

EXECUTIVE SUMMARY: SOUTH AFRICAN TIMSS 2019 GRADE 5 RESULTS

The Trends in International Mathematics and Science Study (TIMSS) assesses mathematics and science knowledge of fourth and eighth grade learners around the world. South Africa, where learners were assessed at the fifth grade, participated in TIMSS 2015, assessing mathematics; and in TIMSS 2019, assessing both mathematics and science. Participation in TIMSS allows countries to evaluate their learners' achievement and compare their national achievement with other countries, as well as to monitor the health of their education systems over time. In addition, the study allows the exploration of how various contextual factors are associated with mathematics and science achievement.

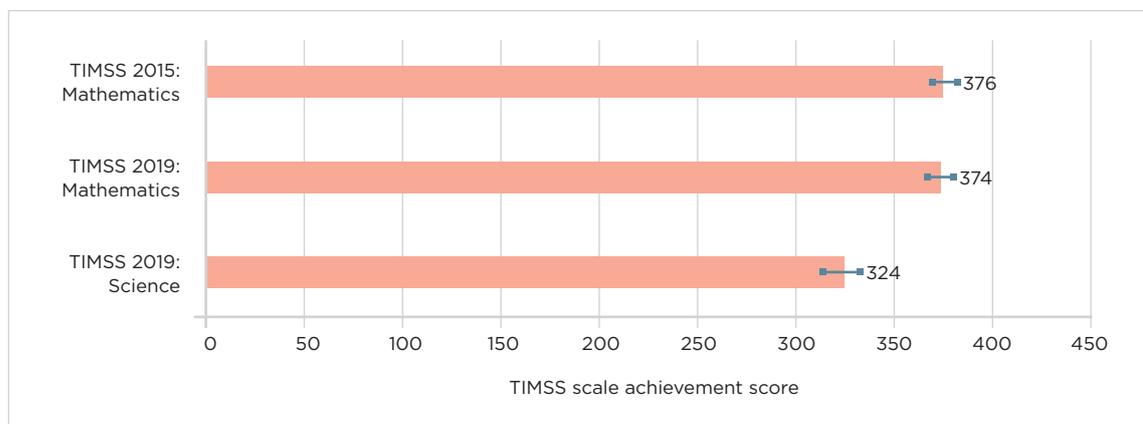
In October 2018, we collected achievement and contextual data in 297 schools across the nine provinces from 11 891 learners and their parents or caregivers, school principals, and mathematics and science educators. The results of the TIMSS 2019 Grade 5 study are presented in this report.

MATHEMATICS AND SCIENCE ACHIEVEMENT, ACHIEVEMENT TRENDS AND GAPS IN THE INTERMEDIATE PHASE

In TIMSS 2019, South African Grade 5 learners achieved an average achievement score of 374 (SE 3.6) on the mathematics assessment and 324 (SE 4.9) on the science assessment². The results also showed that, in this cycle, 37 percent of mathematics learners and 28 percent of science learners had acquired the basic subject knowledge and skills for their grade.

South Africa's participation in the TIMSS 2015 and 2019 cycles at Grade 5 also provides a trend measure of mathematics achievement in the Intermediate Phase. The difference in the average mathematics scale score of 376 (3.5) in TIMSS 2015 and 374 (4.7) in TIMSS 2019 was not statistically significant. The Grade 5 trend results are perplexing as the Grade 9 TIMSS mathematics scores significantly increased over the same period.

The figure below illustrates the TIMSS 2015 and 2019 mathematics scores and TIMSS 2019 science scores, together with the confidence interval.



² The standard error (SE) gives us an estimate of where the true achievement lies.

There was very high variation in the mathematics and science achievement scores. The achievement difference between the 5th and 95th percentiles (i.e. distribution inequality) was 330 points for mathematics and a higher 434 points for science.

As in the Senior Phase (Grade 9), South African achievement in the Intermediate Phase continues to be low, highly unequal and socially graded. Achievement gaps continue to be linked to learners' socioeconomic background and gender, the spatial location of the school and the school type (fee-paying versus no-fee), learner proficiency in the language of the test, the extent of overage learners and the province where the learner lives and attends school.

This confirms the well-known narrative that advantage begets advantage at one end of the distribution and compounding disadvantage at the other end.

THE MATHEMATICS AND SCIENCE CURRICULUM AND ACHIEVEMENT

Ninety percent of the TIMSS Grade 5 mathematics content and 80 percent of the science content was reported to have been taught in the South African curriculum before learners took the assessment.

TIMSS is not a simple assessment, with approximately 60 percent of the assessment items requiring learners to use higher cognitive skills of application and reasoning. The South African Grade 5 Curriculum and Assessment Policy Statement had a higher focus on the skills of knowing and solving routine problems, and there was limited emphasis on the skills of applying and reasoning. The mathematics scale score for knowledge and applying items was the same as the national average score, while it was significantly lower for reasoning items.

In relative terms, science achievement was lower than mathematics achievement with fewer science learners (28%) than mathematics learners (37%) acquiring the knowledge and skills for the grade. Science achievement was much lower for learners in poorer home and school environments due to factors such as a limited proficiency in the test language, poor teaching, and learning in poorly resourced environments.

Learners performed relatively better in items requiring them to select a response (multiple choice items) as they had difficulty answering items requiring them to coherently write descriptions or explanations.

INDIVIDUAL CHARACTERISTICS AND ACHIEVEMENT

The learner characteristics of gender, age and proficiency in the language of the test explained 16 percent of the achievement variance.

We found that one in four learners (30% in no-fee schools and 19% in fee-paying schools) were overage for Grade 5. Learners who were the correct age for the grade achieved significantly higher achievement scores than those who were overage.

Just over one in three learners (one in four in no-fee schools and one in two in fee-paying schools) spoke the language of the test at home. Learners who were more proficient in the language of the test achieved significantly higher mathematics and science achievement scores than those who were less proficient.

Girls significantly outscored boys in both mathematics and science achievement in the bivariate analysis, but with an interaction between gender and age, the achievement difference was no longer significant.

THE HOME ENVIRONMENT, EARLY LEARNING, AND ACHIEVEMENT

The socioeconomic conditions in which learners live and learn explained 21 percent of the achievement variance. About a quarter of South African households were categorised as high socioeconomic status (SES), a quarter as medium SES and half as low SES. There was a significant, positive association between the SES of the household and learners' mathematics and science achievement, thus confirming the enduring finding in the literature that the circumstance of one's birth continues to be a predictor of one's educational and life trajectory.

A quarter of South African parents or caregivers reported that they often engaged their children in early literacy and numeracy tasks at home, and these learners achieved significantly higher TIMSS mathematics and science scores. Learners whose parents or caregivers rated their literacy and numeracy school readiness skills highly achieved higher mathematics and science scores than those who were rated lower.

Close to half the learners' parents were able to assist them with homework regularly as they could understand the language and content of the homework. There was a significantly positive association between the extent to which parents were able to assist learners with their homework, and their mathematics and science achievement.

Ninety-two percent of Grade 5 learners had attended Grade R classes and 68 percent had at least two years of preschool engagements. Learners attending two years of preschool achieved significantly higher scores than those attending for only one year.

THE SCHOOL AND ACHIEVEMENT

There was a high achievement variation among schools. The poverty rank of the school (quintile) a learner attended explained 30 percent of the achievement variance. Two-thirds of learners in no-fee schools came from low SES households.

Many South African schools and learners reported a school climate that was unsafe, with high levels of discipline problems, incidences of bullying and disorderly behaviour in classrooms. All three school climate factors (safe and orderly schools, school discipline, and learner bullying) were significantly associated with mathematics and science achievement.

There is a continuity of home-to-school conditions where learners from lower income households with fewer assets enter schools with limited access to resources and poorer teaching and learning cultures, perpetuating existing social inequality.

CLASSROOMS AND ACHIEVEMENT

Educator and classroom characteristics explained 20 percent of the achievement variance.

It is clear from the results that resources matter for educational success. Learners achieved higher scores in schools with better resources. Learners having their own workbook was significantly associated with higher mathematics and science achievement. Overall, 83 percent of mathematics learners and 58 percent of science learners had their own workbooks.

The number of learners in a class matter. The average TIMSS class size was 44 learners (47 learners in no-fee schools and 38 learners in fee-paying schools). Fifty-seven percent of TIMSS Grade 5 learners were taught in classes with more than 40 learners. Learners in classes with less than 40 learners achieved significantly higher scores than those in classes with more than 40 learners.

The quality of instructional practices matters. Learners taught by educators rated as providing high instructional clarity in their lessons achieved significantly higher on the mathematics and science assessments.

LEARNER ATTITUDES TO MATHEMATICS AND SCIENCE

An interesting finding relates to learner attitudes towards mathematics and science, and their achievement. Positive attitudes and higher achievement go hand in hand, with each mutually reinforcing the other. Learner attitudes explained 20 percent of the achievement variation.

Learners who liked learning mathematics and science, and had a positive self-reflection of their mathematical and scientific abilities (i.e. confidence in learning), achieved higher scores.

IMPLICATIONS AND RECOMMENDATIONS FROM THE TIMSS RESULTS

While an individual's circumstance of birth remains a critical determinant of their subsequent educational and life trajectory, schools and classrooms still have the capacity to positively improve educational outcomes. There is wide recognition of the importance of building solid knowledge and skills foundations in the earlier years of schooling. Since mathematical and science knowledge acquisition is hierarchical in nature, subsequent learning is dependent on prior knowledge. Thus, we highlight five high-level recommendations, based on the TIMSS 2019 Grade 5 results, to improve educational outcomes in South Africa.

1. We were perplexed that South African Grade 5 mathematics scores did not change between the TIMSS 2015 and 2019 cycles. Thus, it is highly unlikely that the country's achievement scores will improve enough to achieve the Medium-Term Strategic Framework's (MTSF) 2019–2024 target score of 426 points in TIMSS

2023. To understand why there was no improvement in the Intermediate Phase, we recommend a **review of the primary school sector**, including a focus on issues such as support provided to primary schools in comparison to secondary schools; the effectiveness of interventions in Foundation Phase teaching and learning; the nature of teaching, learning and assessments in primary schools; and educators' subject knowledge and their teaching allocation (timetabling) in schools.

2. **Prioritise the first 1 000 days of formal learning, i.e. Grades RR, R and 1**, to plant strong educational roots and build solid foundations. All children must receive at least two years of pre-school education. Early learning must focus on both access to, and high quality, learning experiences in the first 1 000 days of formal learning. Children must be in cognitively rich and stimulating environments that focus on first language development and reading with meaning, basic computational skills and writing simple sentences. Learners must demonstrate proficiency in reading, writing and computation before progressing to the next grades.
3. **Increase the number of well-functioning schools**. About 30 percent of schools (mostly fee-paying) are considered as better functioning schools. The state must focus on whole school development with a key target being to increase the proportion of well-functioning schools so that schools can play the equalising influence role. Learners in no-fee schools depend on quality school inputs to improve educational outcomes. The whole school development focus must be on improving learning infrastructure; improving school climate by encouraging greater emphasis on academic success and making schools safer places for learners and educators; and improving instructional clarity in classrooms.
4. **Resource availability and how it is used matters**. In the short term, all learners must have their own mathematics and science workbooks, especially in remote rural schools. Decreasing class sizes is also an important piece of the resourcing puzzle: learners should be taught in smaller classes with less than 40 learners. The longer-term strategic interventions that are needed include increasing access to computers and Internet connectivity, and the availability of science laboratories and equipment.
5. Pay attention to building both learners' mathematics and science **knowledge, as well as the non-cognitive dimensions** of liking and being able to honestly appraise their abilities in these subjects. In the mutually reinforcing relationship between achievement and attitudes, the honest appraisal by learners of their ability to learn mathematics and science could be the start of a conversation about the effort that learners need to put into the learning process, and the support they require from homes and schools, to improve their achievement.

IN CONCLUSION

The South African education system remains a fragile one, and the coronavirus pandemic has dealt it a major blow, especially for the poor and most vulnerable groups. It is predicted that the country will not reach the achievement targets in the Intermediate Phase as set out in the MTSF.

TIMSS 2019 has provided an evaluation of the current South African education system, indicating that our learners are still experiencing multiple barriers to achievement. Building back better and building up the education system, within the context of limited financial and other resources, requires the state to make careful choices.

From the evidence, prioritising the first 1 000 days of a child's formal schooling by building strong educational foundations is an important leverage point to improve the educational performance of learners. This is especially so for learners in no-fee schools whose learning losses have been exacerbated as a result of the coronavirus pandemic. Within the context of school closures and disruptions and reduced and streamlined curricula over the last two years, our recommendation is to focus on building learners' reading, writing and computational skills in the earlier years. This would provide a solid foundation on which subsequent learning will depend.

As is the case with nearly all research investigating the influences on learner achievement, there is no single 'silver bullet' that will fix low performance and remediate years of unequal and socially graded performance throughout the system, but these results highlight that there are many areas that can and must be improved upon.