South Africa

Mark Chetty
Elspeth Khembo
Nonhlanhla Shozi
Department of Basic Education

Introduction

The Department of Basic Education (DBE) assumes a multifaceted role encompassing oversight, monitoring, and support for the nine Provincial Education Departments (PEDs). Within this capacity, the DBE formulates policies for implementation by PEDs. These policy priorities guide endeavors within the education sector, particularly shaping the DBE's engagement with provinces through interprovincial forums dedicated to the implementation of diverse policies aimed at enhancing the quality of basic education.

South Africa (SA) grapples with pronounced economic disparities between affluent and disadvantaged segments of the population.[1] Scholars contend that this economic inequality significantly contributes to uneven educational opportunities for learners from divergent socioeconomic backgrounds.[2,3] Furthermore, there is discernible educational inequity, encompassing access, performance, and resource availability, that is particularly prevalent in the field of mathematics, where certain segments of African learners consistently display low outcomes.[4] In response to these challenges, the South African government developed the National Norms and Standards for School Funding (NNSSF) that aim to improve equity in the funding of education by using quintiles.[5] Categorizing public schools into five quintiles has attempted to facilitate the equitable allocation of financial resources.[6,7] The categorization is based on the socioeconomic status of a school and is determined by measures of average income, unemployment rates, and general literacy level in the school's geographic area. Quintile 1 schools, situated in the most economically disadvantaged areas, receive more financial support, whereas Quintile 5 schools, located in more affluent regions, operate as fee-paying institutions, assuming less reliance on government funding.[8] The assumption prevalent across the nine provinces posits that schools sharing the same quintile ranking should be comparable in socioeconomic status and education standards.[9]

Overview of Education System

The South African education system is divided into two bands: the General Education and Training (GET) band (Grades R[a] to 9) and the Further Education and Training (FET) band (Grades 10 to 12). GET is subdivided into three phases: Foundation (Grades R to 3), Intermediate (Grades 4 to 6), and Senior (Grades 7 to 9) (see Exhibit 1).

Exhibit 1: Structure of the South African Education System

Band	Phase	Grades/Qualifications	Structure
General Education and Training	Foundation	Reception–Grade 3	primary school
	Intermediate	Grades 4–6	primary school
	Senior	Grades 7–9	Grade 7 is typically at primary school; Grades 8 and 9 are at secondary school.
Further Education and Training		Grades 10–12	secondary school
	Higher Education	undergraduate and postgraduate degrees, diplomas, higher education certificates, technical and vocational qualifications	universities, technical colleges, community colleges, and other nonformal postgeneral educational institutions

Education in the GET and FET bands are provided by two types of schools: public schools and independent schools (private schools). Independent schools must be registered with the Department of Basic Education and must maintain standards comparable to public schools. Finally, the Higher Education phase covers all postschooling education in various institutions.[10]

South Africa has made considerable strides in ensuring access to primary school education for all children, regardless of socioeconomic status or geographic location. Key initiatives such as no-fee schools, scholar transport, and school nutrition programs have significantly contributed to enhancing accessibility.

The South African curriculum is detailed in the National Curriculum Statement (NCS) and has been implemented since 2012. The three elements that constitute the NCS include the following:

a Grade R, or Reception, is the year before Grade 1.

- Curriculum and Assessment Policy Statements (CAPS) are part of a single, comprehensive, and concise national policy document set out by the Department of Basic Education that states what should be included in the curricula of schools for each grade in South Africa, as well as how the curriculum is to be assessed.[b] Each school subject has its own CAPS document. Annual Teaching Plans (ATPs) are formulated from the CAPS documents.
- The document *National Policy Pertaining to the Programme and Promotion Requirements* (NPPPPR) describes how subjects are grouped in the NCS for Grades R to 12 and general requirements, including the duration, approved subjects for each phase, promotion requirements, assessment, time allocation, and certification requirements for the National Senior Certificate (NSC).
- The National Protocol for Assessment (NPA) describes the importance of assessment and types of assessments in the NCS. It gives further guidance on requirements for the end-of-the-year examination and how to record and report learner performance.

In South Africa, learners in the Foundation phase (Grades R to 3) are taught in their home language. However, when learners start the Intermediate phase (Grade 4), they are taught in either English or Afrikaans. From this point on, most learners are taught in English while they speak their indigenous African language at home. Assessment data from international and national studies have revealed that in South Africa, there is low performance among learners who learn in multilingual contexts.[11]

Language is the learner's prime vehicle of expression and way of exchanging thoughts in the classroom.[12] Learners who speak one of the nine indigenous African languages at home have a twofold disadvantage: Not only do they start studying in an unfamiliar language in fourth grade, usually English, but they also tend to come from socioeconomically disadvantaged homes with lower incomes.[13] It has been observed that using English or Afrikaans to teach mathematics and science in upper primary and lower secondary grades complicates matters when the learner is not used to speaking either of those languages. This contributes to a barrier in understanding complex concepts in a second language, which historically has been identified as a factor contributing to low academic performance in South Africa. South Africa is currently undergoing a review of its language policy with a view toward greater promotion of mother tongue–based bilingual education.

b In 2020, the DBE issued revised Annual Teaching Plans (ATPs) for every subject in response to the loss of teaching and learning time and other disruptions caused by COVID-19. These revised ATPs were substantially trimmed from the original ATPs and set out the essential work that should be done within the limitations of teaching and learning during the pandemic. In 2021, in anticipation of a full return to school, the DBE published Recovery ATPs (RATPs) that restored some content according to subject and grade level; however, the continuing disruption in the education process prevented successful implementation of the RATPs. In 2022, the RATPs were implemented again and identified the core content in the CAPS that must be completed. This was aimed at simplifying decision-making for teachers faced with too little time to cover all of the content in the CAPS.

Use and Impact of TIMSS

TIMSS 2023 represents the seventh instance of South Africa's involvement in TIMSS at the ninth-grade level and the third instance at the fifth-grade level. TIMSS serves as a reliable metric for assessing mathematics and science proficiency in South Africa, and the outcomes have been extensively utilized by politicians, national and provincial governments, policymakers, the media, researchers, and the public.[14] The data from TIMSS are widely employed in scholarly works, including journal articles, books, and book chapters, by researchers from both South Africa and other nations. Furthermore, numerous university students have incorporated TIMSS data into their dissertations and theses. The contextual information and its correlation to mathematics and science achievement from TIMSS 2011, 2015, and 2019 have significantly influenced education policy.

Established in 2015, the TIMSS SA website serves as a valuable resource, furnishing information and periodic newsletters addressing diverse education issues in the country.[c] These newsletters often feature blogs, op-eds, or infographics. The website houses various TIMSS SA publications, including reports, journal articles, and policy reviews, and provides links to the TIMSS International Database. The TIMSS country reports of 2019 feature prominently on the DBE's website.

The National Assessments team disseminates TIMSS findings across the nine provinces during DBE Director-General Provincial engagements, which are conducted with provincial senior managers, including Chief Directors, District Directors, Chief Education Specialists for Management and Governance, Curriculum Coordinators, and Circuit Managers, along with school principals.

TIMSS diagnostic reports and frameworks are distributed to all provincial coordinators for dissemination to schools. TIMSS data from reports are used by all education stakeholders to improve mathematics and science teaching, as they afford schools with information related to how contextual factors affect learners' achievement.[15]

The Mathematics Curriculum in Primary and Lower Secondary Grades

The primary and lower secondary mathematics curriculum is detailed in the NCS. The curriculum is rooted in principles of social transformation, human rights, inclusivity, environmental justice, and social justice, and outlines the guidelines for mathematics education. As per the NCS, the cultivation of fundamental mathematical skills involves fostering proficiency in the language of mathematics and cultivating an understanding of the pivotal role mathematics plays in real-life contexts, contributing to the personal development of each student. The desired skills for students encompass proficiency in calculation, application, attentive listening, effective communication, logical reasoning, and adept problem-solving.

c See https://www.timss-sa.org/ for more information.

The Science Curriculum in Primary and Lower Secondary Grades

South Africa adheres to an integrated science curriculum articulated in the NCS. The objective of attaining proficiency in the natural sciences is to foster scientific knowledge and comprehension, science process skills, and an awareness of the roles of science within society. South African learners are initially introduced to natural sciences and technology in Grades 4 to 6 (Intermediate phase) through a focus on the promotion of science and technology, their historical development, and their societal contributions. This phase also encompasses illustrating the diverse cultural contexts in which Indigenous knowledge systems were formulated, recognizing their distinct origins and histories.

As learners progress from Grade 7 onward (Senior phase), their natural sciences education delves deeper into the aforementioned areas and incorporates instruction on the practical and ethical implications of decisions based on scientific knowledge. The teaching and learning of natural sciences focus on cultivating a spectrum of process skills applicable in everyday life, community settings, and the workplace.

Teacher Professional Development Requirements and Programs

In South Africa, educators are required to teach and guide learners while fully committing to exert their utmost effort. They are expected to align their actions with the principles outlined in the South African Council for Educator's Code of Professional Ethics. Therefore, it is crucial for both current teachers and aspiring educators to earnestly consider the disposition, dedication, self-discipline, principles, training, and behavior associated with the teaching profession, as these factors significantly influence the caliber of education provided. This perspective is applicable to educators across all domains, including those specializing in mathematics and the sciences.

The South African Council for Educators oversees the continuing professional teacher development (CPTD) system, ensuring the supervision of the quality of teacher professional development and the recording of professional development points to incentivize continuing education. Additionally, the Integrated Strategic Planning Framework for Teacher Education and Development in South Africa 2011–2025 was introduced to enhance the quality of teacher education and development, ultimately aiming to elevate the standards of teachers and teaching.

The DBE has implemented the following initiatives to build capacity for mathematics and science teachers:

- focused utilization of the national DBE workbook in the Foundation phase for improved and deeper learning opportunities through the flow of topics
- structured and focused content development
- training on how to set quality assessment tasks and the appropriate use of those tasks, including the following:

  - Assessment for Learning (AfL)—formative tasks (classwork, homework, consolidation, and revision) that can assist in identifying learning gaps, enabling feedback, encouraging learner involvement, informing teaching practices, and supporting learning progressions
  - Assessment of Learning (AoL)—evaluating skills mastered (used per topic or skill assessed). Questions may be selected according to levels of difficulty (easy, moderate, or difficult) and can be used to support learning according to different cognitive demands or be used to support advanced learners.
  - Assessment as Learning (AaL)—classroom assessment that contributes to learners learning, by the teacher (for learning) and by the learner (as learning)
- conducting error analysis—When conducting error analysis, the teacher checks the learner's mathematics problems and categorizes the errors. The purposes of error analysis are to
  - identify patterns of errors or mistakes that students make in their work,
  - understand why students make the errors, and
  - provide targeted instruction to correct the errors.[16,17]
- development of self-study guides for Grades 10 to 12
- access to remote and digital learning videos for Grades R to 12, such as those provided by Tswelopele and Woza Matric
- Mental Starters Assessment Project (MSAP), an assessment unit for Grade 3 students that is supported by the DBE. Drivers of this project are math subject advisors.

Monitoring Student Progress in Mathematics and Science

The DBE is responsible for guiding schools on the program of assessment. A circular is issued to schools on an annual basis to provide revised subject weightings relating to the Programme of Assessment (PoA) for the GET band (Grades 1 to 9).[18]

This circular builds on the key principles of implementing assessment tasks in the GET band that were introduced in 2020 and proceeds according to processes developed around the Revised School-Based Assessment (SBA)/Examination Weightings, curriculum trimming, and reorganization that occurred in 2023 (due to the RATPs). The focus on SBA remains on utilizing strategies aligned to an Assessment for Learning (AfL) approach to assist learners to achieve the learning outcomes for each grade and subject. The PoA is aligned to the revised ATPs for a particular year for each of the subjects and grades in the GET band (see Exhibit 2).

Exhibit 2: Revised School Based Assessment and Examination Weightings

Phase	2023 Revised SBA/Examination Weightings
Foundation (Grades R–3)	100% School-Based Assessment (SBA)
Intermediate (Grades 4–6)	80% SBA, 20% November examination[d]
Senior (Grades 7–9)	60% SBA, 40% November examination

At the international level, South Africa has participated in a number of large-scale assessments in science and mathematics, most notably TIMSS 1995, 1999, 2003, 2011, 2015, 2019, and now, TIMSS 2023. At a regional level, the country participated in the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SEACMEQ), which tests literacy and mathematics at the Grade 6 level, in 2000, 2007, 2011, 2017, and 2021.

Nationally, there are two studies that the DBE administers: the Early Learning National Assessment (ELNA), which is administered at the beginning of Grade 1; and the South African Systemic Evaluation (SASE), which is administered in Grades 3, 6, and 9.

The purpose of the ELNA is to assess early literacy and numeracy skills that are aligned with the Grade R curriculum as specified in the CAPS. The ELNA seeks to provide diagnostic feedback about the education system pertaining to the academic readiness of learners who are to start Grade 1.[19]

The purpose of the SASE is to gain insight into the factors that facilitate learning and teaching and those that act as barriers. This study is administered every 3 years. The data from the SASE are used to inform education policy and intervention. Therefore, while the SASE seeks to measure learner achievement in reading and mathematics, it is also focused on identifying and investigating the contextual factors that influence this achievement.

At the provincial level, the Western Cape province conducts annual population-based assessments in language and mathematics in Grades 3, 6, and 9. The results are used to streamline curriculum delivery and pinpoint areas for policy intervention in the education system.

Special Initiatives in Mathematics and Science Education

Various special initiatives focusing on mathematics and science education have been implemented at different levels of government and by nongovernmental organizations. At the national level, the Mathematics Teaching and Learning Framework was introduced in 2018. This framework emphasizes teaching mathematics for understanding (TMU) and complements the existing CAPS for mathematics. The aim is to revolutionize teaching and learning practices in the classroom, focusing on enhancing learner outcomes. It provides guidance for teachers at both basic and higher education levels to address challenges associated with mathematics education. The TMU approach has been field-tested in Foundation phase schools in various

d In South Africa, the year-end examinations for students in the Intermediate and Senior phases are taken in November. For students in the Intermediate phase, these examinations account for 20% of their total mark for the year, while in the Senior phase, they account for 40% of students' total mark for the year.

provinces as a collaboration between the DBE, the National Education Collaboration Trust (NECT), researchers, and two conceptual advisors from the Japan International Cooperation Agency (JICA).

Moreover, the national government allocates a conditional grant to provinces specifically designated for special programs aimed at promoting mathematics, science, and technology (MST) initiatives.

Following a review of the 2001 MST Strategy by a Ministerial Task Team, in collaboration with sister departments Science and Innovation and Higher Education, an Integrated National Mathematics, Science and Technology Strategy (INMST) was developed and approved by the Cabinet for implementation by PEDs and the national DBE. The INMST (2019–2030) provides for the development of provincially tailored implementation plans based on the following:

- Strategic Aim 1: to provide quality learning for all learners through relevant MST curriculum and interventions
- Strategic Aim 2: to improve teacher demand, supply, utilization, development, and support
- Strategic Aim 3: to improve provision, management, and effective utilization of resources
- Strategic Aim 4: to improve partnerships to enhance quality MST education

All provinces have undertaken to develop new-build and existing Public Ordinary Schools into Focus Schools/Schools of Specialization for learners with particular talents and aptitudes in MST subject offerings. 2022–2023 PED annual progress reports reflect a total of 124 operational MST/IT (information technology) Focus Schools.

Nationwide MST enhancement programs include the Mathematics Foundation's Mathematics Olympiad, the Eskom Expo for Young Scientists, and the Samsung "Solve for Tomorrow" competition. Engagement in these activities begins at the school level with MST subject teachers being trained on how to introduce and maintain learner interest through participation in cocurricular science clubs.

The introduction of novel curricula that align with the needs of the 21st-century workspace is a significant manifestation of the INMST Strategy (2019–2030).

The following innovations have been introduced in the South African education system:

- A coding and robotics curriculum has been developed and is being implemented for Grades R to 9.
- Marine sciences, a subject integrating oceanography, marine biology, environmental science, and the relationships between humans and the ocean, was introduced in 2019 and has seen a twelvefold increase in learner participation at the Grade 12 level since 2021.

- The Three Streams Model, which provides for academic, vocational, and occupational learning pathways, is linked to the development of novel curricula. The curricula being developed are for aviation and aerospace sciences, mining studies, and aquaponics.
- Since 2012, the DBE has partnered with TEACH SA to provide employment opportunities to high-performing graduates who are then placed in schools that are in need of MST-subject teachers. These graduates do not have education-related degrees and undertake part-time studies toward a postgraduate certificate in education. Sixty percent of these young professionals who otherwise would not have entered the teaching profession are retained in the system as professionally qualified teachers.
- Subject committees have been established in all subjects. In the MST sphere, with technologies advancing and changing rapidly, these committees ensure that pedagogic content and the quality of learning and teaching materials remain relevant to the needs of 21st-century learners.

Suggested Reading

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