GMMDC
Govan Mbeki Mathematics Development Centre
empowering young minds

NELSON MANDELA UNIVERSITY

Short Summaries of Key STEM Engagement Projects

The Govan Mbeki Mathematics Development Centre (GMMDC), a specialized engagement entity within Nelson Mandela University is committed to transforming STEM education in public schools. It pioneers innovative support models for Mathematics and Physical Sciences educators and learners, enhancing teaching effectiveness and learner success outcomes. With a strong focus on accessibility and success, GMMDC aims to strengthen the STEM pipeline, ensuring more learners transition successfully into higher education.

0. Background: *Visit our Website:* GMMDC Website

South Africa's economic growth is threatened by persistently low mathematics performance in public schools, which is rooted in historical inequalities, socio-economic barriers, and inadequate teacher training. Despite the National Development Plan's push for improved maths education, systemic challenges hinder the development of STEM talent. Over 50% of learners drop mathematics between Grade 10 and 12, weakening workforce readiness for the Fourth Industrial Revolution. To address this, the GMMDC has pioneered transformative education solutions.

Developed over more than a decade, its innovative Techno-blended Teaching and Learning Model (TBM) integrates online and offline strategies to enhance CAPS-aligned instruction in underserved schools. Aligned with global STEAM[1] education trends, the TBM fosters mathematical proficiency and improves STEM learning outcomes.

The Centre's mandate to promote Science in Society includes a range of initiatives in under-served schools:

- Accredited professional development for Mathematics teachers, addressing pedagogical gaps and equipping them with 21st-century technology skills.
- Structured Technology-assisted After-school Programme Support (TAPS) to foster self-directed learning in Mathematics and Physical Sciences.
- Mobile STEM learning solutions through curated digital applications and interactive applets, expanding access to quality education with technology.
- STEAM education seminars and workshops, empowering educators and learners with critical thinking, creative problem-solving skills, and inspiration for STEM careers.

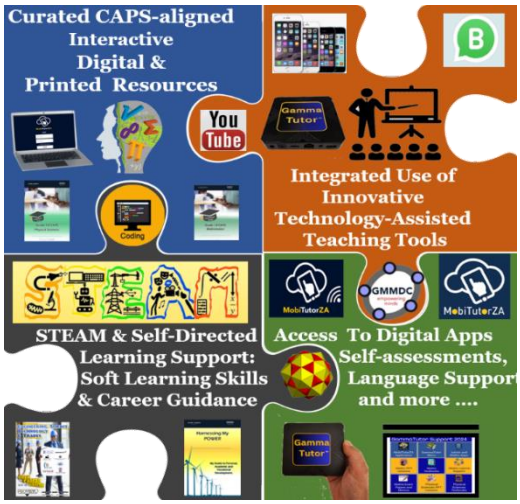


Figure 1. GMMDC Techno-Blended STEM Education Model

[1] *STEAM education integrates Science, Technology, Engineering, Arts, and Mathematics to provide students with a well-rounded modern education that emphasizes active learning and skills development for the workplace of the future, including problem-solving, critical thinking, creativity, innovation, and peer collaboration.*

By integrating accessible technology with interactive teaching methods, GMMDC empowers school learners for STEM studies and equips them with skills to meet future workforce needs, driving South Africa's socio-economic transformation.

As such, GMMDC is well-positioned as a national leader in scalable, sustainable education reform.

1. Project Description:

SACE Accredited Professional Learning Network Programme for In-Service Mathematics Teachers

"Accredited 1-Day Mathematics Short Learning Programmes (SLPs): Elevating CAPS Teaching with 21st Century Techno-Pedagogy"

The Govan Mbeki Mathematics Development Centre (GMMDC) proudly offers a transformative, South African Council for Educators (SACE[2]) - accredited Professional Learning Network (PLN) programme. This bespoke professional development initiative is meticulously designed for in-service secondary school Mathematics educators from under-resourced public schools, equipping them to deliver the Curriculum and Assessment Policy Statement (CAPS) Mathematics syllabus with innovative 21st-century techno-pedagogy. Separate programmes are offered for designated school phases (Senior Phase or FET Phase). By seamlessly integrating curated digital resources and innovative teaching strategies, the programme empowers educators to engage in professional networking and to prepare learners for a dynamic, technology-driven world of work.

Figure 2. Accredited Model

Innovative Techno-Blended Approach

The PLN programme integrates Content Knowledge (40%), Pedagogy (20%), and Technology (40%) through GMMDC's pioneering techno-blended model. This approach, refined over a decade in under-served urban and rural schools, also leverages interactive digital resources tailored for CAPS Mathematics. Key tools for inclusion include the GammaTutor and MobiTutorZA apps, alongside interactive Mobile learning Mathematics applets, which support both classroom instruction and learner self-directed study through Technology After-School Programme Support (TAPS). Provision of offline and online digital resources ensure accessibility, empowering educators to create engaging, technology-enhanced learning environments.

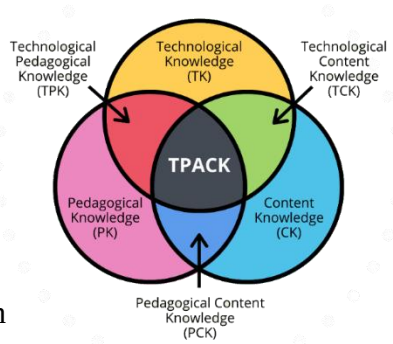


Figure 3. PLN Programme Model

[2] *SACE is the professional council for educators, that aims to enhance the status of the teaching profession through appropriate Registration, management of Professional Development and inculcation of a Code of Ethics for all educators*

Programme Overview

Spanning 24 months, the PLN programme comprises eight SACE-accredited one-day Short Learning Programmes (SLPs), strategically scheduled during quieter periods of the academic year or as coordinated with education authorities. Normally delivered in pairs over consecutive days, these SLPs target cohorts of Mathematics educators from under-resourced public schools in regions as agreed to with funders. On average of two to three teachers per school phase are selected to participate. This structure fosters opportunities for robust professional learning communities, enabling educators to share best practices and sustain long-term pedagogical growth.

Figure 4. SLP Training Session Model

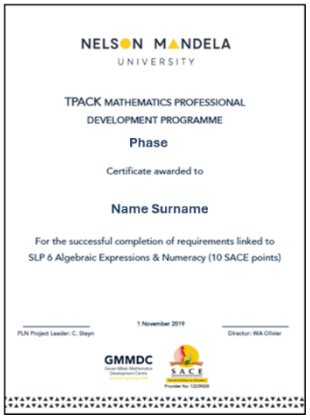
STEAM Integration

Since 2020, the PLN has championed the STEAM (Science, Technology, Engineering, Arts, and Mathematics) teaching approach, fostering interdisciplinary learning that bridges creative and analytical skills. By embedding STEAM principles, the programme equips educators to cultivate learner-centred methods to promote critical thinking, innovation, and real-world problem-solving in their classrooms, preparing learners for future challenges in a rapidly evolving global landscape.

Programme Structure and Assessment

Each SLP focuses on specific CAPS-aligned Mathematics themes, delivered through dynamic, face-to-face training sessions. Six SLPs emphasize syllabus-aligned content areas, while two focus on innovative pedagogy and technology skills, including lesson planning, taxonomy-based assessment, and awareness of technology-assisted teaching strategies. Pre- and Post-tests, and classroom practice assignments ensure mastery of each SLP's objectives.

Each SLP is SACE-accredited, awarding 10 Continuing Professional Development (CPD) points upon successful completion. Attendance certificates, issued by GMMDC, recognize educators' commitment to professional excellence after each PLN programme cycle.


NELSON MANDELA
UNIVERSITY

TPACK MATHEMATICS PROFESSIONAL
DEVELOPMENT PROGRAMME

Phase

Certificate awarded to

Name Surname

For the successful completion of requirements linked to
SLP 6 Algebraic Expressions & Numeracy (10 SACE points)

1 November 2019

PLN Project Leader: C. Steyn

Director: WA Olivier

GMMDC

SACE

Figure 5. PLN Certification

Impact and Outcomes

The PLN programme is designed to establish vibrant professional learning networks among in-service Mathematics educators, fostering collaboration and the sustained integration of 21st-century teaching practices. By equipping teachers with GMMDC's innovative digital tools and STEAM methodologies, the programme enhances classroom engagement and learner outcomes. Educators gain the confidence to leverage technology, from interactive apps to AI, to create inclusive, learner-centred environments that align with CAPS school requirements.

Why Choose GMMDC's bespoke PLN Programme?

- **SACE-Accredited Excellence**: Earn 10 CPD points per SLP, recognized by South Africa's leading educator council.
- **Proven Techno-Blended Model**: Benefit from a decade of success in under-served schools, with tailored digital resources.
- **STEAM-Driven Innovation**: Integrate arts and technology to foster creative real-life problem-solving and interdisciplinary learning.
- **Sustainable Professional Growth**: Build lasting professional networks to support ongoing pedagogical development and practice.
- **Flexible, Accessible Delivery**: Engage in face-to-face SLPs with access to both online and offline resources for maximum impact.

Join the GMMDC Professional Learning Network and transform your teaching practice. Empower your learners with the skills to access STEM programmes at Higher Education level and to thrive in the 21st century world of work.

2. Project Description:

Mathematics ACADEMY empowering minds

Transformative STEM Education:

The TAPS Learner Incubation Model

The **Technology-assisted After-school Programme Support (TAPS)** model, pioneered by the **Govan Mbeki Mathematics Development Centre (GMMDC)** at Nelson Mandela University, is revolutionizing STEM education support in South Africa's under-resourced schools. This innovative, techno-blended approach, refined over a decade, empowers high school learners with the tools, skills, and confidence to excel in Mathematics and Physical Sciences, breaking the cycle of poverty through sustainable education.

Key Features of the TAPS Model

- **Engaging Digital Learning Ecosystem**: TAPS delivers high-quality, interactive digital lessons, applets, exercises with guided examples, self-tests with instant scoring and feedback, exam-focused practice, multi-language support and soft skills development. Aligned with the CAPS Mathematics syllabus, these resources empower learners and facilitators to master critical concepts.

- **Accessible Anytime, Anywhere**: Through user-friendly **MobiTutorZA** and **GammaTutor** apps, learners access materials 24/7 on Android devices or Tablets. Available online and offline, these tools ensure uninterrupted learning, whether at school, home, or community centres.
- **Structured After-School Support**: The TAPS programme also offers a series of **Topic Learning Cycles** throughout the academic year, reinforcing CAPS curriculum delivery. These structured, syllabus-aligned sessions promote self-directed learning, supported by printed TAPS learner guides for reflection and independent study.
- **Equitable Access for All**: Learners from under-resourced schools gain access to digital resources via **MobiTutorZA** apps or **GammaTutor** mobile resource centres at school or public facilities, levelling the playing field for those with potential in STEM.
- **Empowering Teacher Facilitators**: TAPS equips educators with **GammaTutor** teaching resources and comprehensive training to manage after-school sessions, fostering peer-supported learning and maximizing impact.

Figure 6. Facilitated TAPS Session Structure

A Proven Solution for STEM Success

The TAPS model addresses critical challenges in under-resourced South African schools, including inadequate infrastructure, limited teaching capacity, and unsupportive home environments.

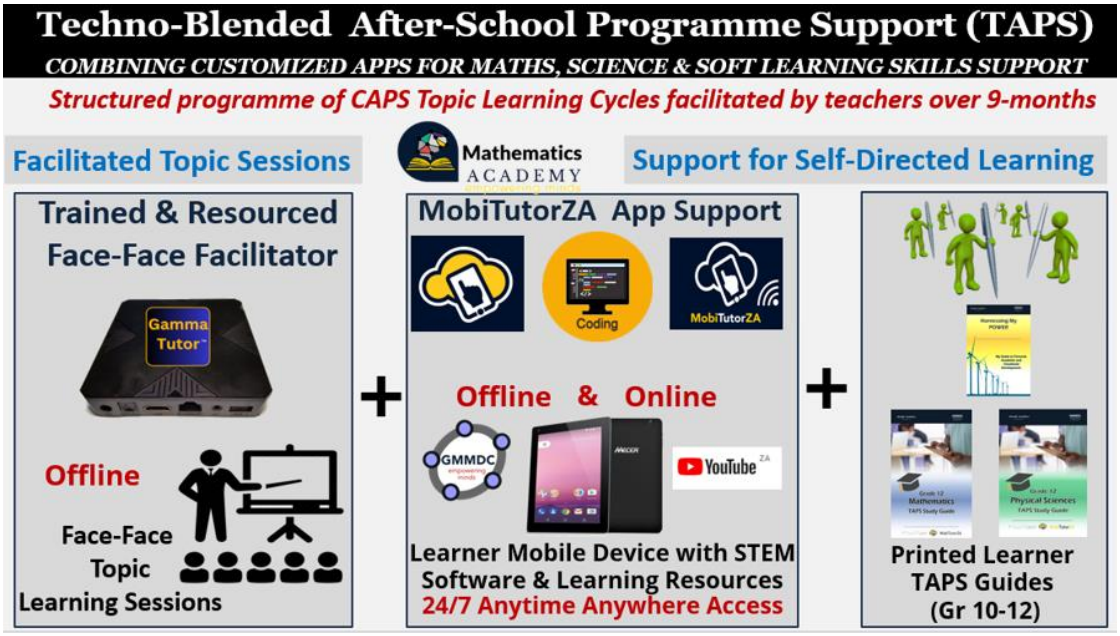


Figure 7. GMMDC's TAPS Learner Support in Under-served Schools

By integrating cutting-edge technology with structured pedagogy, TAPS has delivered **remarkable results**:

[View Recent GMMDC TAPS Learner Incubation Project Successes]

- **Significant Improvement in Academic Performance**: Learners show marked progress in Mathematics and Physical Sciences grades.
- **Boosted Self-Directed Learning**: Students develop confidence and skills for independent study, fostering a lifelong love for learning.
- **Increased STEM Career Aspirations**: TAPS inspires learners to pursue STEM programs at university, paving the way for sustainable skills development.

Why TAPS Stands Out

The **GammaTutor** platform is more than a bespoke classroom tool—it's a game-changer for after-school learning support at under-served schools. Its offline techno-blended approach supports learners across all grades, offering flexible, curriculum-aligned digital resources for both individual and group study. During and post-COVID, GMMDC's TAPS model has proven its resilience, successfully supporting in-school and out-of-school matric learners, including repeat candidates, with tailored resources and structured guidance.

By addressing the unique challenges faced by learners in poor and rural communities, TAPS transforms potential into achievement, equipping the next generation with the skills to thrive in a STEM-driven world. Join the GMMDC team and empower South Africa's youth to break barriers and build brighter futures through education.

3. Project Description:

GammaTutor Mobile Resource Centre Support

Figure 8. GammaTutor Mobile Resource Centre

The tailor-made GammaTutor mobile Resource Centre model, integrated with the offline MobiTutorZA app, is a transformative educational initiative by the GMMDC, launched in 2019 to address STEM education disparities in under-resourced South African public schools, particularly in the Eastern Cape. Developed through extensive action research, this innovative, compact, mobile plug-and-play device delivers offline access to a comprehensive suite of CAPS-aligned Mathematics and Physical Sciences resources for all grades, making it an invaluable tool for teachers and learners in areas with limited or no internet connectivity.

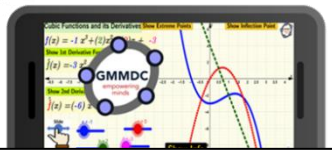


Figure 9. Embedded Maths

Compatible with any data projector, digital screen, or smart TV, the GammaTutor simplifies lesson delivery, enabling teachers to facilitate high-quality, interactive, and

learner-centred classroom experiences. Its pre-installed software includes animated PowerPoint lessons, English and Afrikaans textbook series, past exam papers with memos, interactive Mathematics applets, self-assessments with automated scoring, and career guidance materials, all tailored to the CAPS curriculum. The device's wireless mouse functionality allows teachers to move freely, fostering constructivist learning environments, while its pre-prepared digital content frees up time for deeper learner engagement and concept exploration. Its portability ensures secure and flexible use across classrooms or after-school venues. The offline MobiTutorZA app, embedded within the GammaTutor™ or installed on tablets for learners, supports after-school self-directed learning with video lessons, interactive topic tests, and customized Mathematics applets, empowering learners to revise and master concepts independently. The MobiTutorZA app also extends support functionalities with multi-language Mathematics concept explanations, ensuring personalized support.

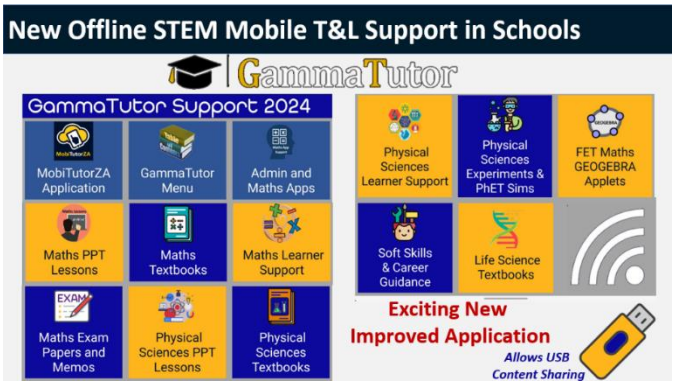


Figure 10. GammaTutor Offline Digital

By bridging digital divides, the GammaTutor educational tool empowers teachers to deliver engaging, curriculum-aligned classroom lessons and enable learners to pursue autonomous, interactive after-school learning, ultimately contributing to South Africa's socio-economic transformation through enhanced STEM education.

Key Properties of the GammaTutor Model:

Offline Accessibility: Provides comprehensive CAPS-aligned Mathematics and Physical Sciences resources without internet reliance, ensuring access in under-resourced schools.

User-Friendly Design: Mobile Plug-and-play functionality connects to projectors, screens, or smart TVs, simplifying lesson delivery with a single mouse click.

Comprehensive Interactive Content: Includes animated PowerPoint & Video lessons, bilingual textbooks, past exam papers, Mathematics applets, self-assessments, and career guidance, covering all grades.

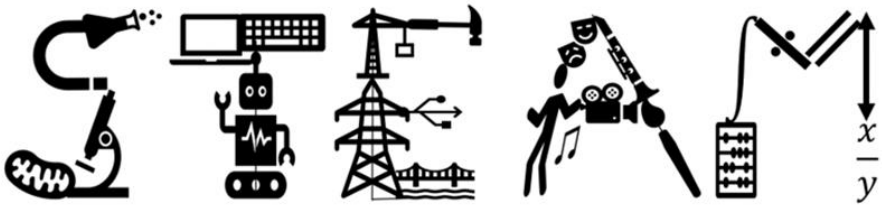
Interactive & Flexible Teaching Support: Wireless mouse enables teachers to move freely, fostering learner-centred, constructivist classroom environments. Wifi- and USB access also allow optimal online and offline sharing of resources.

Time Efficiency: Pre-prepared digital materials allow teachers to focus on learner interaction, concept explanation, and sharing additional examples.

Portability and Security: Compact size facilitates easy movement between classrooms and secure storage, enhancing flexibility.

Self-Directed Learning: GammaTutor with Integrated MobiTutorZA app and structured learner guides offer anywhere anytime topic self-tests with scoring and feedback as well as on-demand language support with Mathematics concept explanations in multiple indigenous languages.

This model's emphasis on creative offline access, interactive tools, and comprehensive resources revolutionizes STEM education, empowering teachers and learners to excel in challenging environments.



4.Project Description:

Provincial STEAM Education Seminar

Annual Regional STEAM Seminar for Mathematics Science and Technology (MST) Teachers

The GMMDC presented a groundbreaking inaugural 2-day STEAM Education Seminar for in-service educators the Eastern Cape Province (ECP) in 2024. This successful strategic skills development and professional networking event was offered in partnership the Independent Schools Association of South Africa (ISASA) with support from the Eastern Cape Department of Basic Education.

Figure 11. 2024 ECP STEAM

In February of 2025 the Centre hosted a second follow-up Provincial STEAM Education Seminar in Gauteng in collaboration with Key Education Stakeholders and with the support of the Department of Science, Technology and Innovation (DSTI). This 2-day event, which was opened by the Deputy Minister of the DSTI, attracted more than 200 MST in-service educators and representatives from leading provincial stakeholders in education and industry.

The GMMDC aims to offer a second 2-day STEAM Education Seminar for in-service MST educators in the in the near-future. This event will be offered at a Mandela University campus in Gqeberha to in-service teachers from public and independent schools across the province.

Figure 12. 2025 GAUTENG STEAM

A Two-Day Immersion in Innovation and Collaboration

From expert-led presentations to interactive hands-on workshops and STEAM exhibits, the seminar exposes educators to best professional practices, equipping them with real-world tools to inspire the minds of learners under their care. Attendees will also engage with national STEAM education expert presenters, explore innovative practical teaching methodologies, and connect with peers and stakeholders to forge sustainable professional learning networks.

Participating educators will also be supported with access to an online STEAM repository of downloadable STEAM teaching resources to ensure sustainable post-seminar activities at project schools.

Seminar Goals:

The STEAM Seminar focusses on advancing innovative STEAM methodologies, equipping educators with practical tools to foster trans-disciplinary critical thinking, creative problem-solving, and digital literacy in their classrooms. Thus, the initiative aims to address persistent STEM education challenges in STEM education, particularly within under-served South African public schools. These include limited teaching resources, uneven teacher proficiency, and low STEM learner engagement at the FET level. By providing a platform for professional skills development and peer-teacher engagement, the seminar seeks to:

- **Enhance Instructional Quality:** Encourage educators to try new best practices and innovative teaching strategies to improve STEAM education delivery in schools.
- **Foster Collaboration:** Build a community of practice among educators, stakeholders, and STEAM leaders to share knowledge and resources.
- **Promote Equity and Inclusion:** Support educators in creating inclusive learning environments that engage diverse learners and bridge skill gaps.
- **Inspire Learner Engagement:** Encourage educators to integrate STEAM activities with technology that spark curiosity and creativity in students.

Call for Project Support:

This STEAM Education Seminar Initiative is a crucial step in addressing South Africa's STEM education challenges and equipping teachers with the skills needed for the Fourth Industrial Revolution. By investing in this programme, funders will help build a sustainable pipeline of skilled educators and learners, fostering long-term socio-economic transformation.

With an all-inclusive budget of R1,750 per educator for the two-day seminar, including one night's accommodation, a total investment of R350,000 will ensure the successful implementation of the Provincial STEAM Education Project. This funding will support broad stakeholder dissemination post-seminar and provide access to online STEAM teaching resources, expanding the programme's reach.

Your support enables GMMDC and its partners to scale this impactful initiative across provinces, ensuring equitable access to quality STEAM education. By empowering educators and learners, we can transform futures and drive national progress.

Invest in South Africa's future today. Support GMMDC's STEAM Education Seminars and be part of a movement that empowers educators, inspires learners, and fosters sustainable socio-economic growth.

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