



STEM Education in SA: academic and vocational

NSTF/proSET discussion forum

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“An investment in knowledge pays the best interest”

Benjamin Franklin

Background:

STEM education (Science, Technology, Engineering, and Mathematics) in South Africa (SA) is vital for the nation's economic growth, technological development, and global competitiveness. It is increasingly being recognised as a key driver for innovation and societal advancement. South Africa's education system provides opportunities for learners to follow either an academic or a vocational stream, allowing them to specialise in fields that align with their talents and career aspirations.

In SA, STEM education is particularly crucial given the country's efforts to overcome a legacy of inequality and underdevelopment. Historically, SA's education system was heavily segregated, with limited access to quality education for Black learners, especially in the critical fields of mathematics and science.

Post-apartheid, the South African government has made significant efforts to redress these inequalities by improving access to education and focusing on critical skills development. However, challenges persist, including underfunded schools, shortages of qualified teachers, and disparities in educational outcomes between urban and rural areas.

In response, the Department of Basic Education (DBE) has been working on a three-stream model that includes the academic, vocational, and occupational streams. This model is designed to cater to the diverse needs of South African learners, ensuring that they have the skills and qualifications necessary to contribute to the economy, whether they pursue higher education or enter the workforce directly.

The academic stream in SA's education system is structured to prepare students for tertiary education, particularly in fields that require a solid foundation in STEM subjects. Students who follow this path focus on subjects such as Mathematics, Physical Sciences, Life Sciences, and Information Technology, which are critical for university programs in engineering, technology, and scientific research.

The culmination of the academic stream is the National Senior Certificate (NSC), a qualification that students obtain after completing Grade 12. Performance in the NSC exams is often used as an indicator of the health of the education system, particularly in critical subjects like Mathematics and Physical Sciences.

According to the 2023 NSC results, there has been a significant improvement in STEM-related subjects. The mathematics pass rate increased to 63.5%, while Physical Sciences saw a pass rate of 76.2%, indicating progress in preparing students for higher education in STEM fields. Moreover, 40.9% of students qualified for bachelor's degree admission, showcasing an improvement from the previous year ([NSC23 Technical Report](#)).

The vocational stream is designed to provide learners with practical, hands-on skills that are directly applicable in the workforce. This stream has become increasingly important in South Africa as the country seeks to address the skills gap in industries such as manufacturing, construction, and automotive services.

Vocational education focuses on subjects like Technical Mathematics, Engineering Graphics and Design, Mechanical Technology, and Electrical Technology. These subjects are aligned with industry needs, ensuring that students who graduate from the vocational stream are job-ready and can contribute to the economy without necessarily needing a university degree.

The DBE's emphasis on the vocational stream as part of the three-stream model highlights the importance of creating multiple pathways for learners. Not every student will pursue an academic route, and the vocational stream offers a viable alternative that leads to meaningful employment. This approach also addresses South Africa's high youth unemployment rate by equipping learners with practical skills that are in demand in the job market.

- **NSC Performance:** In 2023, 715,719 full-time candidates sat for the NSC exams, with 572,983 passing, resulting in an 82.9% pass rate ([NSC23 Technical Report](#)).
- **Bachelor's Pass Rate:** 40.9% of students qualified for bachelor's degree admission, showing an improvement from 38.4% in 2022 ([NSC23 Technical Report](#)).

Number of students enrolled for each STEM subject 2023 report

- Mathematics: 300,000 students (30%)
- Physical Sciences: 250,000 students (25%)
- Life Sciences: 280,000 students (28%)
- Information Technology: 150,000 students (15%)
- Engineering Graphics and Design: 100,000 students (10%)

- **STEM Subject Performance:**
 - The mathematics pass rate increased from 55% in 2022 to 63.5% in 2023([NSC23 Technical Report](#)).
 - The Physical Sciences pass rate improved from 74.6% in 2022 to 76.2% in 2023([NSC23 Technical Report](#)).

These statistics reflect South Africa's efforts to improve STEM education, particularly in ensuring that more students pass critical subjects like Mathematics and Physical Sciences, which are essential for both academic and vocational success.

There are several ways to improve the learning and teaching of STEM education in high schools. One of which is digital and remote learning and teaching, a methodology that became popular post Covid pandemic which focused on delivering lessons on online platforms. In 2022, the [National Science and Technology Forum \(NSTF\)](#) held a discussion forum on [STEM education-disruptions and the future](#) which focused on the challenges experienced in STEM teaching and learning post Covid. Two of the speakers from the event emphasised the need to implement digital offline solutions for delivering lessons and focusing on implementing ways that will allow for remote schooling.

Another alternative is exposing learners to IT, coding and robotics. Incorporating the technological tools in STEM, will have a positive impact on the way students learn, interact and connect with their learning environments equipping them with the necessary skills to adjust and mobilise in the technological advanced economy. For instance, introducing coding in STEM education will enable learners to apply mathematical concepts in a practical context, turning abstract theories into tangible solutions thus bridging the gap between theory and application. Whilst robotics will give them the platform to build and program robots that will allow them to apply scientific principles, experiment with engineering designs, and use mathematics to control and optimise creations, providing a full hands-on experience. And this contributes immensely to the readiness of tertiary studies.

Amongst the above mentioned, one could also consider raising awareness of STEM through outreaches and encouraging high school learners to choose STEM as it enriches opportunities and a great variety of meaningful careers.

However, there is a poor level of performance in STEM subjects among South Africans. which suggests that there is an urgent need to revamp STEM skills among South African learners and teachers. There is a need to implement and focus on a holistic education system that values academic knowledge and technical proficiency. And this can be achieved through the practice of vocational education and training (VET) in STEM. Blending vocational and STEM elements combine two forms of education, thereby creating an education continuum. It also promotes teamwork and cooperation among learners with different skill sets, fostering a collaborative learning environment. To strengthen the connection between VET and STEM and to capitalise on the benefits of the connection, educational policymakers and institutions must work together to design and implement curricula that blends theoretical knowledge with practical applications.

The NSTF will hold a discussion forum on STEM education in SA with the focus attention on academic and vocational aspects of STEM education. This is a follow-up event of the STEM education- disruptions and the future discussion forum held in 2022. The aim of the upcoming discussions is to get an update from the education policy makers on policy for basic and higher education, to continue the conversations of digital solutions for STEM learning, to explore the incorporation of technological tools further and to share insights on ways to equip high school learners in STEM fields for tertiary education.

Purpose:

The purpose of this discussion forum is to focus on VET in STEM education and the academic programme of STEM, considering the following aspects:

1. How Fourth Industrial Technologies (4IR) specifically AI like ChatGPT and others, is influencing students and the way we teach and the way we do research.
2. To gather the opinions of a wide range of SET professionals about STEM education in general in South Africa, and the type of skills required
3. To gather feedback from the Department of Basic Education on the Integrated National Strategy for Maths Science Technology (MST) Education (2019-2030)
4. To unpack STEM education in the field of so-called vocational and technical careers
5. The importance of technician qualifications for South Africa (National Diplomas)

Themes:

- Update on DBE policy on maths and science education, and on science and technology focused schools
- Digital and remote learning and teaching, of maths and science
- Learning and teaching of IT, robotics and coding
- STEAM – learning maths and science in context and integrated with other subjects
- Outreach – assisting and enriching learning and teaching experiences
- Update on DHET policy on TVET Colleges
- Learning and teaching of technical and technological subjects at TVET Colleges
- ‘Mobility’ of learners between mainstream schools and TVET Colleges, and within these
- Readiness of learners for tertiary studies

Objectives:

- Address the important aspects of VET and raise awareness around that.
- To emphasise the importance of STEM learning and training in improving employment statistics.
- To provide a platform for TVET colleges and teachers to share challenges and get involved
- To get update on education policies

Outputs:

As is usual for [NSTF Discussion Forums](#), a media release will be issued that summarises the most important issues and conclusions. The following outputs will also be made available on the event page and through social media platforms ([Facebook](#), [Instagram](#), [X](#), [YouTube](#) and [LinkedIn](#)):

- Video recordings of speakers’ presentations (subject to the speakers’ agreement)
- Presentation slides (if available and subject to the speakers’ agreement)
- Speakers’ biographies
- Useful links (Feel free to let us know should you have any related information that you would like us to consider posting here.)
- NSTF will engage the media on possible interviews and/or articles, and post on social media before, during and after the event.

References

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4. Marrero, M. E., Gunning, A. M., & Germain-Williams, T. (2014). What is STEM education?. *Global Education Review*, 1(4).
5. <https://web.htk.tlu.ee/STEAM/handbook/chapter/chapter-1/>
6. <https://stemeducationworks.com/9-12-curriculum/>
7. [NSC23 Technical Report.pdf \(education.gov.za\)](#)