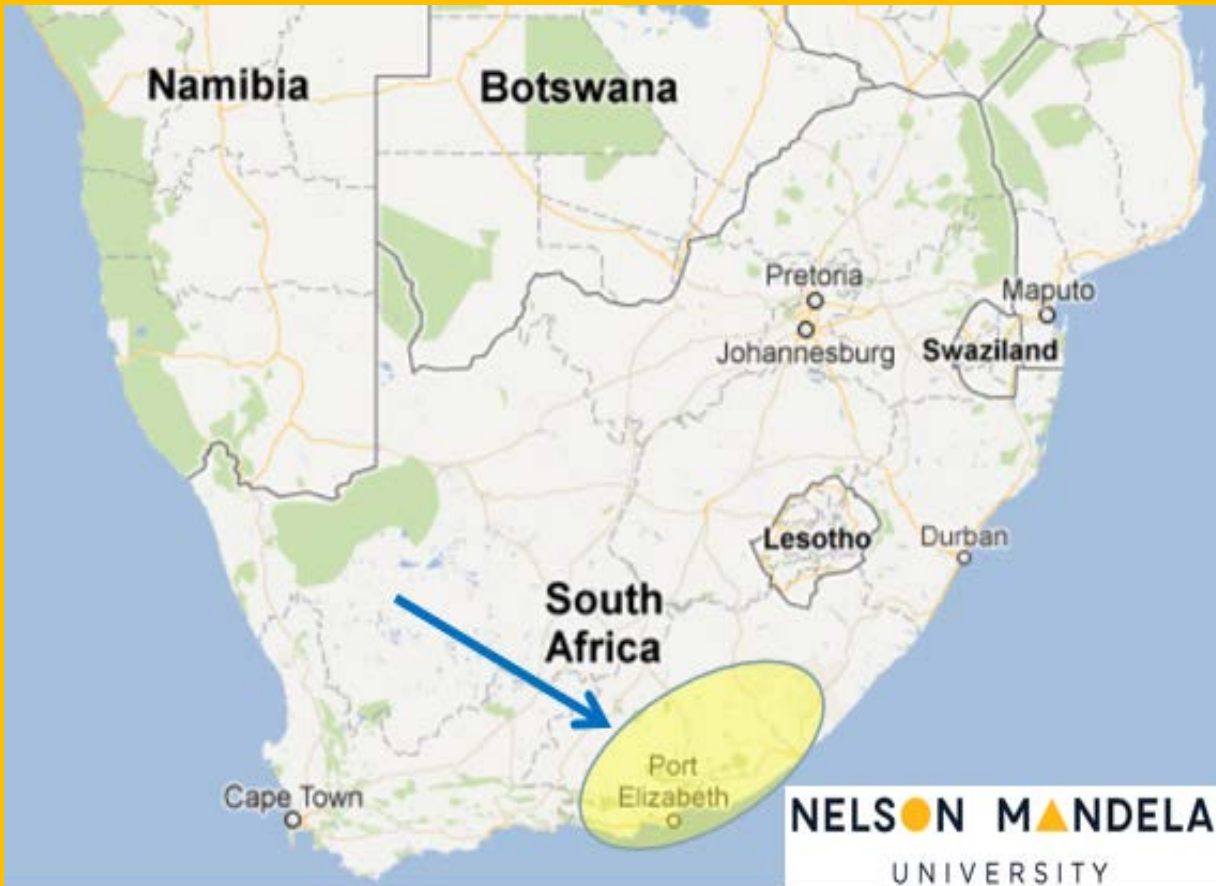
Change the World

mandela.ac.za

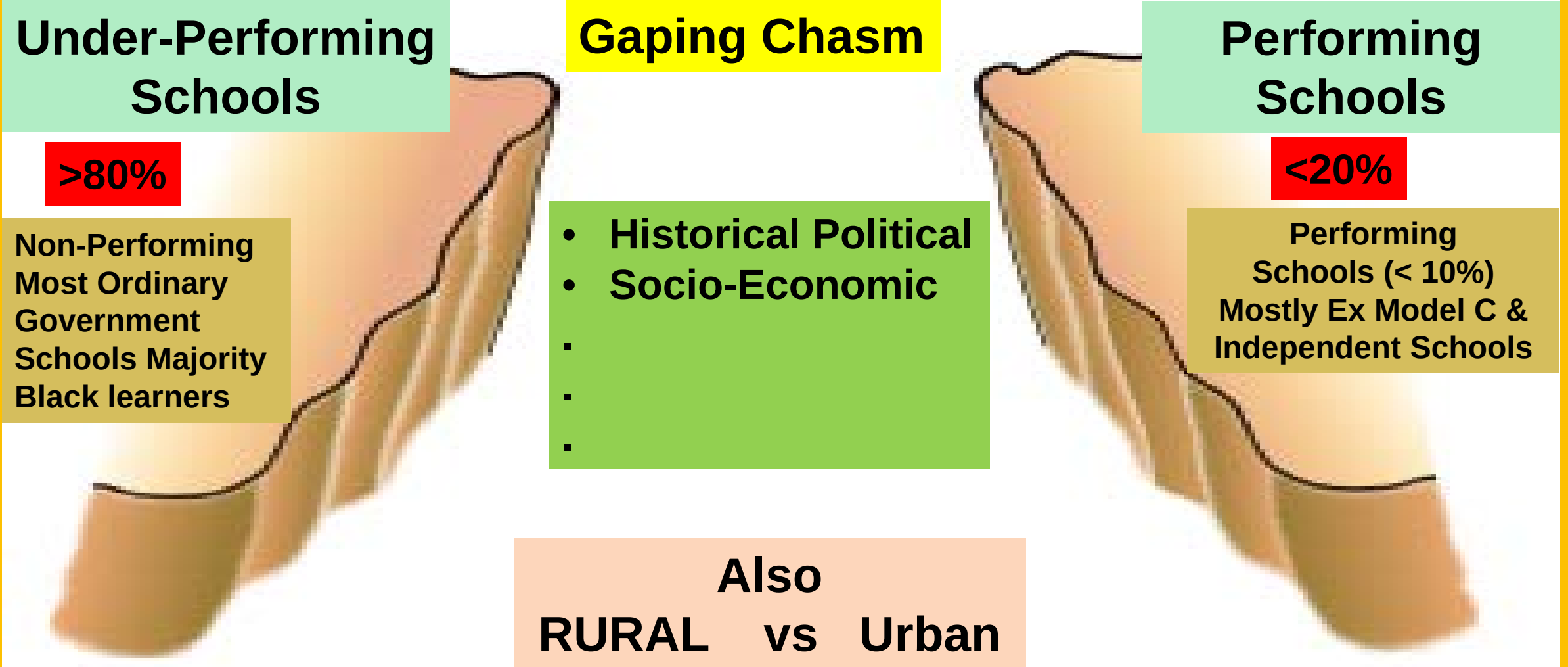
About our Centre, Our University and our City



Port Elizabeth, SA



Basic Education Scenario in SA



Basic Education – Challenges in SA Schools

- **Teacher Shortage:** South Africa cannot continue to rely solely on current systems to train more and better teachers CDE, 2011.

Teacher shortage crisis affects half SA's schools

JUN 18, 2012 | TEBOGO MONAMA EDUCATION REPORTER | 3 COMMENTS

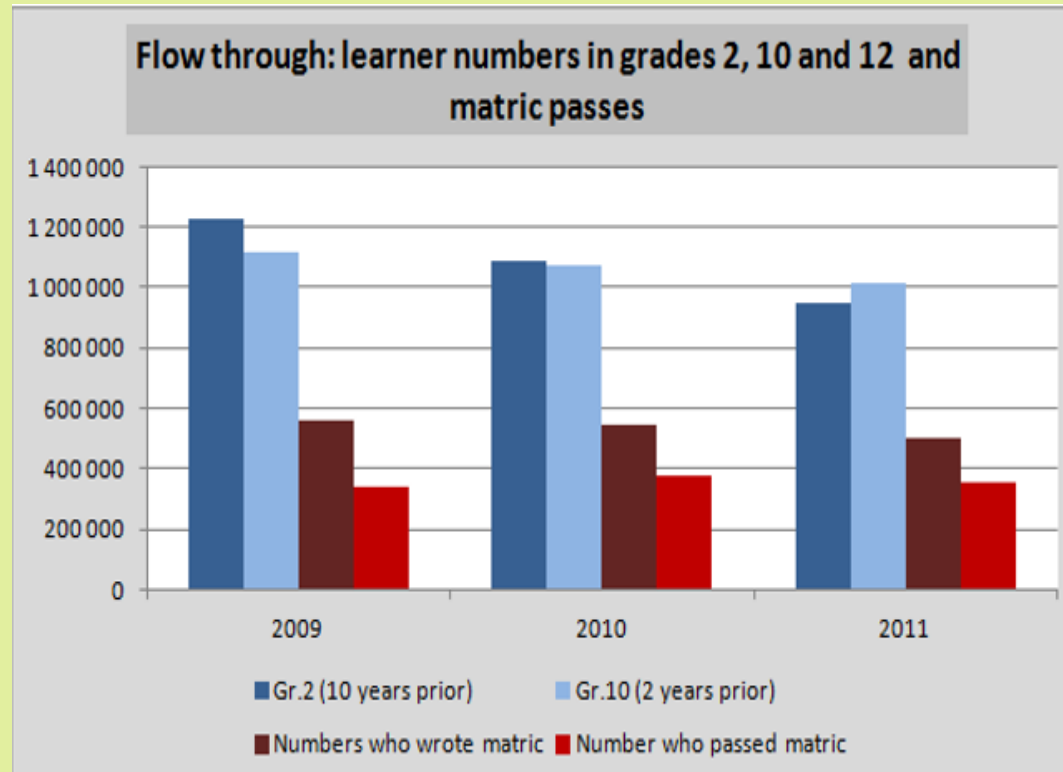
- **Teacher Qualifications:** 60% of mathematics teachers had completed a degree (vs 87% avg. internationally)
- **Teacher Practice:** Absence from classrooms in previously disadvantaged schools result in loss of 3 years of teaching time (out of 12 years) – *HSRC report*
- **School Infra-structure:** Thousands of schools in South Africa lack the infrastructure necessary to provide learners with the quality education which they are legally entitled to receive
- *Equal Education Campaign – 2013*
- **T&L Resources:** Each year thousands of learners are without textbooks and access to libraries etc.



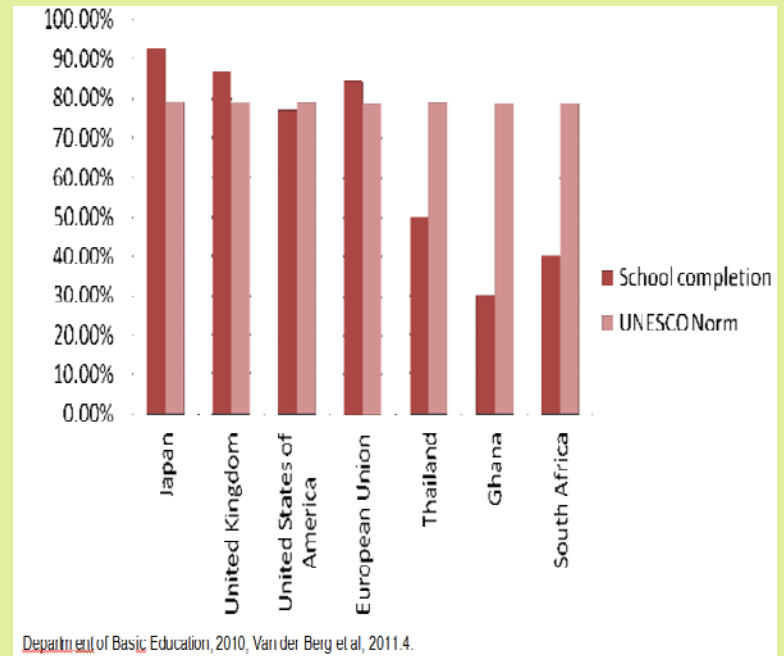
Basic Education – Challenges in SA Schools

School learner throughput:

Disappearance of about 50% of Learners from Year 1 – Year 12



<https://www.equaleducation.org.za/article/2015-01-07-on-the-2014-matric-results>



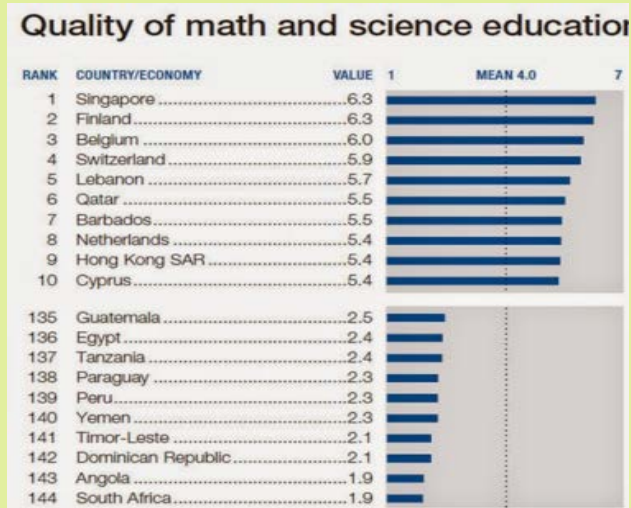
Regardless of the money spent, South Africa's primary education system was rated 126th out of 138 countries in the [World Economic Forum 2016–17 Global Competitiveness Report](#). While South Africa's higher education and training was ranked 134th.

Education in SA: A tale of two systems; Nic Spaull |31 August 2012

Mathematics Education – Challenges in SA Schools

Learner attainment:

- World Economic Forum Report 2014



In South Africa a pass mark in Mathematics is 30% and above....

- World Economic Forum Report 2016

A 2015/16 survey conducted by the [World Economic Forum \(WEF\)](#) showed that South Africa ranked 138 out of 140 countries in the quality of mathematics and science education.

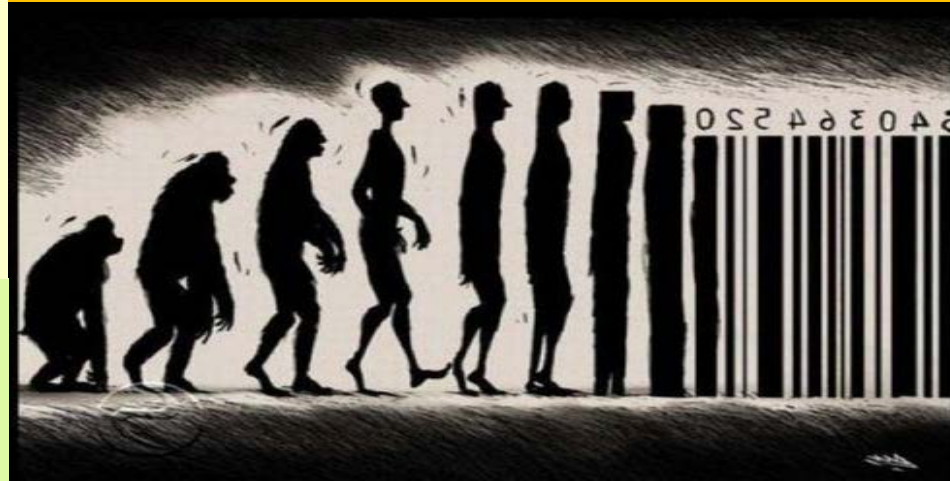
General lack of access to ICT to support T&L, in particular minimal infra-structure and skills to utilize software and digital materials in classrooms

Importance of using Technology in Modern Society

Learning Expectations of Millennials

- **Flexible Accessible**
- **User-Friendliness**
- **Challenges & Rewards**
- **Quick Feedback**
- **Collaboration/Sharing**
- **Stimulating and Meaningful**
- **Include Playful Discovery**

Towards Digital Citizenship



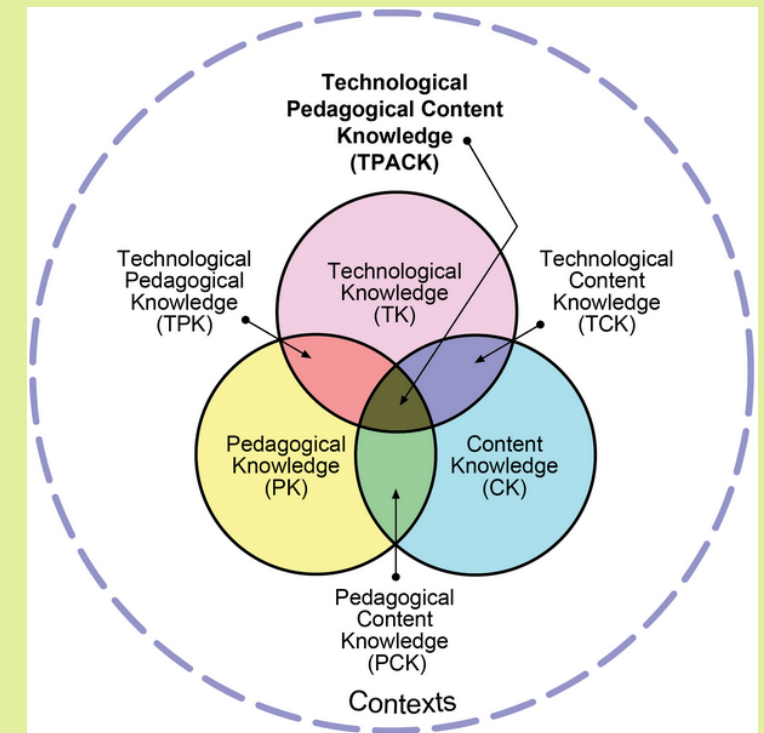
Mathematics

- **Problem Solving**
- **Modelling**
- **Design**



Integrated use of ICT for Teaching and Learning: Offline vs Online

- Blended Learning – web based combined with face-to-face (**1st -world**)
- Challenges in SA (under-resourced schools in **developing countries**):
 - Web Access & Bandwidth
 - Content Knowledge of Teachers
 - Curriculum alignment of material
 - Guidance to choose good material
 - Technological skills of teachers
 - Pedagogical skills of teachers
 - Academic profile of learners
 - Security at schools
 - School infra-structure and management



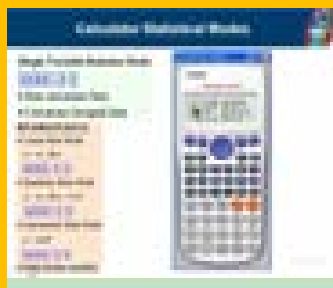
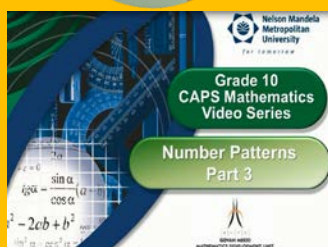
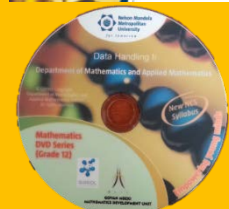
Koehler & Mishra - TPACK

21st Century Maths Education

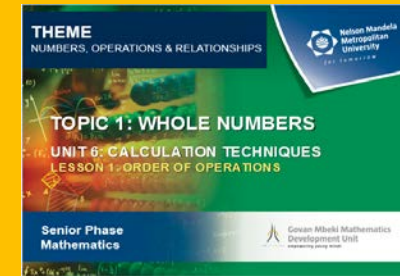
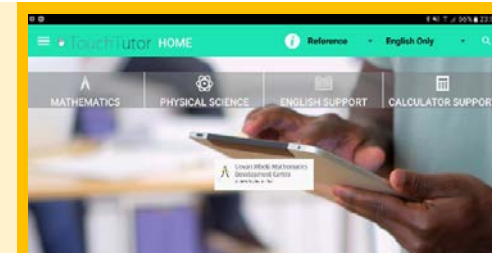
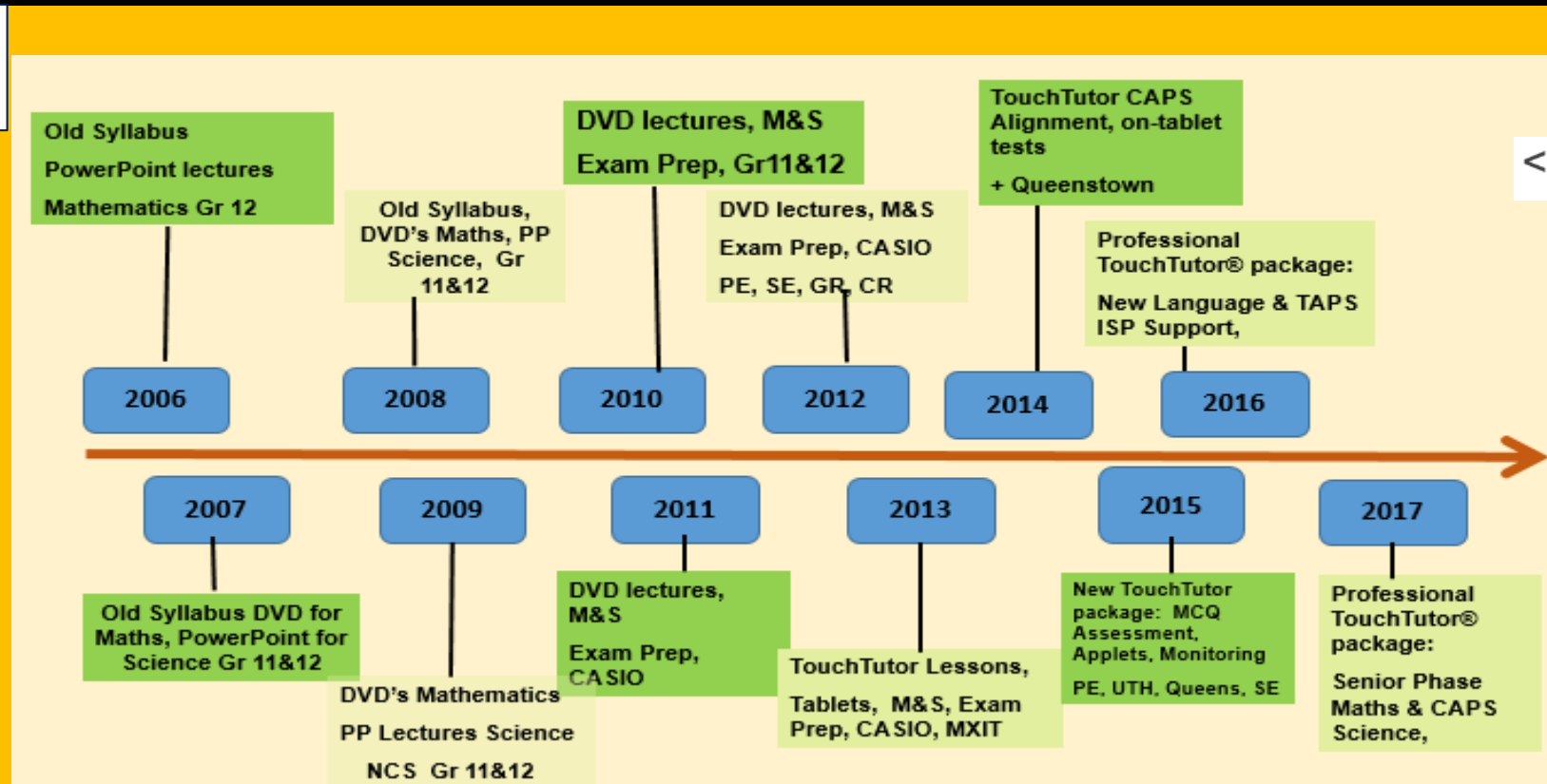
Educational Paradigms that defined a modern Offline Techno-Blended Model (TBM) for Teaching and Learning Maths in South African secondary schools

- **Integrated use of available ICT's** - 24/7 offline access to different technologies and curriculum-aligned digital resources
- **Learner centeredness** - Interactive material and facilitation of own-paced and peer-learning
- **Constructivist Learning Environments** - Visualization and Multiple representation for richer meaning and understanding
- **Independent ICT-assisted Scaffolding** - support for self-directed learning after school hours
- **Experiential Learning Opportunities** – exposure to cross-disciplinary applications of Mathematics and Career Paths

GMMDC: Historic Evolvment of ICT-assisted Offline Support Models and Resources for Schools



	is expanded by multiplying out brackets e.g. $(2x + 3)(x - 1) = 2x^2 + x - 3$	yequlor's phindwe ngokuphindwe okungakulula agqenisi, umis: $(2x + 3)(x - 1) = 2x^2 + x - 3$
expenditure	an amount spent	imali sasephensilempa
experiment	a statistical experiment is a repeatable activity or process for which each repetition gives rise to exactly one outcome	ukufundisa okwenziwa kwisibalo ngumsebenzi ukusetya ukuba uphinde uphindwe, ukuba oku kwenzeka kuba kunka isiphumo esinye cofanayo
explain	to give reasons why something happened	ukusika isizathu rala kutheni into ethe yenzeka
exponents	in the form 2^n , we refer to 5 as the exponent of the number; it means 2 must be multiplied by itself five times	isimo okuthatha isigaba kwenkqubo libonisa ukuba kufakwa isiphindo esikhulu kangaphi; kwezi 2, i-5 kelo nam lekhava ukuba i-2 kufakwa isiphindo kabini
exponential form notation	recording a number as a power, e.g. 2^5	ukubhala inani ngamandla achile, umis: 2^5



Innovative Design to Address Challenges in South African School Education



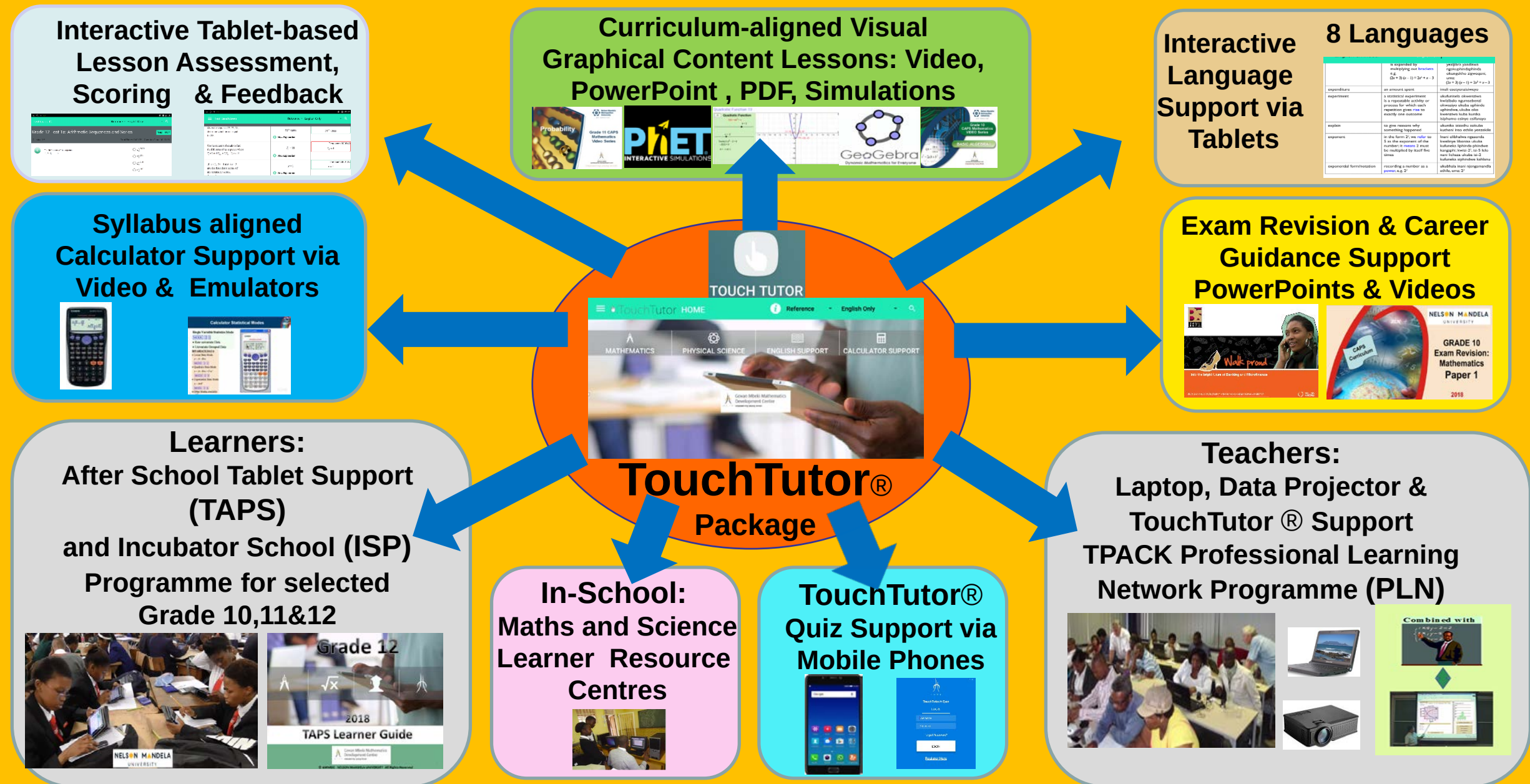
- Modern, Digital & Graphically Enhanced
- Complete School Curriculum Coverage – Year 8-12
- Flexible & User-Friendly 24/7 Online Access
- Content – Narrated Video Lessons & Demo's
- Self-assessment, Scoring & Solution Feedback
- Calculator Support Demos
- Exam Revision Guidance and Support
- Multiple Language Support

**Integrated Package on
Phones & Tablets**

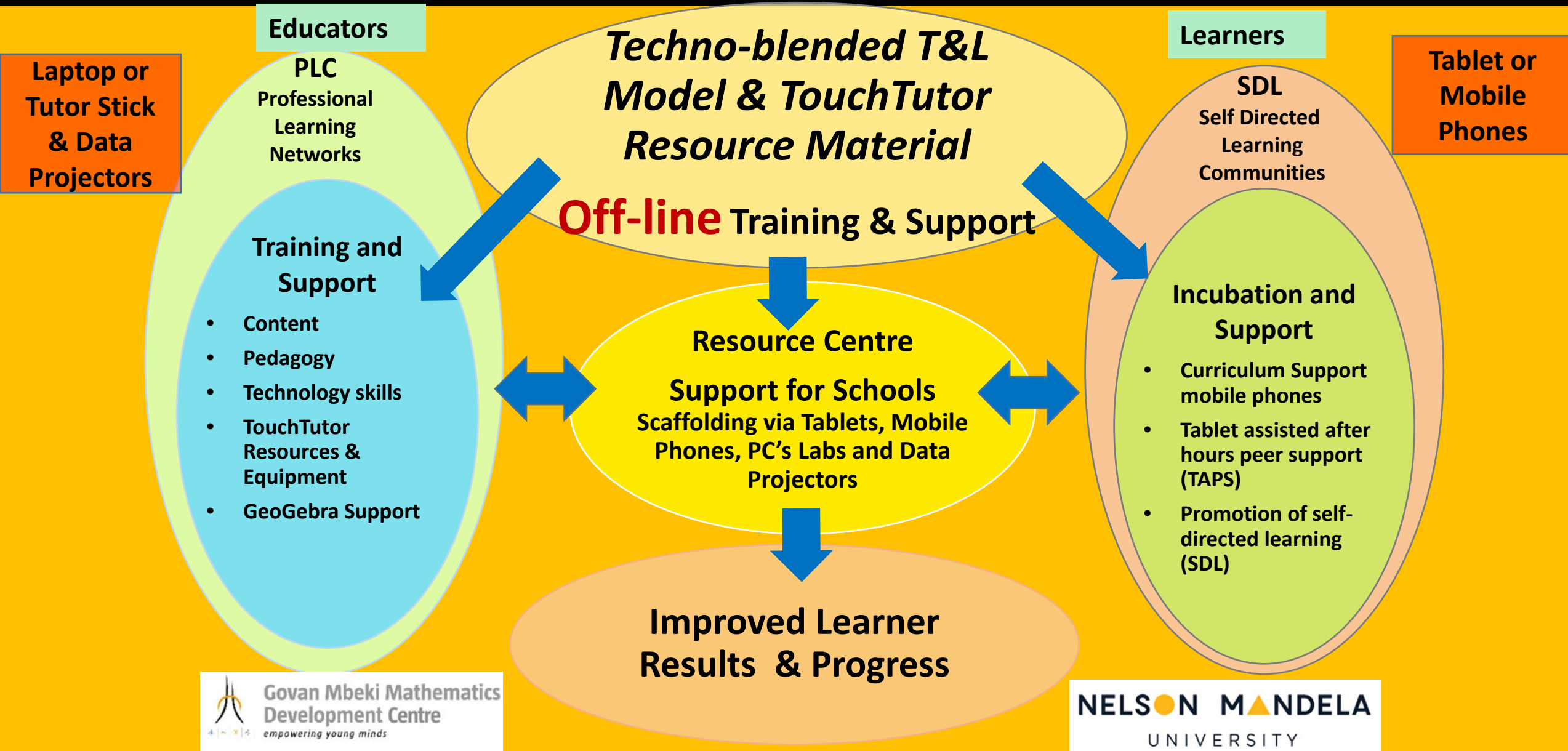
Interactive



Techno-Blended Maths T&L Support Model for Secondary Schools 2018



Techno-Blended Model: Theory of Action for Supporting Mathematics Teaching and Learning in Schools



Tablet –Assisted Peer Support & Incubation Model for Mathematics and Physical Sciences Learners with potential



 **TouchTutor®**



- Curriculum – aligned content support - CAPS Mathematics &



Promoting Self - Directed Learning

- Interactive Formative Assessment

- Curriculum Support via Mobile Phones





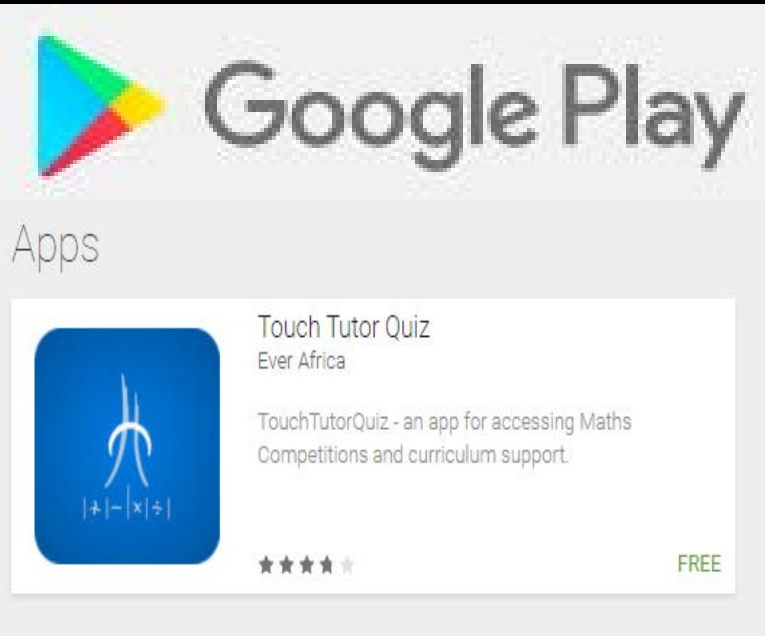
Offline Learning In Action



“... having an expert explaining the syllabus visually anywhere, anytime is just what I need.”

[illegible]

Support via Mobile Phones & School Competitions



Android Application

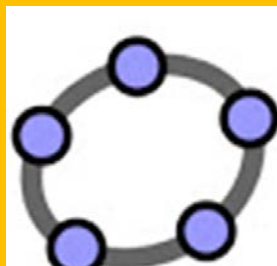
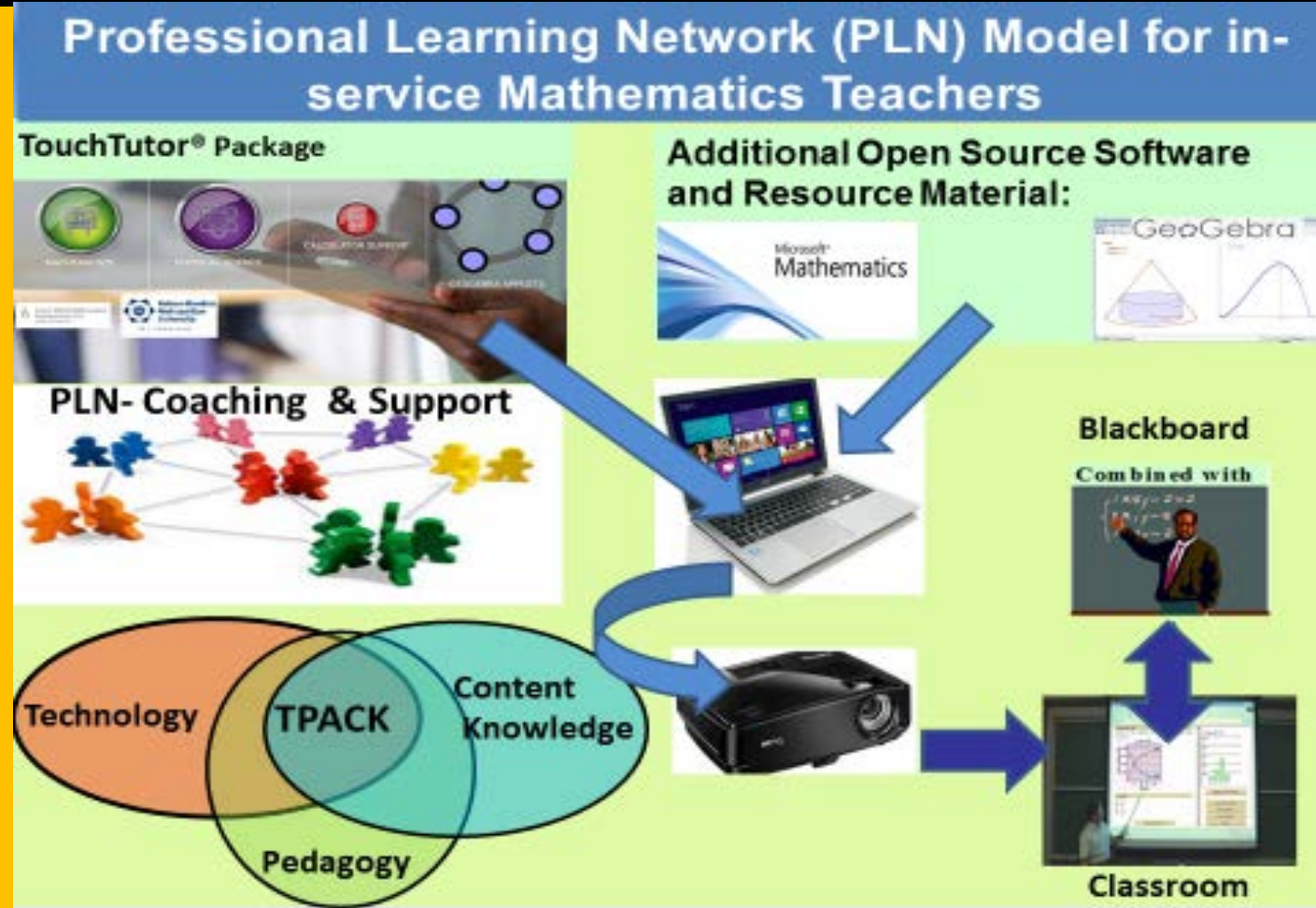
The image shows the login screen of the TouchTutor Quiz app. It has a blue background with a white logo at the top. Below the logo is the text 'TouchTutor® Quiz'. There is a 'LOGIN' link. Below that are two input fields: 'Username' and 'Password'. A 'Forgot Password?' link is also present. At the bottom is a large white 'LOGIN' button and a 'Register Here' link.

Online/Can be used Offline Mobile App **Free Maths Curriculum Support**

- ***Interactive Self-Tests, Scoring and Feedback***
- ***Content downloads***
- ***Multi-language Support***
- ***School Competitions***



Setting up Professional Learning Networks of Practicing In-Service Mathematics Teachers – SACE accredited series of SLP's



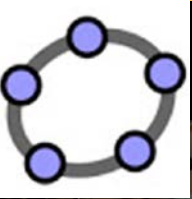
New: Innovative Presentation Architecture to Take TBM into Classrooms in Secondary Schools in SA



Android Mini PC (Tutor Stick) Presentation System via:

- Data Projector
- Any screen
- Any TV

- Creation of Rich Constructivist Learning Environment
- Logistical simplicity
- Easy Manageable Security
- Maximum flexibility – movement within and between classrooms



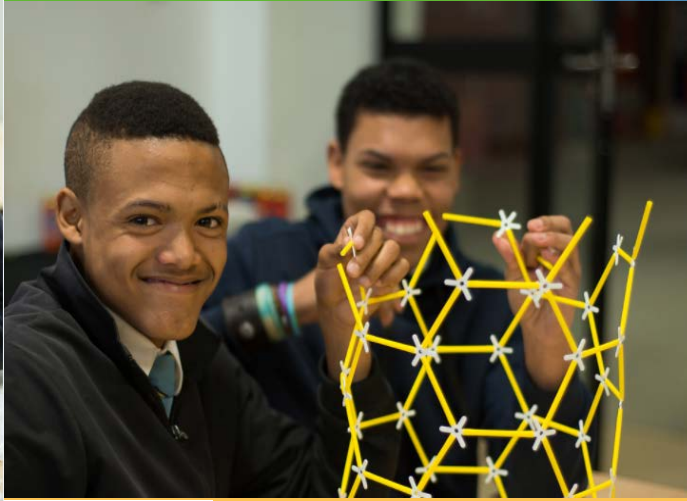
Integrating GeoGebra and STEAM Education



THEME

STE(A)Ming Ahead

Promoting creative cross-curricular collaboration
with GeoGebra



What is STEAM Education?????

What does STEAM mean for mathematics development projects in SA?

*STEAM represents a paradigm shift from traditional teacher centred learning, to a modern learner-centered approach which does not only focuses on results, but also aim to enrich learning processes of pupils through exposure to cross-disciplinary real life applications of mathematics, integrated use of ICT and **practical experiential learning** opportunities*



The Benefits of Experiential Learning

- **Connection with the “Real World”**
- **Opportunities for Creativity**
- **Opportunities for Reflection**
- **Mistakes Become Valuable**
- **Accelerated Learning**
- **Improved Attitudes toward Learning**
- **Guides Learners toward Further Studies and Careers**
- **Prepares Learners for problem solving in Real Life**

Scope GMMDC Maths Development Projects in 2018

- 80 Secondary Schools
- 1400 TAPS Learners with Tablets
- 150 In-service Mathematics educators
- 6 Districts of the Eastern Cape Province
- Grades 10, 11 & 12 Learners
- Learners - TouchTutor® Packages & Tablets, Phones
- Educators - TouchTutor® Packages & Laptops, Data Projectors, GeoGebra & STEAM Support



- Port Elizabeth
- Somerset East
- Bedford
- Queenstown
- Mthatha
- King Williamstown
- East London

TBM: Successes, Lessons and Challenges

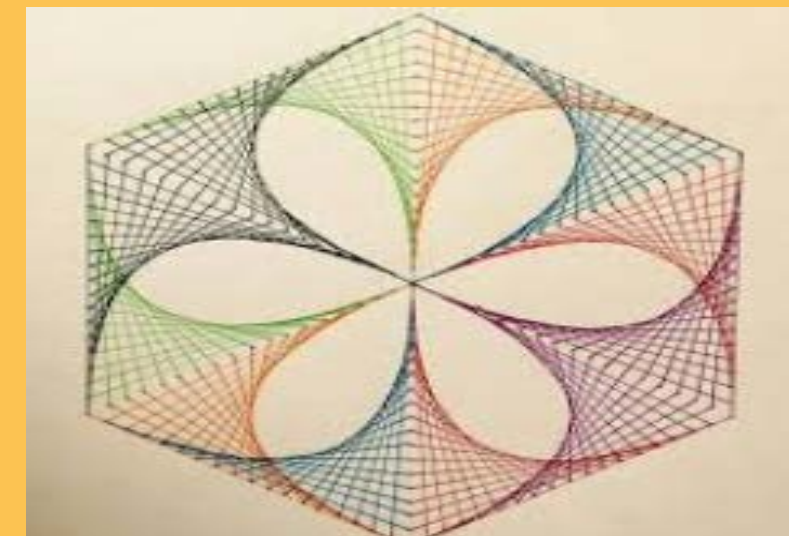
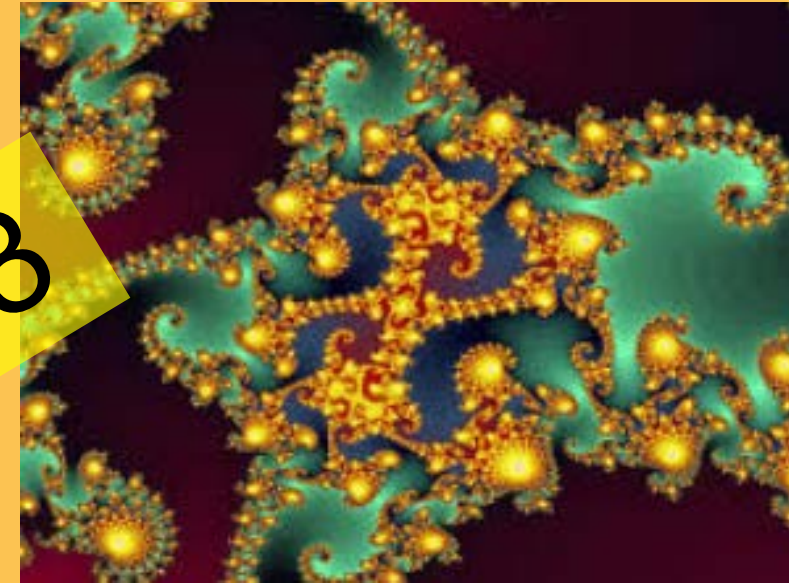
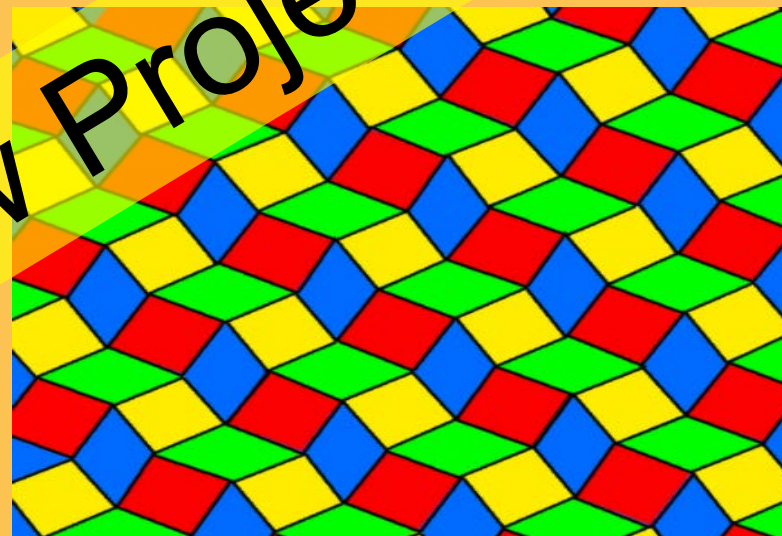
In-service Educators:

- + Strong willingness to adopt customized offline ICT-assisted teaching approaches to respond to some classroom challenges and expectations of modern learners**
- Urgent need for more T&L skills training that support 21st century T&L practices**
- Fear of technology and lack of knowledge of related pedagogical practices calls for much more training and support**
- School infra-structure and lack of management skills and support in schools poses stumbling blocks in the way of effective classroom implementation**

Mathematics Learners:

- + Overwhelmingly positive response to TBM model and TouchTutor® digital resources**
- + Improved of results of learners who use the Tablet & Touchtutor® assisted support platforms**
- + Positive impact on level of engagement with curriculum and with peers**
- + Improved SDL practice**
- Hurdles of Content Gap and Lack of Culture of Learning to much for some many learners**

New School Competition: Awareness of the Beauty of Mathematical & Links between Maths and the Arts

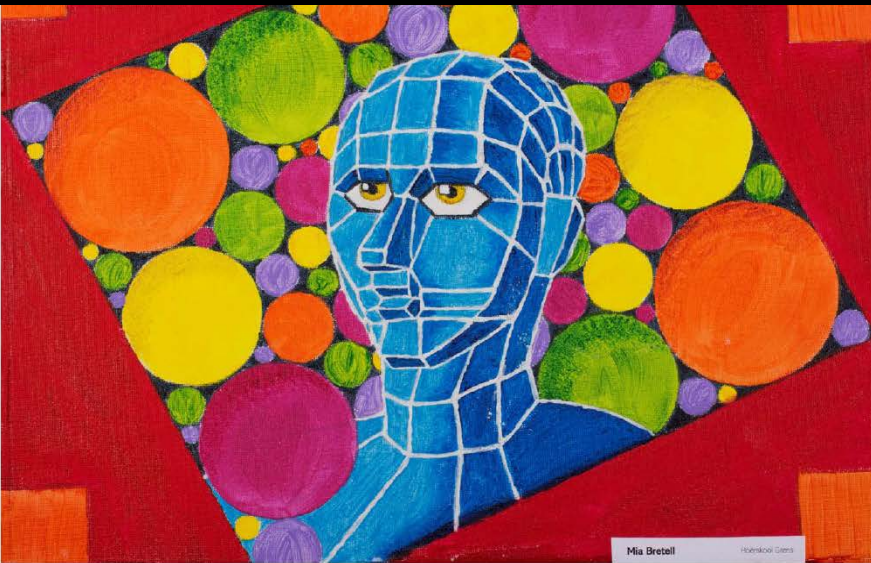


MATH-ART Competition for Secondary Schools 2018 Creative Expressions of Links between Mathematics and Art

Math-O-Man

Mia Brettell gr 10

It is a representation of how mathematical proportions, in the form of various shapes, for example quadrilaterals, etc can be assembled together to form facial features. The human mind so interprets and recognises a face, as proportions of the anatomy are calculated mathematically.



Shanay Archery Gr 10

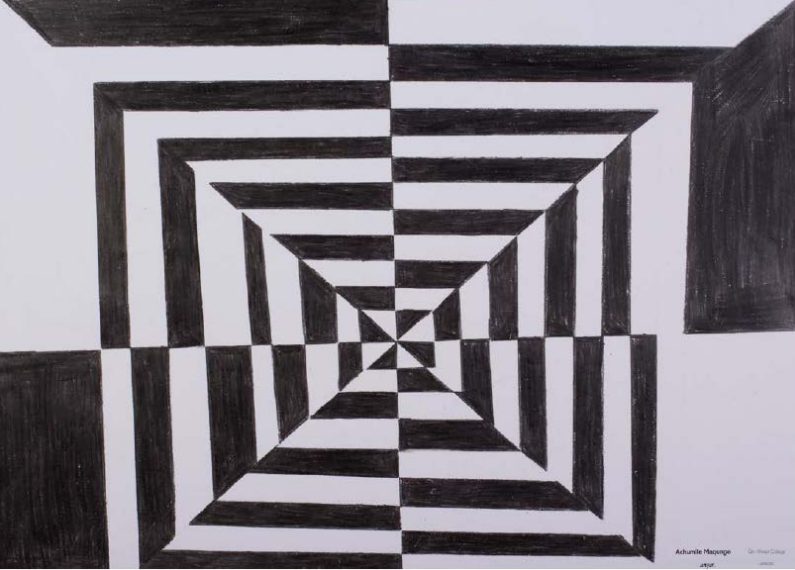
Maths is a universal language as shown by angles, shapes and numbers. It can be understood by anyone around the world. The compass on the side of the pyramid shows that Maths gives us direction.



Maths in Africa

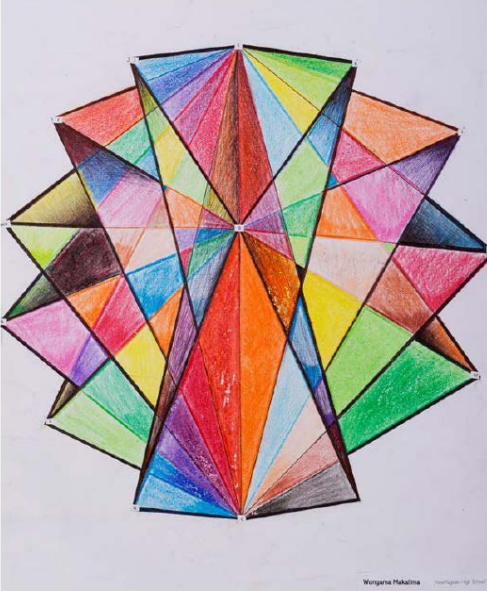
Zikhona Xongo gr 12

Mathematics ranges all over Africa. From the shapes found in the types of fabric Africans wear, to the patterns they have on their faces when they go to events. The patterns on the face; are simple mathematical shapes (triangle, rectangle and circles). These patterns are also used by the Ndebele tribe to decorate their huts. These patterns are connected to Mathematics, not only by their pattern sequence, but also the function graphs present (parabola and linear). The hair, well the curls are a combination of oval and circular shapes overlapping to make up the hard natural African hair of the Khoisan tribe. The brown colour reflects the dominant colour of the people in Africa. Lastly, the orange and green background which is in the form of two joint identical rectangles shows the way of life. A combination of the sun and the lush vegetation (Trees, grass).



All about rectangles

Achumile Maqungo gr 7

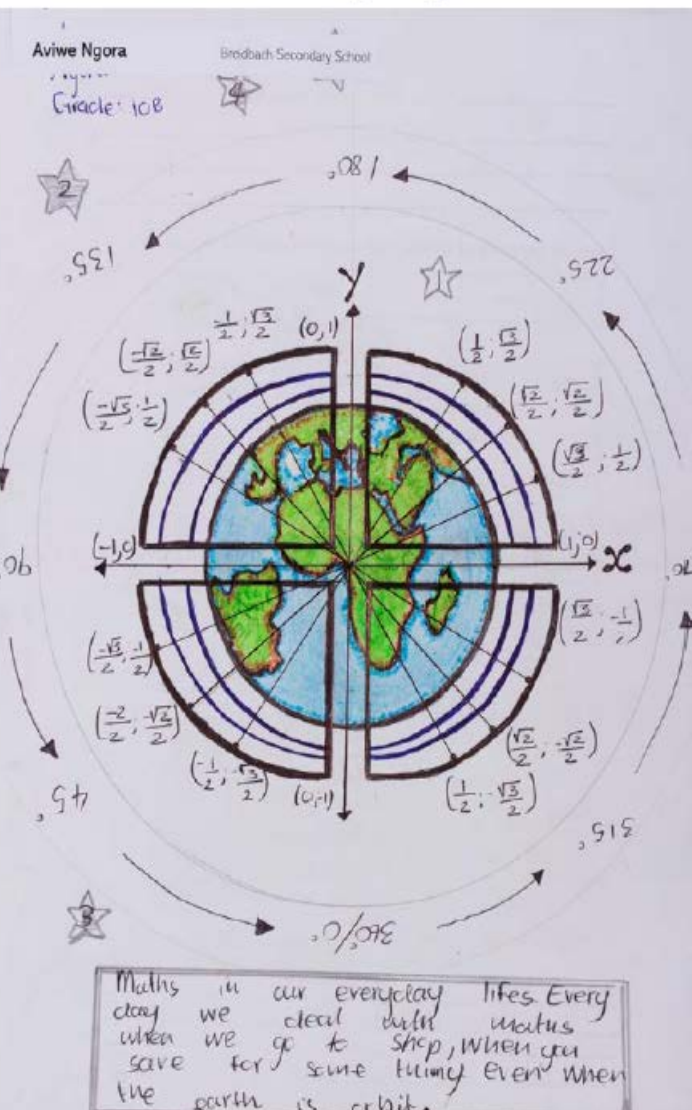


Triangles

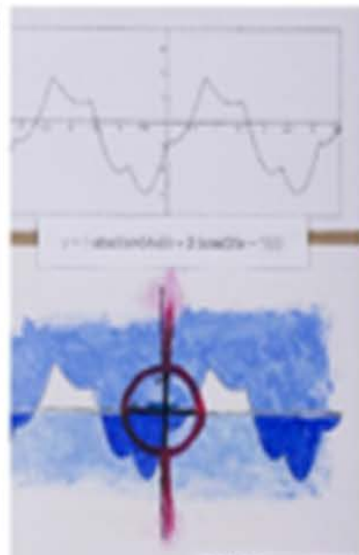
Wengame Makalima gr 9

MATH-ART Competition for Secondary Schools 2018 Creative Expressions of Links between Mathematics and Art

Maths in our everyday lives
Awiwe Ngora gr 10



GMMDC MATH ART COMPETITION 2018



Thank You



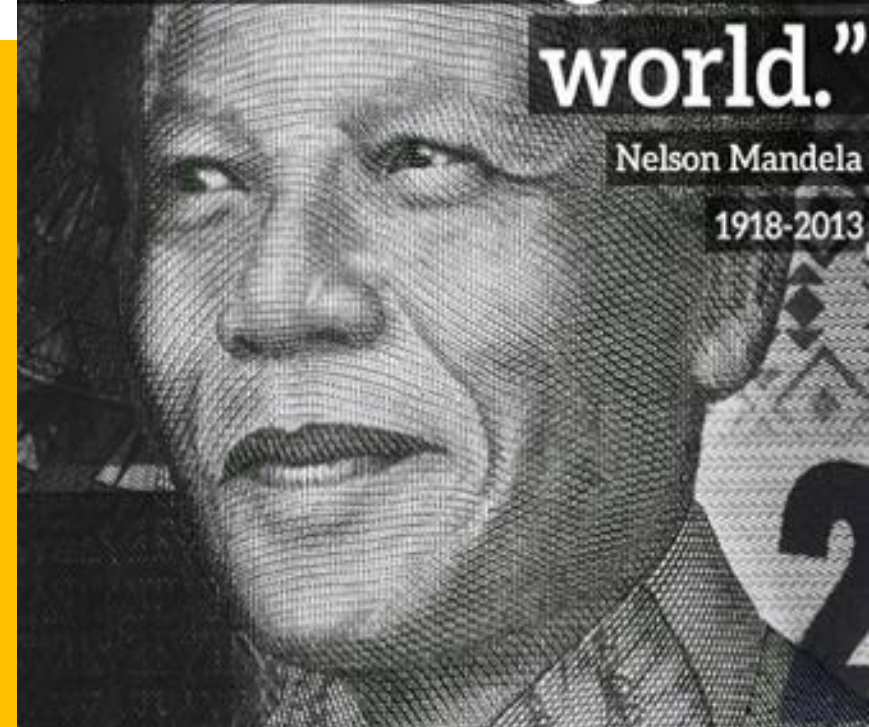
Dr Govan Mbeki (LLD)



Govan Mbeki Mathematics
Development Centre
empowering young minds



“Education is the most powerful
weapon which **change the**
you can use to **world.”**



Nelson Mandela
1918-2013

NELSON MANDELA
UNIVERSITY