RESEP
Research on Socio-Economic Policy

Stellenbosch University Iyunivesithi Universiteit

forward together
sonke siya phambili
saam vorentoe

RESEARCH POLICY BRIEF

Department of Economics, Stellenbosch University

Policy Brief No.
04/25

NOVEMBER 2025

This research brief was produced as part of the MILAPS project, funded by Optima and utilises Data Driven Districts data

Heterogeneity in South African classrooms

Authors

Gabrielle Wills, Jess Qvist, Heleen Hofmeyr

OPTIMA

Research brief: Heterogeneity in South African classrooms

Date: November 2025

Author: Gabrielle Wills, Jess Qvist and Heleen Hofmeyr[1]

SUMMARY

In the context of South Africa, this research brief examines the extent of learning variation in classrooms – referred to here as "within-class heterogeneity". We find substantial differences in academic achievement among learners in the same grade within a school, and even within the same class. In primary schools, COVID-19 disruptions appear to be associated with increased within-class heterogeneity in reading and mathematics achievement, whereas in secondary schools, within-class heterogeneity in mathematics did not rise between pre- and post-pandemic assessments. Although highly mixed-ability classrooms pose instructional challenges, the level of within-class heterogeneity observed in South Africa is comparable to, or in some cases lower than, that found in other middle-income countries. These findings highlight the need for instructional strategies that support differentiated teaching to meet learners' diverse proficiency levels.

1 INTRODUCTION

South Africa's levels of learning inequality between schools have been well documented in previous research.[2] The most recent evidence indicates that by 2021 the gap between the wealthiest and poorest 10% of schools in Grade 4 reading equated to about 4-5 years of learning (Böhmer & Wills, 2025).

Learning inequality between schools is a concern where low achievement in under-resourced parts of the education system can undermine young people's future economic opportunities, reinforcing barriers to social mobility and resulting in a broader societal loss

1 All researchers at Research on Socio-Economic Policy, Stellenbosch University.

2 Pre-COVID learning inequality in South Africa, while high, was not uniquely unequal (Van der Berg, S. & Gustafsson, 2019) In 2016, South Africa's reading inequality was typical for its low performance level. But by 2021, South Africa's measure of reading inequality in the Grade 4 PIRLS assessment was much higher than expected for its low 2016 reading level (Böhmer & Wills, unpublished).

when children's potential remains undeveloped due to inadequate support (Sacerdote, 2011).

But in a context with high learning inequality between schools, what often receives less attention in the research is the extent to which there is variation or heterogeneity in learning within classrooms in South Africa. This is a topic of importance in educational research and practice. Heterogeneous (mixed-ability) classrooms can raise opportunities for peer learning and inclusive schooling but they also create serious instructional challenges, especially where class sizes are large, where there are large mismatches between learners' level of learning and the demands of a grade-based curriculum, and where teachers lack the requisite skills and resources to adapt their instruction for a highly mixed ability classroom (Oketch, Rolleston & Rossiter, 2020). Heterogeneity is also an increasingly topical subject as education systems increasingly move away from grade repetition to more restricted grade repetition practices or automatic progression (OECD, 2023).

In this brief, we aim to answer four research questions:

1. What is the extent of within-class heterogeneity in South African primary and secondary schools as reflected in international assessments such as the Progress in International Reading and Literacy Study (PIRLS) and the Trends in International Mathematics and Science Study (TIMSS)?
2. Was within-grade heterogeneity exacerbated during and after the COVID-19 pandemic?
3. How does heterogeneity vary by school's socio-economic status?
4. How does South Africa's within-class heterogeneity compare to other middle-income countries participating in TIMSS?

Heterogeneous (mixed-ability) classrooms can raise opportunities for peer learning and inclusive schooling but they also create serious instructional challenges.

To answer these questions, we use a combination of TIMSS Grade 5 and 9 data on mathematics outcomes, PIRLS Grade 4 reading data and end-of-year student marks from six South African provinces as reported in Data Driven Districts (DDD) data (which is a version of SA-SAMS). In this study, when we identify "within-class" heterogeneity measures, they are either specific to one or two classes in a grade within a school, or across an entire grade within a school. This is due to the nature of how students are sampled in TIMSS and PIRLS. More than one class may be sampled, especially if schools implement ability tracking, or classes may be combined if they are very small (LaRoche, Joncas & Foy, 2020).[3] When analysing DDD data, we obtain estimates from across an entire grade within schools. While it may be more correct to refer to "within-grade" heterogeneity in our analysis, we stick to the term "within-class" heterogeneity to make it clear that the results refer to differences in learning in a grade within a school as opposed to differences within a grade across schools.

1.1 What is the extent of within-class heterogeneity in South African primary and secondary schools?

At the primary level in South Africa, we observe considerable within-class heterogeneity. Analysis of Grade 4 PIRLS reading results for South Africa suggests that in 2021 there was roughly a four-year learning gap in reading in Grade 4 classrooms between a typical learner at the 10th and 90th percentile within a class (Böhmer & Wills, 2025). This is suggested in the first panel of Table 1. In PIRLS, the best estimate we have of a year of learning in South African samples is about 55-60 PIRLS points[4], so that an average gap of 218 points between the 10th and 90th percentile learner across classrooms is roughly 3.6-4 years of learning (Böhmer & Wills, 2025). In TIMSS Grade 4/5 there is little evidence yet as to what constitutes a typical year of learning.[5]

Within-class heterogeneity in mathematics is also very high in secondary schools. The average range in Grade 9 mathematics scores within a school between learners at the 10th and 90th percentile was 125 TIMSS points in 2023. This could represent a gap of as much as 6 years in learning on average in a grade within a school, assuming 21 TIMSS points represents a year of learning between Grade 8 and 9 in South Africa.[6]

One would expect that learning trajectories would widen over time between learners who did and did not grasp the fundamentals of literacy and numeracy in earlier primary grades, so that more within class heterogeneity is expected by Grade 9 than Grade 5 (Spaull & Kotze, 2015). It would be useful to explore this further in future analysis using the South African Systemic Evaluation which contains vertically linked standardised assessment data from Grades 3 to 6, and 6 to 9.

---

3 In TIMSS, a school is considered as participating if at least one of its sampled classes has a student participation rate of at least 50 percent. In the South African Grade 9 sample in 2023, in 62 schools just one class was sampled while in 218 schools, two classes were sampled (Department of Basic Education, 2024a).

4 A year of learning in South Africa equates to roughly 55–60 PIRLS points, based on the 2016 assessment of Grade 4 and 5 cohorts (Böhmer & Wills, 2025). The Grade 5 sample in 2016 covered Afrikaans, English, and isiZulu learners, with mean differences of 55 points for isiZulu and 62 points across all three groups between Grade 4 and 5 cohorts. Assuming untested language groups align more closely with isiZulu performance, a year of learning prior to the pandemic may lie between 55 and 60 PIRLS points.

5 A longitudinal component to TIMSS Grade 4/5 will be released in January 2026. While South Africa has not participated in this longitudinal study, it should provide some clues as to learning over a year in other international contexts.

6 In 2003, South Africa participated in TIMSS at both the Grade 8 and 9 level. On average, Grade 9s scored 21 TIMSS points higher at 285 TIMSS points than the Grade 8 sample that performed at an average of 264 points (Reddy, 2021).

Table 1: Range and inequality in PIRLS reading and TIMSS mathematics scores within schools in South Africa, school-weighted

	PIRLS grade 4				TIMSS Grade 5 math				TIMSS Grade 9 math		
School level variable	**2016**	**2021**	**Diff ('21-'16)**		**2019**	**2023**	**Diff ('23-'19)**		**2019**	**2023**	**Diff ('23-'19)**
Standard deviation	73.5	84.6	11.1***		62.7	69.2	6.5***		48.4	48.7	0.3
	(1.3)	(1.0)	(1.6)		(1.0)	(1.0)	(1.3)		(0.6)	(0.9)	(1.0)
Range p25 to p75	102	122	20.1***		85.4	96.3	10.9***		64	66.1	2
	(2.8)	(2.4)	(3.9)		(1.3)	(2.1)	(2.6)		(1.3)	(1.4)	(1.9)
Range p10 to p90	194	218	24.5***		163	179	15.8***		123	125	1.5
	(3.2)	(3.0)	(4.3)		(2.8)	(3.4)	(4.7)		(2.2)	(2.5)	(3.2)
Range p5 to p95	235	271	36.6***		202	225	22.8***		159	159	0.2
	(3.7)	(3.6)	(5.2)		(3.8)	(3.5)	(5.1)		(2.3)	(2.4)	(3.2)

Source: PIRLS Grade 4 results from Böhmer & Wills (2025). Grade 5 and 9 TIMSS estimates calculated from raw data. Notes: Means are school-weighted with standard errors in parentheses. *** reflects that differences are significant at 1% level. Ranges are calculated at the school level using the mean of the 5 plausible reading achievement values and are student-weighted within the school. Once ranges were obtained at the school level, the means, differences and standard errors in brackets were calculated with school weights using jack-knifing, using Stata's repest or pv command.

Table 2: Percentage of learner samples meeting PIRLS / TIMSS international benchmarks, scoring below a very low score of 200 and the percentage with scores too low for estimation

	PIRLS Grade 4 reading		TIMSS Grade 5 math		TIMSS Grade 9 math	
	2016	**2021**	**2019**	**2023**	**2019**	**2023**
Below Very Low[a] (<200 points)	13.4 (1.0)	26.5 (1.2)	2.6 (0.4)	6.0 (0.7)	0.2 (0.1)	0.3 (0.1)
Very Low (200 - 400 points)	64.6 (1.2)	54.1 (1.2)	60.1 (1.4)	59.2 (1.1)	59.1 (1.3)	54.6 (1.6)
Low (400 - 475 points)	14.5 (0.7)	10.8 (0.6)	21.1 (0.9)	17.9 (0.7)	27.6 (1.0)	30.6 (1.2)
Intermediate (475 - 550 points)	5.6 (0.7)	5.6 (0.6)	11.0 (0.7)	10.6 (0.6)	10.0 (0.5)	10.7 (0.8)
High & Advanced (≥550 points)	1.9 (0.4)	3.0 (0.5)	5.2 (0.5)	6.4 (0.8)	3.2 (0.3)	4.0 (0.8)
	100	**100**	**100**	**100**	**100**	**100**
% too low for estimation[b]	8 (0.6)	> 25	6 (0.4)	10 (0.1)	26 (0.7)	20 (0.8)

Source: PIRLS estimates from Böhmer & Wills (2025) using South African Grade 4 PIRLS Literacy 2016 and PIRLS 2021 datasets. Notes: [a]The "Very low" threshold is set at 200 points. Standard errors shown in brackets, calculated using jack-knifing at up to 250 sample schools with 125 zones, using either repest or PV commands. Neither are the TIMSS and PIRLS scales directly comparable, nor are Grade 5 and 9 TIMSS scales. [b]Reflects the percentage of students whose assessment performance was so poor that it was no better than what could be achieved by randomly guessing on multiple-choice questions.

1.2 Was within class heterogeneity exacerbated during and after the COVID-19 pandemic?

Within-class heterogeneity in reading in South African primary classrooms widened during and just after COVID-19 disruptions to education. Within schools in South Africa, the average gap in PIRLS Grade 4 reading scores between a learner at the 10th percentile and a learner at the 90th percentile grew from 193 points in 2016 to 218 points in 2021. A gap of 218 PIRLS points represents a learning gap of about 3.6 to 4 years (where a year of learning in PIRLS in South Africa is about 55-60 points (Böhmer & Wills, 2025)).

It is possible, however, that the increase in within-class heterogeneity in reading scores from 2016 to 2021 may have been even larger, where floor effects on the PIRLS 2021 assessment present a concern for reliably estimating very low levels of reading skills, COVID-19 school disruptions led to stunted development of the most foundational reading skills in primary grade cohorts (Ardington, Wills & Kotze, 2021). The percentage of the learner sample with scores too low for reliable estimation increased from 8% to over 25% between the 2016 and 2021 PIRLS assessments as seen in Table 2. Floor effects present less of a concern for interpreting TIMSS Grade 5 mathematics outcomes.

In Grade 5 mathematics, within-class heterogeneity also grew between the years 2019 and 2023. For example, the average gap in learning between a Grade 5 learner at the 10th and 90th percentile within a school increased from 163 points in 2019 to 179 points in 2023. However, **at the secondary school level (Grade 9), within-class heterogeneity in mathematics did not increase significantly between 2019 and 2023.**

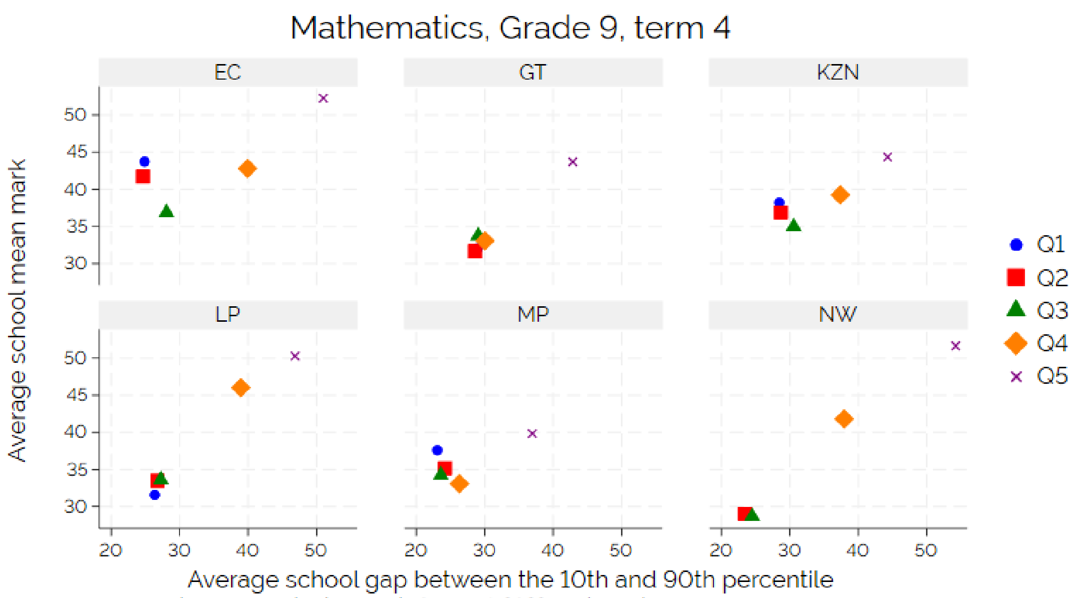
COVID-19 disruptions appeared to augment within-class heterogeneity in reading and mathematics in South African primary schools.

1.3 How does heterogeneity vary by a school's socio-economic status?

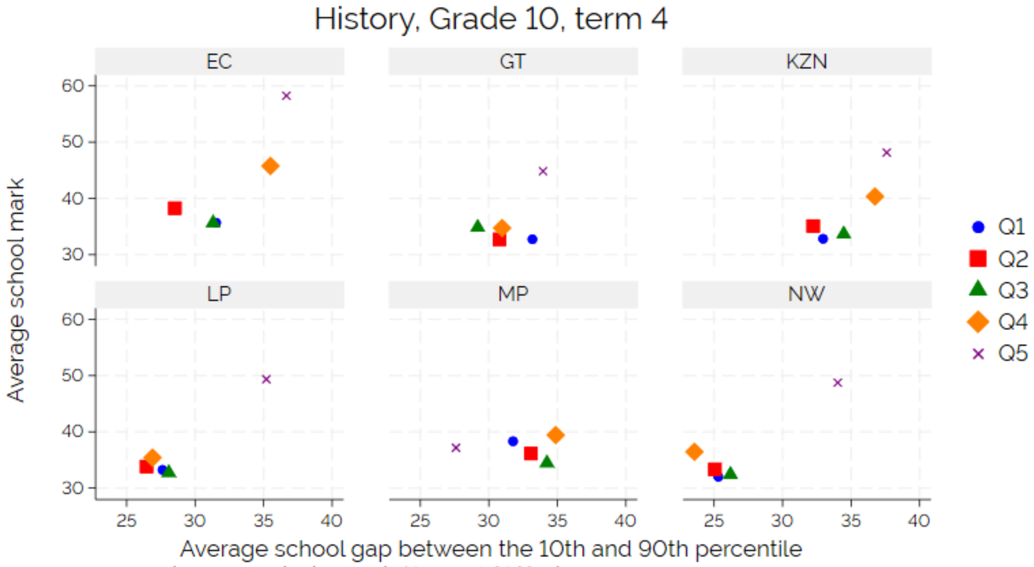
There does not appear to be a consistent pattern in how within-class learning heterogeneity varies by the schools' socio-economic status in South Africa. Patterns change depending on the grade, subject, term, province and dataset one uses to measure this. But there is possibly more support for the existence of higher levels of heterogeneity in learning outcomes in more affluent schools than in less resourced schools. This is seen in Figure 1, drawing on term 4 learner marks in 2023 for six of nine South African provinces. In Grade 9 Mathematics and Grade 10 History there was typically more within-class heterogeneity (as measured by the average within-school range between the 10th and 90th percentile mark) in Quintile 5 schools than in Quintile 1 schools. But the same pattern does not necessarily hold for Grade 9 English First Additional Language, taken by a more select population of learners. But on average, term 4 student marks were typically higher in Quintile 5 schools than Quintile 1 schools in all three figures.

In TIMSS 2023 Grade 9 Mathematics, there is little evidence that within-class heterogeneity is any larger in poorer schools than in wealthier schools. Using classical scores (the percent of items correct), the very poorest schools (in the first socio-economic decile) are identified as having the most homogenous group of students with very low mathematics proficiencies.

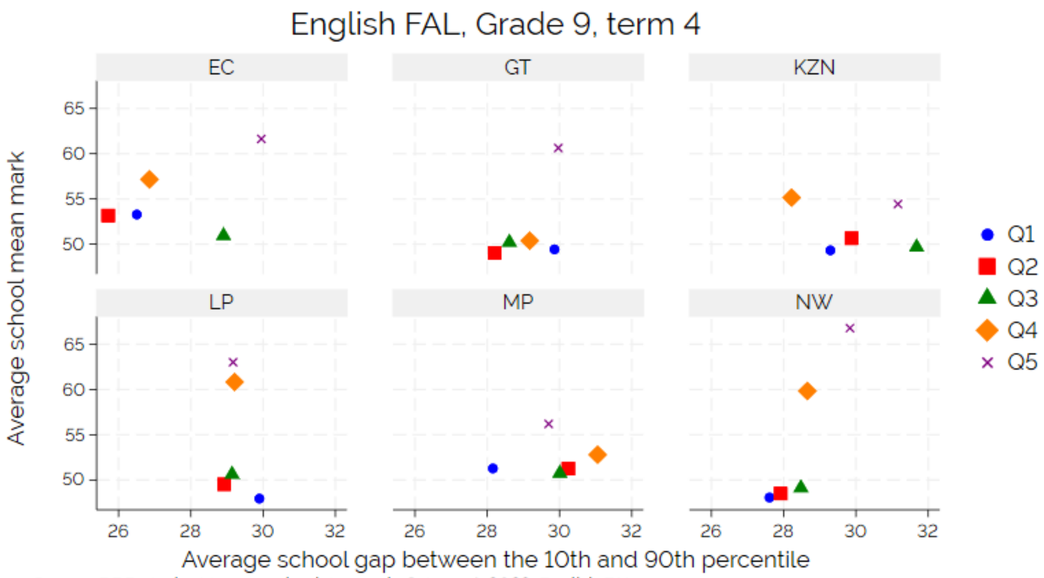
Figure 1: Average student marks vs. average within-school gap between 10th and 90th percentile mark in selected grades and school subjects by school Quintile, 2023 Data Driven Districts data for six provinces



Source: DDD student term marks data, grade 9, term 4, 2023. Mathematics.
Gap reflects the average of each school's gap between the 10th and 90th percentile mark.



Source: DDD student term marks data, grade 10, term 4, 2023. History.
Gap reflects the average of each school's gap between the 10th and 90th percentile mark.

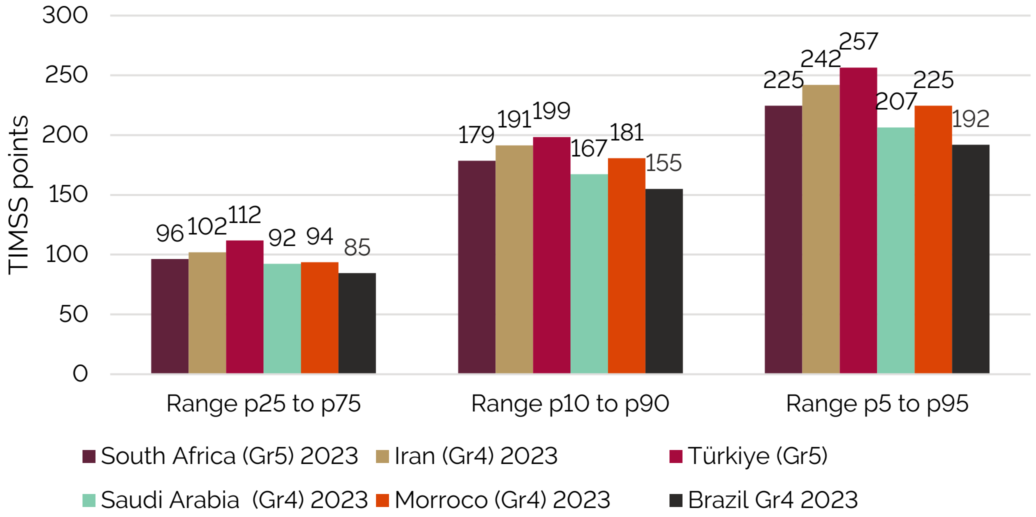


Source: DDD student term marks data, grade 9, term 4, 2023. English FAL.
Gap reflects the average of each school's gap between the 10th and 90th percentile mark.

1.4 How does the extent of within-class heterogeneity in South Africa compare to other middle-income countries participating in TIMSS?

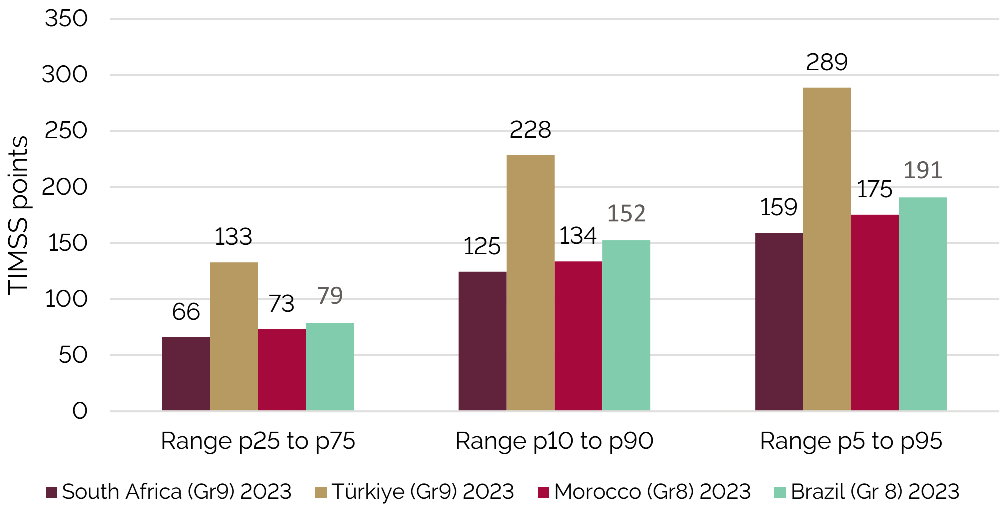
Within-class heterogeneity in school achievement in South Africa, while sizeable, is not unusual when compared to some other middle-income countries. Using TIMSS 2023 data for selected countries we calculate the national average of each school's mathematics score gap between the 25th or 75th percentile student, or the 10th and 90th percentile student or the 5th and 95th percentile student. In 2023, within-class heterogeneity in mathematics at the Grade 5 level in South Africa was roughly similar to what is seen in other middle-income countries including Iran, Türkiye, Saudia Arabia, Morocco or Brazil (see Figure 2). And within-class heterogeneity in Grade 9 mathematics was comparatively larger in countries such as Türkiye, Morrocco or Brazil compared to what is seen in South Africa (see Figure 3). In Türkiye, there are many schools where the range between the 10th and 90th percentile student in Grade 9 is more than 250 TIMSS points as seen in Figure 4.

Figure 2: Grade 4/5 within-school heterogeneity in TIMSS mathematics, select middle-income countries, 2023



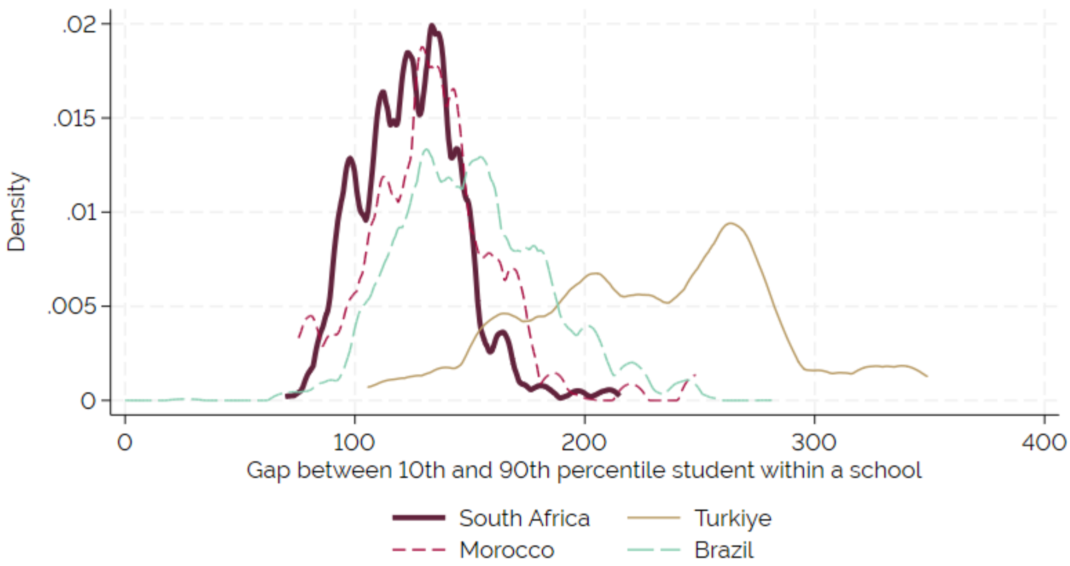
Source: Own calculations from TIMSS 2023 Grade 4/5 data. Notes: Means are school-weighted with standard errors in parentheses (*** significant at 1% level). Ranges are calculated at the school level using the mean of the 5 plausible reading achievement values and are student-weighted within the school. Once ranges were obtained at the school level, the means, differences and standard errors in brackets were calculated with school weights using jack-knifing with 125 zones, using Stata's pv command.

Figure 3: Grade 8/9 within-school heterogeneity in TIMSS mathematics, select middle-income countries, 2023



Source: Own calculations from TIMSS 2023 Grade 8/9 data. Notes: Means are school-weighted with standard errors in parentheses (*** significant at 1% level). Ranges are calculated at the school level using the mean of the 5 plausible reading achievement values and are student-weighted within the school. Once ranges were obtained at the school level, the means, differences and standard errors in brackets were calculated with school weights using jack-knifing with 125 zones, using Stata's pv command.

Figure 4: Distribution of the within-school range in Grade 8/9 TIMSS mathematics scores between the 10th and 90th percentile student, select middle-income countries, 2023



Source: Own calculations from TIMSS Grade 8/9 data, 2023.
Notes: Ranges calculated based on average of 5 plausible values and are student-weighted.

2 IMPLICATIONS

South African teachers face challenges of having to accommodate large differences in the learning levels of students in their classrooms. But this brief demonstrates that this problem is not unique to South Africa.

Reducing inequality in learning is valuable, but only if it results from lifting the performance of the lowest-achieving learners rather than holding back those already on track to succeed. The priority is supporting teachers to improve outcomes for learners performing at lower levels of learning while continuing to create extension opportunities for more proficient learners.

One way to do this is to group learners according to performance on diagnostic tests and assigning different activities to each group – a strategy known as differentiated instruction or "teaching at the right level". Many field experiments have shown that this pedagogy can effectively boost learning outcomes (Banerjee et al., 2016). However, we know little about its success as part of regular classroom instruction as the bulk of these interventions were after-school tutoring programmes or holiday camps (Ganimian & Djaker, 2023). There is some evidence that teachers may be reluctant to implement this pedagogy, given concerns that doing so would take time away from the limited time available to cover the curriculum (Banerjee et al., 2016). Preliminary evidence from a local pilot project lends support to these concerns, showing that just the first step in the differentiated instruction process, namely administering diagnostic assessments, could take up almost an entire week of Home Language instruction time (Lobelo et al., 2023). In addition, teachers need excellent classroom management skills to be able to keep learners busy while conducting individual assessments. Another concern regarding the feasibility of differentiated instruction in South Africa is the expertise required to facilitate small-group learning, which is very different from whole-class ("chalk and talk") instruction. Although it has been shown that when trained and mentored, teacher assistants[7] can play a key role in supporting teachers with classroom management, increasing the frequency of small group and one-on-one teaching with significant positive effects for learning (SALDRU, 2024).

Personalised adaptive learning (PAL) software, which delivers individualised content to each learner, could also support differentiated instruction at scale and thereby address within-class heterogeneity (Muralidharan & Singh, 2025). Adopting technology-aided instruction in South Africa will require major infrastructure and hardware investments, however, given low rates of penetration of digital technology (Department of Basic Education, 2023) and internet connectivity (Department of Basic Education, 2024b). Given the significant fiscal constraints, the most viable approach is likely to involve public–private partnerships, as seen in other LMICs implementing technology-aided instruction. However, experimentation and piloting of different technology platforms in varied school settings is a necessary step before adopting new technologies.

3 CONCLUSION

The evidence presented in this brief highlights that large learning gaps within classrooms are a defining feature of South African schooling. While the scale of these disparities mirrors those seen in other middle-income countries, they remain a constraint to improving overall learning outcomes. Addressing this challenge requires rethinking classroom practice to ensure that instruction is aligned with learners' current proficiency levels. Differentiated instruction provides a proven pedagogical framework, yet its effective classroom implementation remains difficult given time, skill, and resource constraints. Personalised adaptive learning technologies, supported through strategic public–private partnerships, could potentially offer a route to making differentiated instruction a routine and sustainable part of South African classrooms. Effectively utilising trained teacher assistants within the education system could also potentially support differentiated instruction in classrooms.

[7] Presidential Youth Employment Initiative (PYEI) through the Department of Basic Education (DBE) offered Teaching Assistant positions to unemployed youth in 2022 and 2023.

4 REFERENCES

Ardington, C., Wills, G. & Kotze, J. 2021. COVID-19 learning losses: Early grade reading in South Africa. International Journal of Educational Development. 86:102480. DOI: 10.1016/j.ijedudev.2021.102480.

Banerjee, A., Banerji, R., Berry, J., Duflo, E., Kannan, H., Mukherji, S., Shotland, M. and Walton, M., 2016. Mainstreaming an effective intervention: Evidence from randomized evaluations of "Teaching at the Right Level" in India. *NBER Working Paper No. w22746.*

Böhmer, B. & Wills, G. 2025. COVID-19 and inequality in reading outcomes in South Africa: PIRLS 2016 and 2021. Large-scale Assessments in Education. 13(1):24. DOI: 10.1186/s40536-025-00256-9.

Department of Basic Education. 2023. *Education Facility Management System (EFMS) report, as August 21 2023*. Pretoria.

Department of Basic Education. 2024a. South African 2023 Trends in International Mathematics and Science Study (TIMSS) Highlights Report. Pretoria. Pretoria.

Department of Basic Education. 2024b. The 2022 School Monitoring Survey: Percentage of schools meeting minimum physical infrastructure standards. DBE Policy Brief. Pretoria.

Ganimian, A. J. & Djaker, S. 2023. *How Can Developing Countries Address Heterogeneity in Students' Preparation for School? A Review of the Challenge and Potential Solutions.* Working Paper.

LaRoche, S., Joncas, M. & Foy, P. 2020. Chapter 3: Sample design in TIMSS 2019. TIMSS and PIRLS International Study Centre, Lynch School of Education, Boston College. Available: https://timssandpirls.bc.edu/timss2019/methods/pdf/T19_MP_Ch3-sample-design.pdf.

Lobelo, A., Nyathi-Mohohlwane, N., Sebaeng, L., Zwane, Z. Mphahlele, R. & Ardington, C. 2023. *Teacher benchmark usage pilot study summary report.* Department of Basic Education.

Muralidharan, K. & Singh, A. 2025. Adapting for scale: Experimental evidence on technology-aided instruction in India. *NBER Working Paper No. 34205.*

OECD (2023), PISA 2022 Results (Volume II): Learning During – and From – Disruption, PISA, OECD Publishing, Paris, https://doi.org/10.1787/a97db61c-en.

Oketch, M., Rolleston, C. & Rossiter, J. 2020. Teacher Value-Added Using Young Lives Ethiopia School Survey Data - Diagnosing the Learning Crisis: Potential Applications of Value-Added Analysis.

Reddy, V. 2021. 25 years of TIMSS in South Africa: Improved achievements but pace of improvement is slowing. HSRC Review. HSRC Review. 19(2).

Sacerdote, B. 2011. Peer Effects in Education: How Might They Work, How Big Are They and How Much Do We Know Thus Far? 249–277. DOI: 10.1016/B978-0-444-53429-3.00004-1.

SALDRU. 2024. Funda Wande Limpopo Workbooks Evaluation Endline Report 2024. Cape Town. Available: https://fundawande.org/wp-content/uploads/2025/03/FW-LP-Endline-Report-April-2024-V03-1.pdf.

Spaull, N. & Kotze, J. 2015. Starting behind and staying behind in South Africa. International Journal of Educational Development. 41:13–24. DOI: 10.1016/j.ijedudev.2015.01.002.

Van der Berg, S. & Gustafsson, M. 2019. Educational Outcomes in Post-apartheid South Africa: Signs of Progress Despite Great Inequality. In South African Schooling: The Enigma of Inequality: A Study of the Present Situation and Future Possibilities. Springer ed. N.S.& J. Jansen, Ed. Switzerland. 25–45.

Wills, G. 2025. Gender and equity in South African education: Report summary. Stellenbosch.