TIMSS 2019

Highlights of South African Grade 5 and 9 Results in Mathematics and Science

Human Sciences Research Council, 8 December 2020

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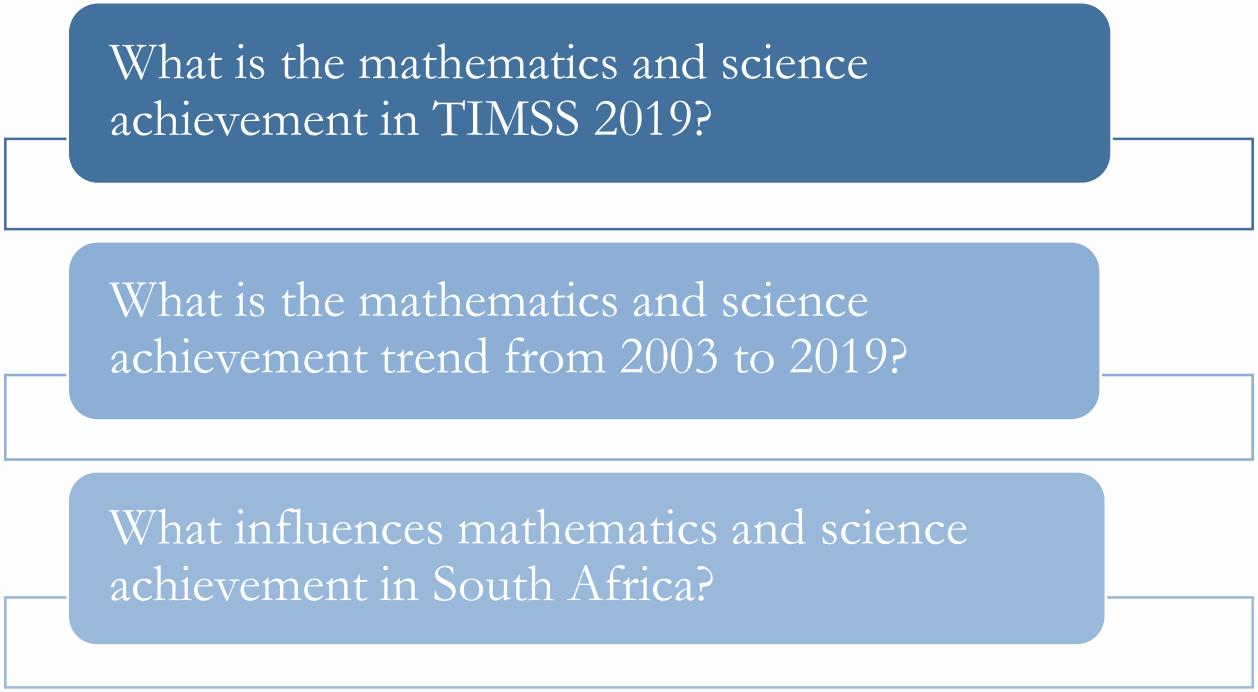
Appreciations

- The Department of Basic Education: Minister, Deputy Minister, Director-General and officials for supporting research
- Provincial co-ordinators who facilitated access to schools
- Principals, educators and learners who allowed us into their schools and classrooms
- HSRC Researchers and administrative staff who went beyond the call of duty

What is TIMSS?

- The Trends in International Mathematics and Science Study (TIMSS) is a cross-national assessment of the mathematics and science knowledge of 4/5th Grade and 8/9th Grade learners.
- The key research questions framing the analysis of the South African TIMSS 2019 data are:



Who participated in TIMSS 2019?

Grade 4/5

- 64 countries and entities
- Nationally representative school sample
- **Realised sample:** 297 schools, 294 Mathematics & science teachers; 11 903 learners and 11 720 parents/guardians

Grade 8/9

- 46 countries and entities
- Nationally representative school sample
- **Realised sample:** 519 schools; 543 Mathematics & Science teachers; 20 829 learners

TIMSS Items: Grade 5 Mathematics

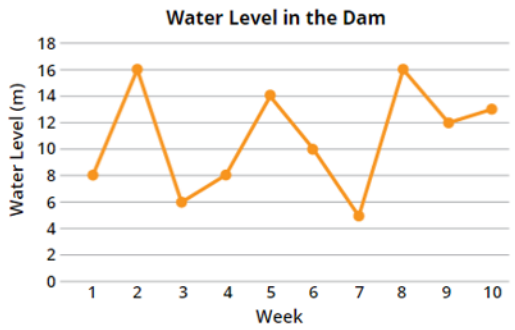
Country	Percent full credit
Japan	95
Singapore	92
Sweden	86
France	68
International average	**68**
Albania	68
Chile	61
Qatar	60
Croatia	59
North Macedonia	52
South Africa (5)	**52**
Iran, Islamic Rep. of	50
Georgia	48
Philippines	28
Pakistan	21

Content Domain: Data

Cognitive Domain: Knowing

Description: Reads data from a line graph

The graph shows the water level in a dam for 10 weeks.



What was the water level for week 8?

Answer: 16 m

The answer shown illustrates the type of response that would receive full credit (1 point).

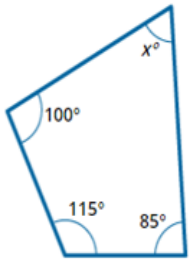
TIMSS Items: Grade 9 Mathematics

Country	Percent full credit
Singapore	90
Japan	89
Cyprus	63
Portugal	57
International average	**56**
Italy	55
Malaysia	52
Lebanon	51
Iran, Islamic Rep. of	51
Israel	46
Western Cape (9)	**44**
United States	39
Gauteng (9)	**37**
France	36
Kuwait	32
Saudi Arabia	30
South Africa (9)	**27**
Chile	26
Morocco	26

Content Domain: Geometry

Cognitive Domain: Applying

Description: Determines the value of an angle in an irregular quadrilateral given the values of the other angles



What is the value of x?

$x =$ 60

The answer shown illustrates the type of response that would receive full credit (1 point).

1. Achievement Story

Building Achievement and Bridging Achievement Gaps

- Achievement & Ability
- Achievement Trends
- Achievement Gaps
- Match between TIMSS and CAPS

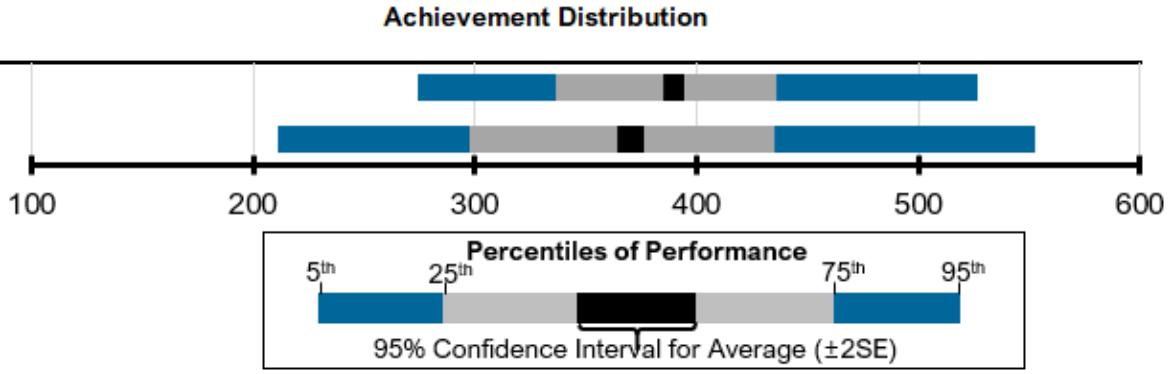
Average mathematics and science achievement and score distributions, 2019

Grade 5

	Average Scale Score (SE)
Mathematics	374 (3.6)
Science	324 (4.9)

Grade 9

	Average Scale Score (SE)
Mathematics	389 (2.3)
Science	370 (3.1)



Science has wider distribution and starts at much lower scores than mathematics. Science needs attention.

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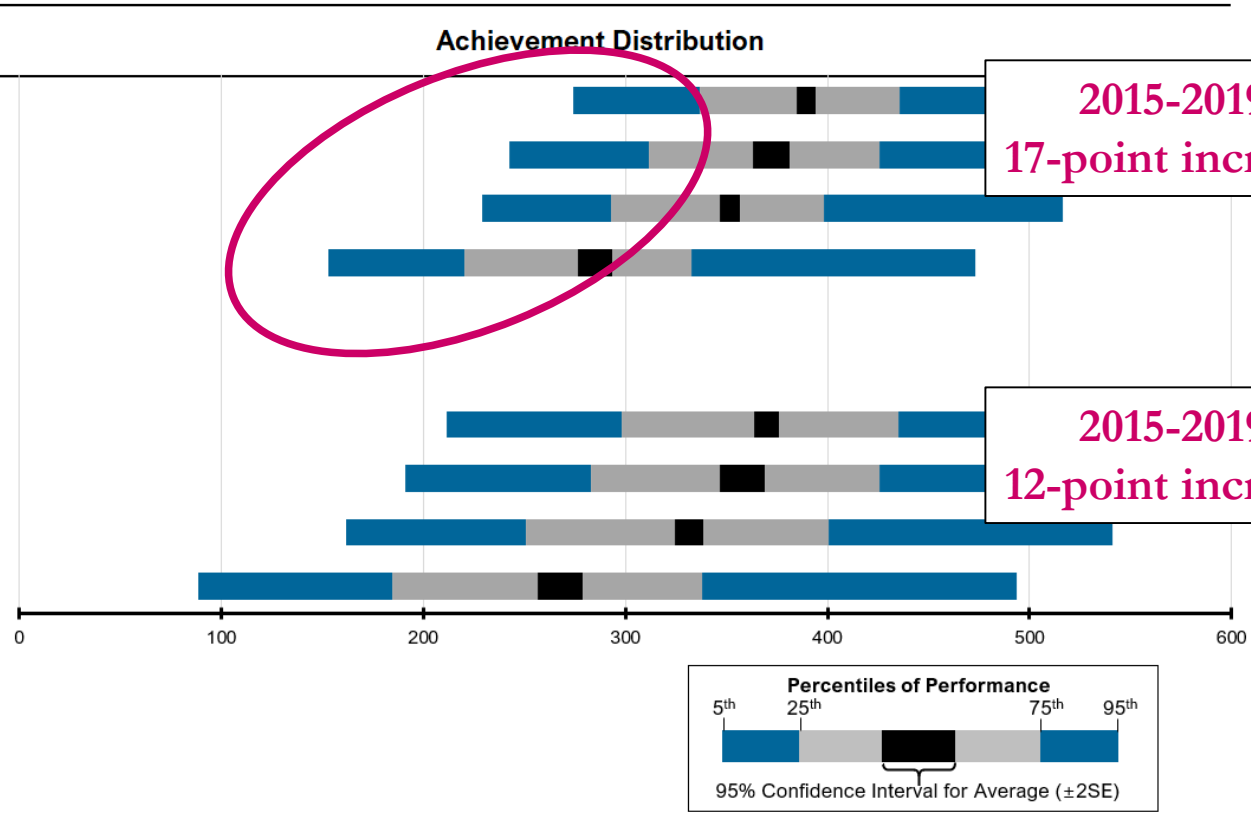
Change in Grade 9 mathematics and science achievement, 2003 to 2019

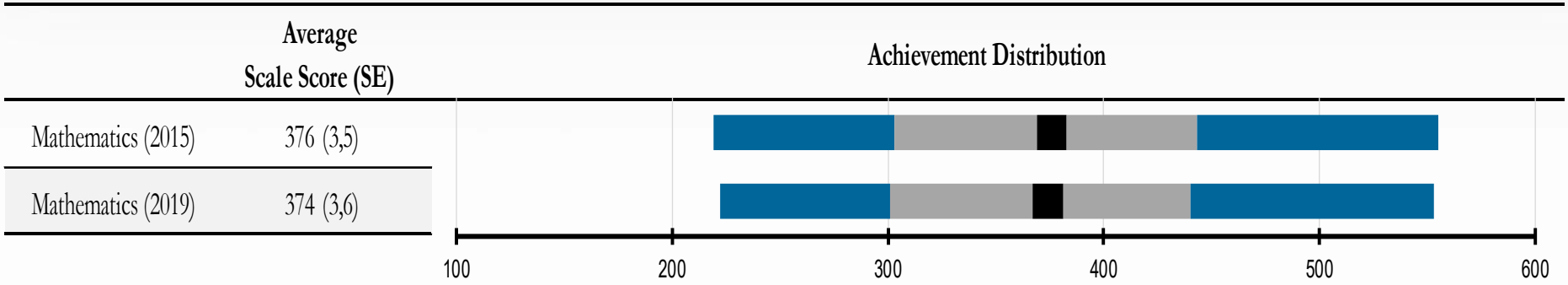
Over 25 years, achievement improved by one standard deviation (100 points)

Mathematics	Average Scale Score (SE)
TIMSS 2019	389 (2.3)
TIMSS 2015	372 (4.5)
TIMSS 2011	352 (2.5)
TIMSS 2003	285 (4.2)

Science	Average Scale Score (SE)
TIMSS 2019	370 (3.1)
TIMSS 2015	358 (5.6)
TIMSS 2011	332 (3.6)
TIMSS 2003	268 (5.5)



Grade 5 South African achievement: 2015 -2019



No mathematics achievement change from 2015 to 2019

- From the data, the only significant changes observed were decreases in Mpumalanga and Independent schools.
- Need to look for reasons of no changes outside TIMSS data.
- Different patterns in primary and secondary schools?

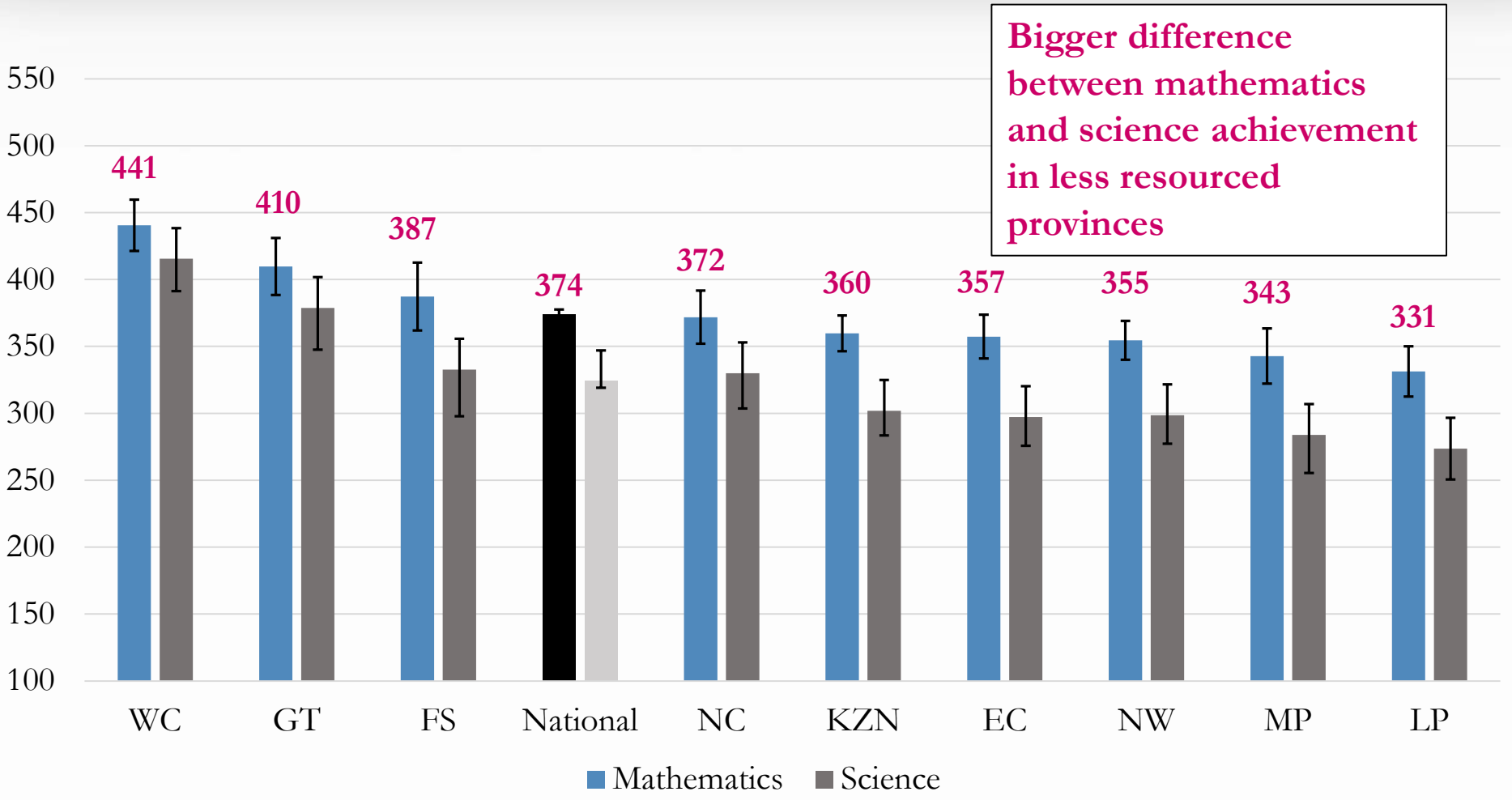
Grade 9 performance by ability level, 2019

Mathematics				Science
Apply and reason in a variety of problems situations and make generalisations.	1%	Advanced benchmark (625)	1%	Communicate understanding of concepts related to biology, physical, and earth sciences in a variety of contexts.
Apply knowledge and understanding in complex situations.	3%	High benchmark (550)	5%	Apply knowledge and understanding of concepts from biology, physical, and earth sciences.
Show and apply basic mathematical knowledge in a variety of situations.	13%	Intermediate benchmark (475)	15%	Have and apply basic knowledge of biology, physical, and earth sciences.
Show some knowledge of whole numbers and basic graphs.	41%	Low benchmark (400)	36%	Have some knowledge of biology, physical, and earth sciences.

Learnings from achievement over 25 years

- Mathematics achievement increase from 2003 to 2019 is 104 points, and science is 102 points. Improvement of 1SD from 1994 to 2019.
- Best improvement at lower end of distribution.
- In 2019, four in ten learners compared to 2003 when one in ten learners demonstrated they had acquired basic mathematical and science knowledge.
- Annual (Mathematics) achievement improvement rate from **2003 to 2011 was 7.4** points and from **2011 to 2019 was 4.6 points**.
- Need to increase annual improvement rate to meet the MTSF achievement target of 420 points by 2023.

Provincial Achievement and Gaps, Grade 5, 2019



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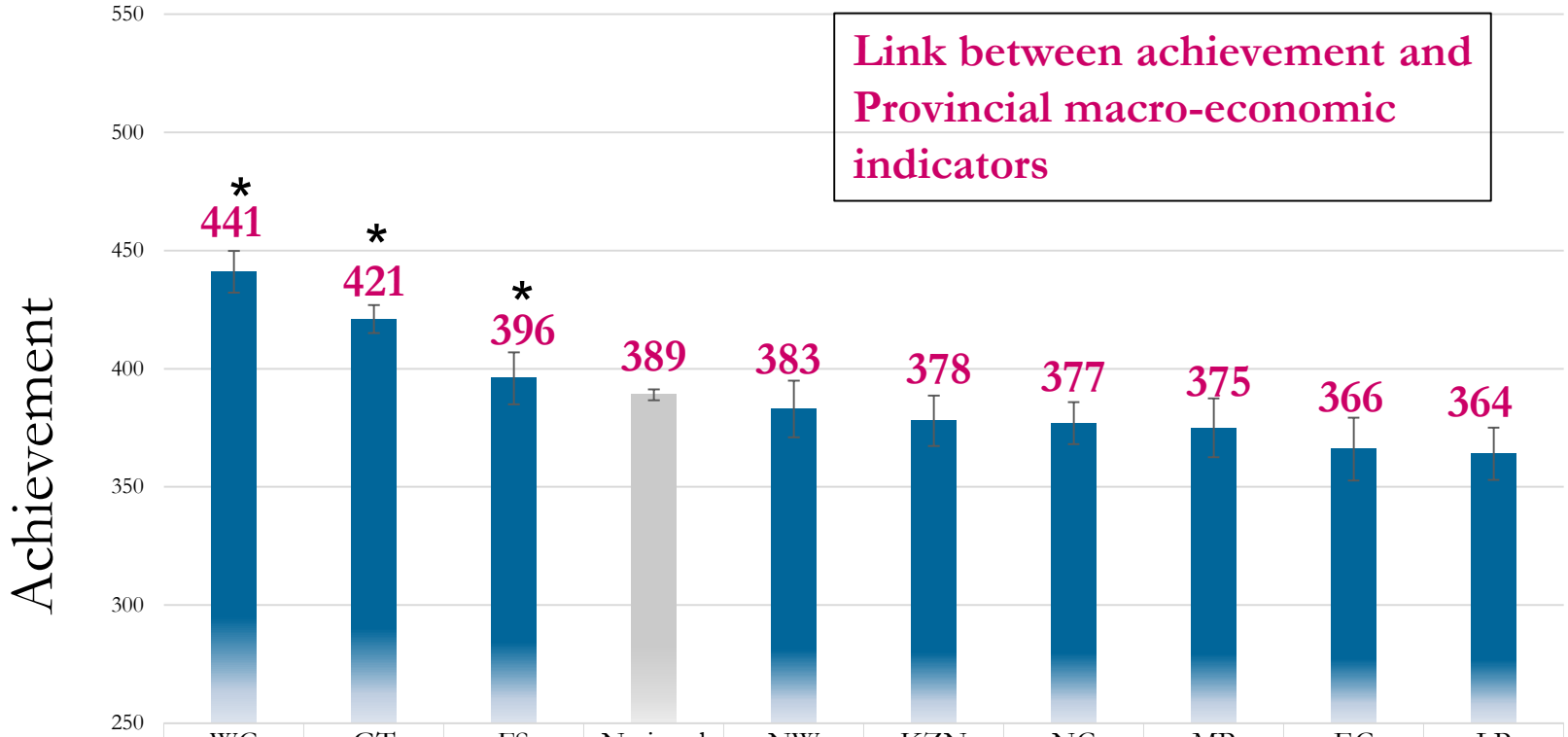
Provincial Achievement and Gaps, Grade 9, 2019



	WC	GT	FS	National	NW	KZN	NC	MP	EC	LP
Mathematics	441	421	396	389	383	378	377	375	366	364
GDP per capita (R000's)	98	111	80	82	77	66	80	78	55	59
Poverty Rate (%)	37,1	33,3	54,9	55,5	64,3	68,1	59,0	59,3	72,9	72,4
School Population (mil)	1,1	2,2	0,7	12,4	0,8	2,8	0,3	1,1	1,8	1,7
% Learners in Q 1,2,3 schools	40	54	84	74	88	75	70	71	92	96

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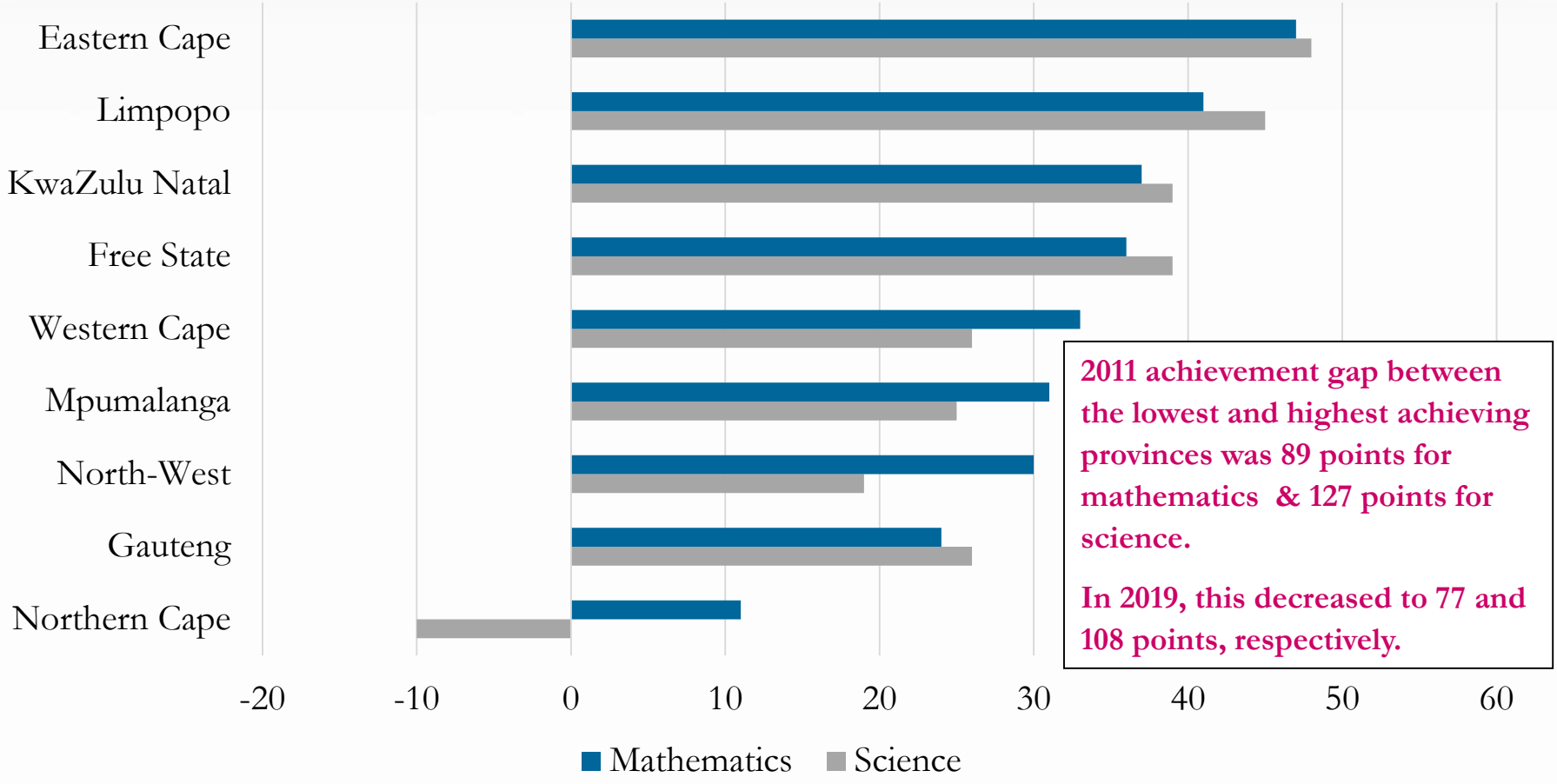
Change in Grade 9 mathematics and science achievement by province, 2011 to 2019



2011 achievement gap between the lowest and highest achieving provinces was 89 points for mathematics & 127 points for science.

In 2019, this decreased to 77 and 108 points, respectively.

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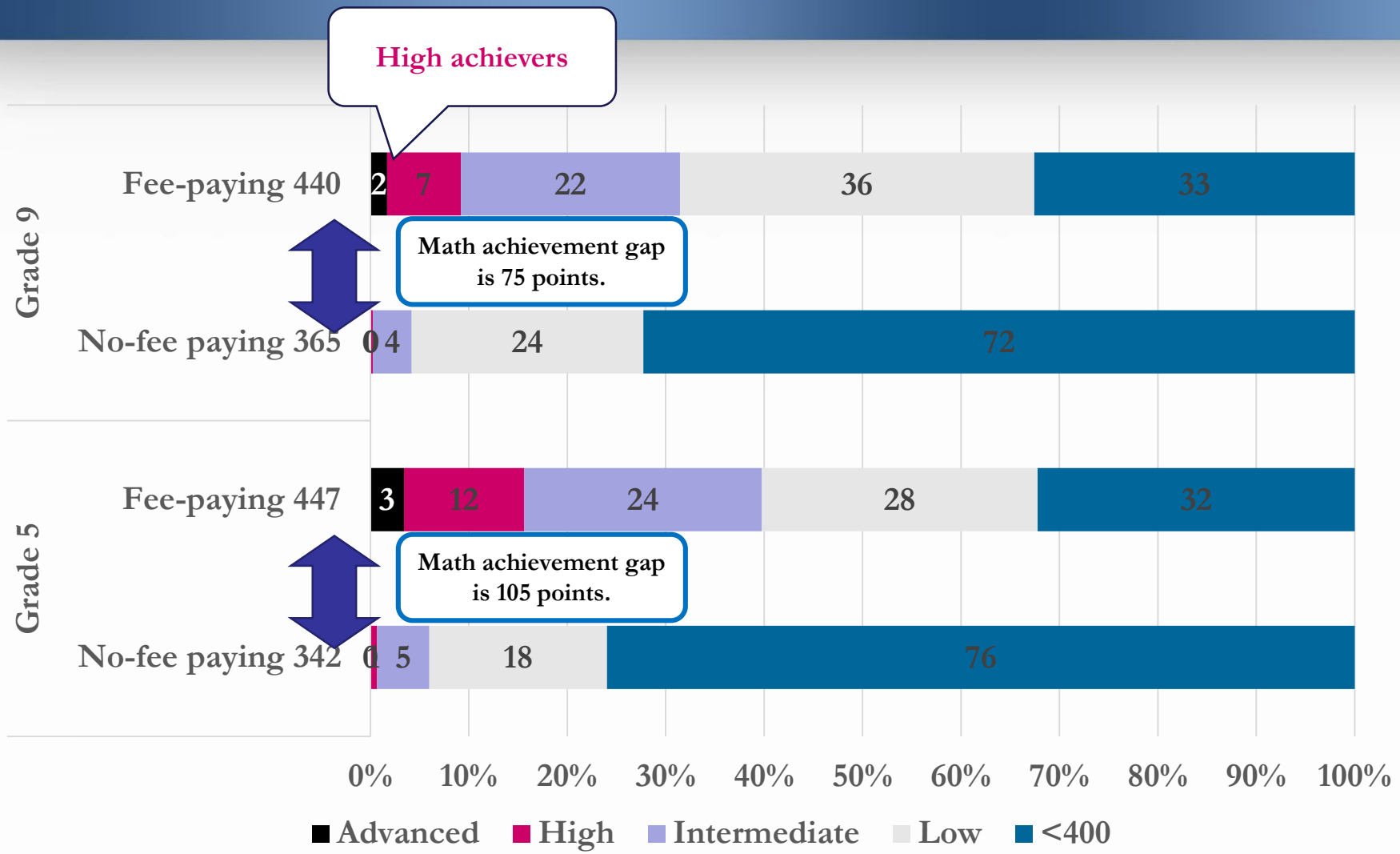
Mathematics Achievement by School fee-status & Gap



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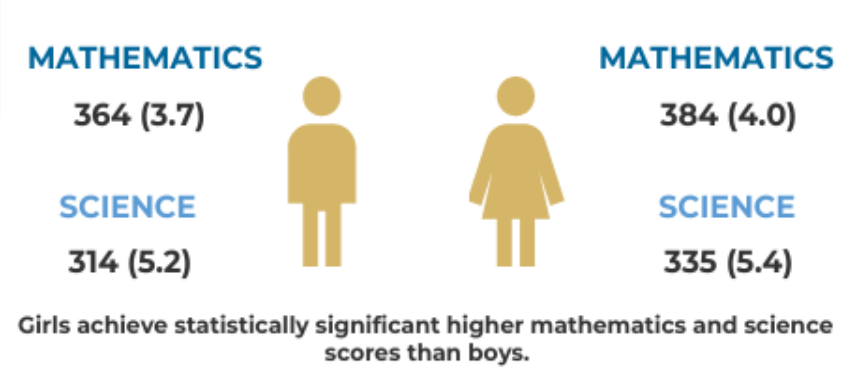
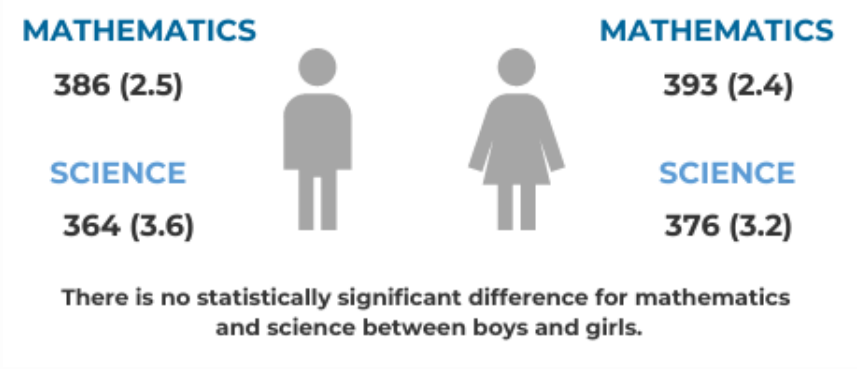
Achievement by Gender and Gaps 2019

Grade 5



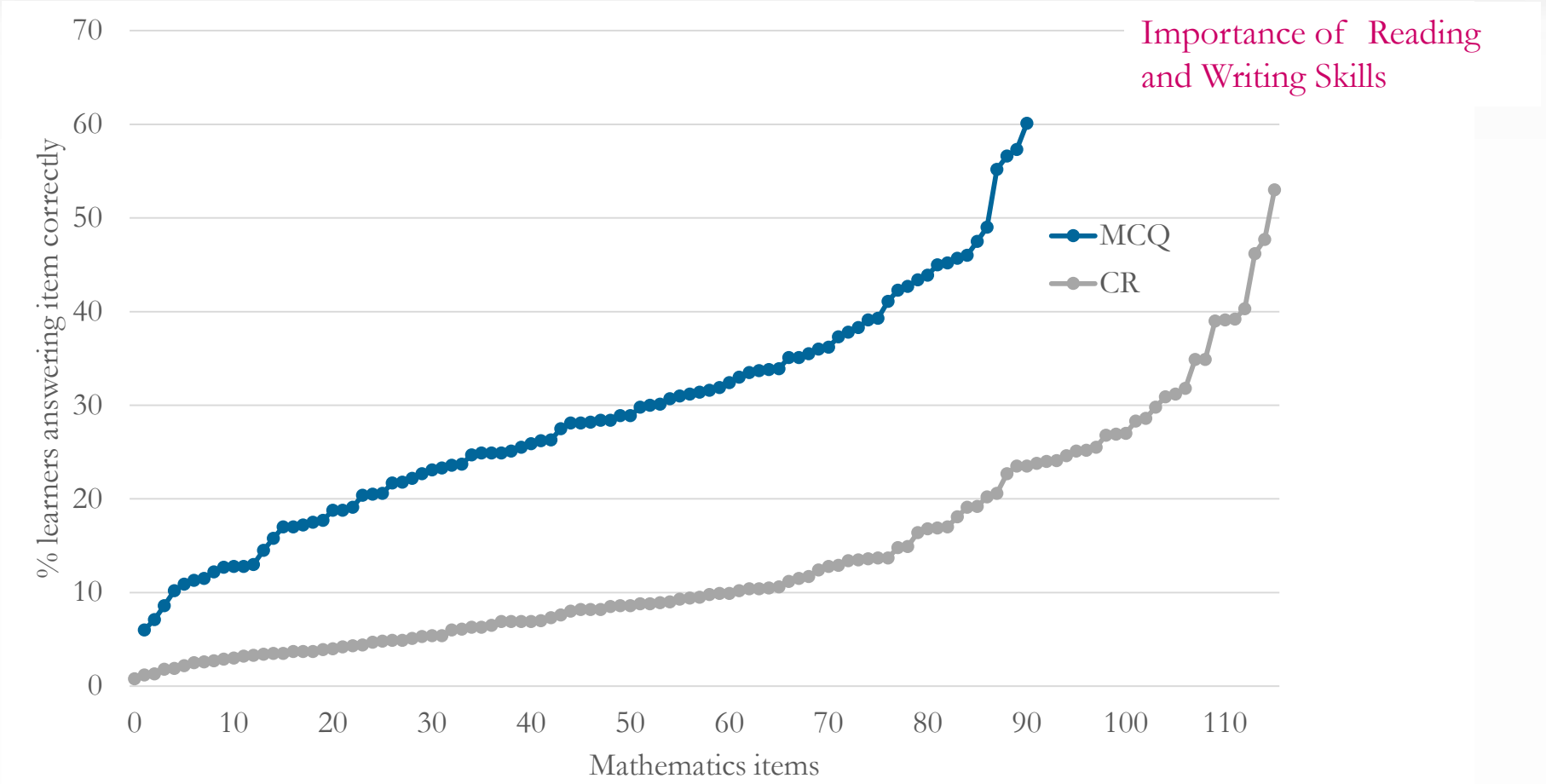
Girls achieve statistically significant higher mathematics and science scores than boys.

Grade 9



There is no statistically significant difference for mathematics and science between boys and girls.

Writing Gaps: Learners answering Selected and Constructed Response correctly



Grade 5 & 9 mathematics performance internationally, 2019

Grade 5

Country	Score (SE)
Singapore	625 (3,9)
Hong Kong SAR	602 (3,3)
Korea, Rep. of	600 (2,2)
Chinese Taipei	599 (1,9)
Japan	593 (1,8)
Serbia	508 (3,2)
Spain	502 (2,1)
TIMSS Scale Centrepoint	**500**
Armenia	498 (2,5)
Albania	494 (3,4)
New Zealand	487 (2,6)
Morocco	383 (4,3)
Kuwait	383 (4,7)
South Africa	374 (3,6)
Pakistan	328 (12)
Philippines	297 (6,4)

Grade 9

Country	Score (SE)
Singapore	616 (4)
Chinese Taipei	612 (2,7)
Korea, Rep. of	607 (2,8)
Japan	594 (2,7)
Hong Kong SAR	578 (4,1)
Cyprus	501 (1,6)
Portugal	500 (3,2)
TIMSS Scale Centerpoint	**500**
Italy	497 (2,7)
Turkey	496 (4,3)
Kazakhstan	488 (3,3)
Oman	411 (2,8)
Kuwait	403 (5)
Saudi Arabia	394 (2,5)
South Africa (9)	389 (2,3)
Morocco	388 (2,3)

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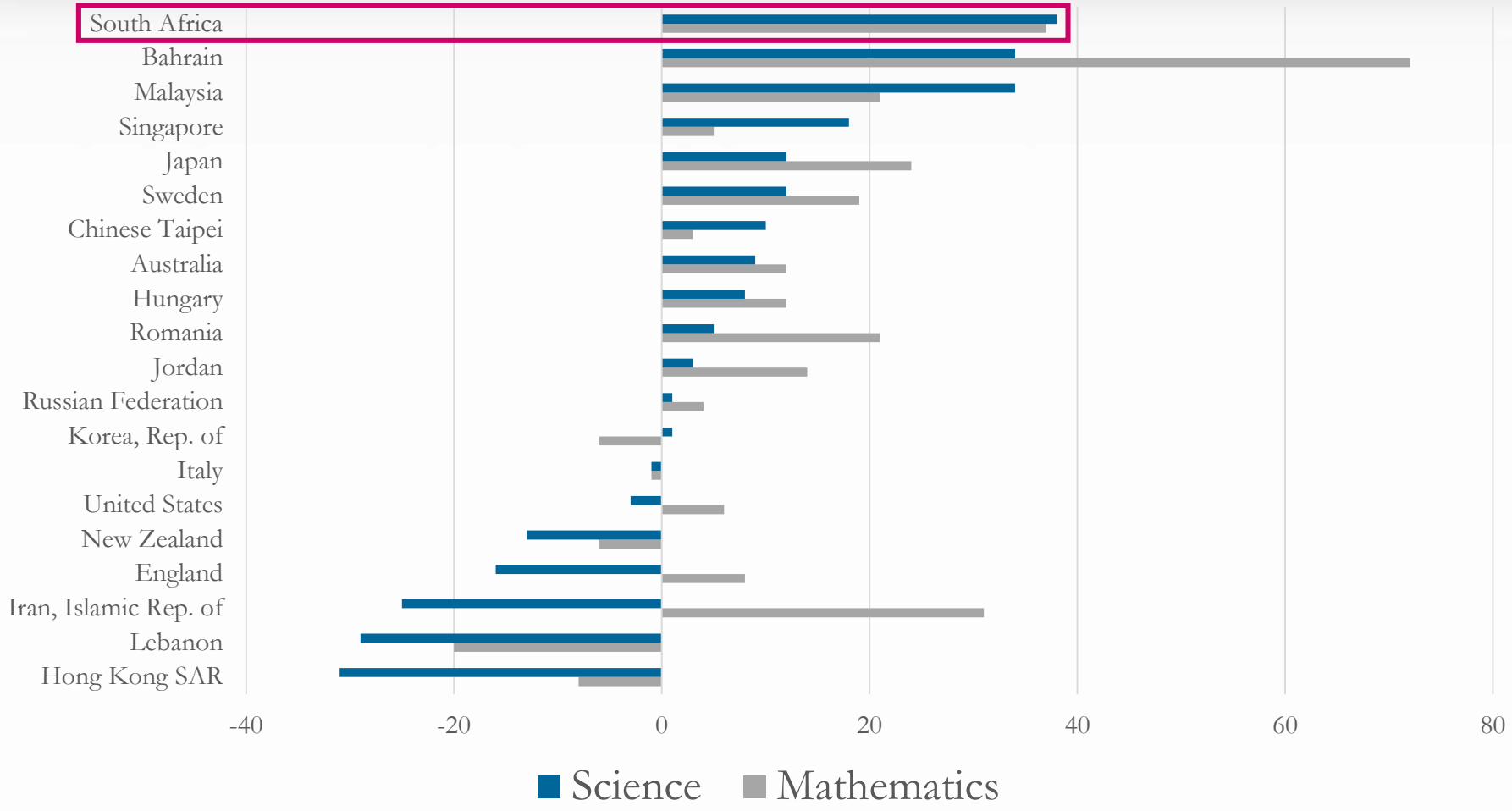
International Change in achievement, 2011 to 2019



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Match between TIMSS and CAPS

	Percentage items in TIMSS Curriculum	Percentage match between TIMSS & CAPS
CONTENT DOMAINS		
Number	30	97
Algebra	30	78
Geometry	20	86
Data and Probability	20	54
COGNITIVE DOMAIN		
Knowing	35	70
Applying	40	20
Reasoning	25	10

Story 2: What influences achievement?

From the bivariate analysis

- Home Resources and Early Learning Activities
- Educator Preparation and Professional Development
- School Climate and Achievement
- Educational Resources in Schools

Home resources (Grade 9)

Asset Type	Possession	National	Fee-paying	No-fee
Basic	Running tap water*	73	90	65
	Flush toilet*	60	91	44
Educational	Parents: Post-Secondary Education*	38	48	34
	Over 25 books in the home*	18	27	13
	Own room*	68	72	66
	Always/almost always speak test language at home*	28	51	16
Digital	Internet connection*	41	59	32
	Computer or Tablet*	48	69	37

*Difference in availability of assets in fee paying and no-fee schools is statistically significant

There are significant differences in the availability of all assets for learners in fee-paying and no-fee schools.

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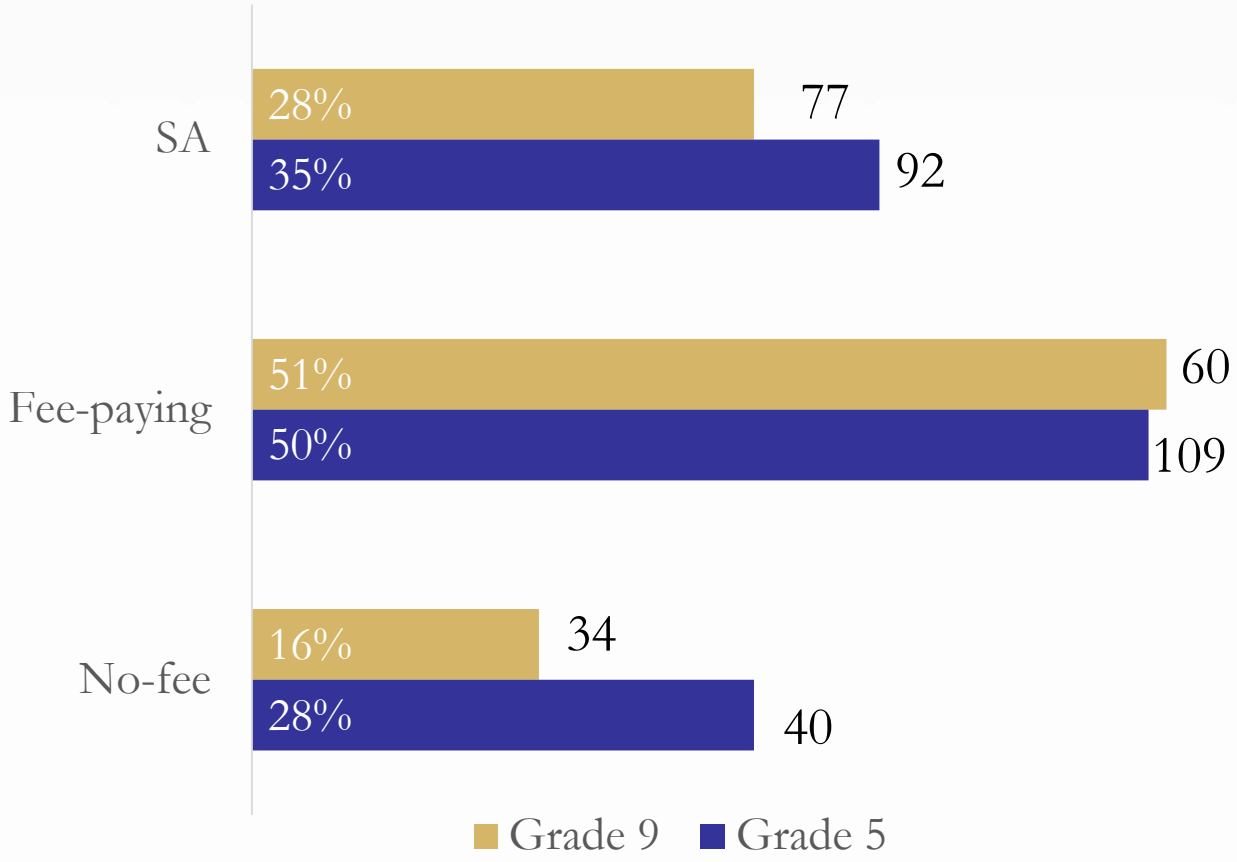
Language of Learning and Teaching (LoLT)

% Learners who speak the LoLT frequently

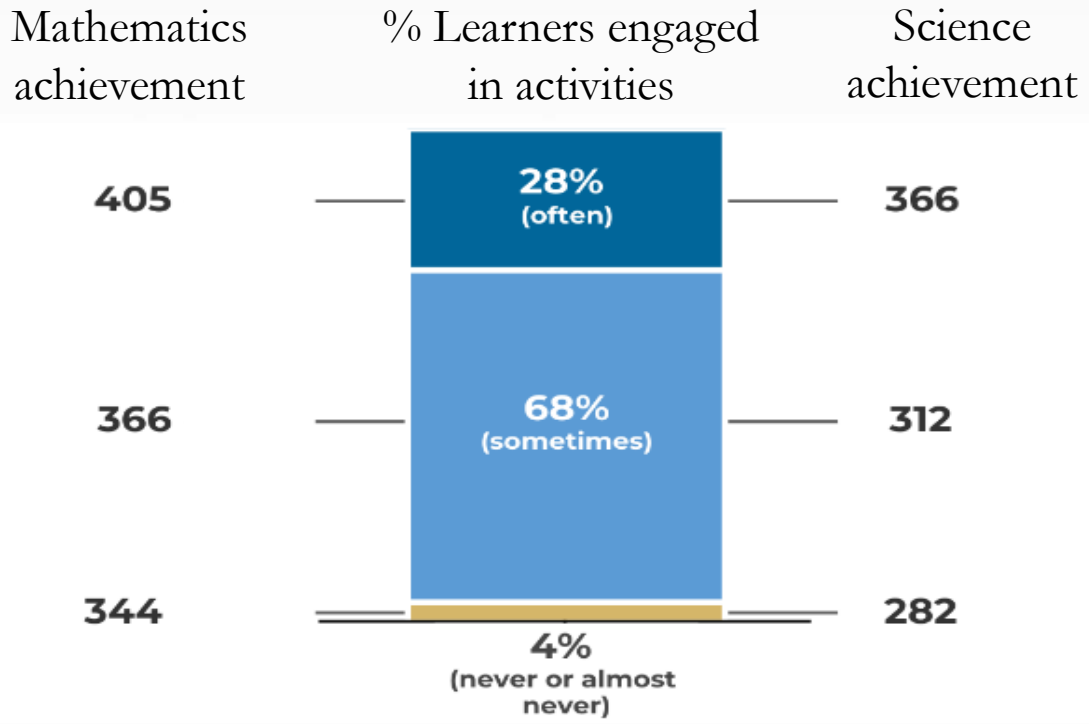


Mathematics achievement difference between those learners who speak the LoLT **frequently at home** and those that **never** speak it at home

Early literacy and numeracy preparation (Grade 5)

Parent reports:

- 35% read books
- 34% played with alphabets
- 37% sang counting songs
- 41% played games with shapes
- 34% played with building blocks



Positive associations between parental engagement in early learning activities and later academic achievement

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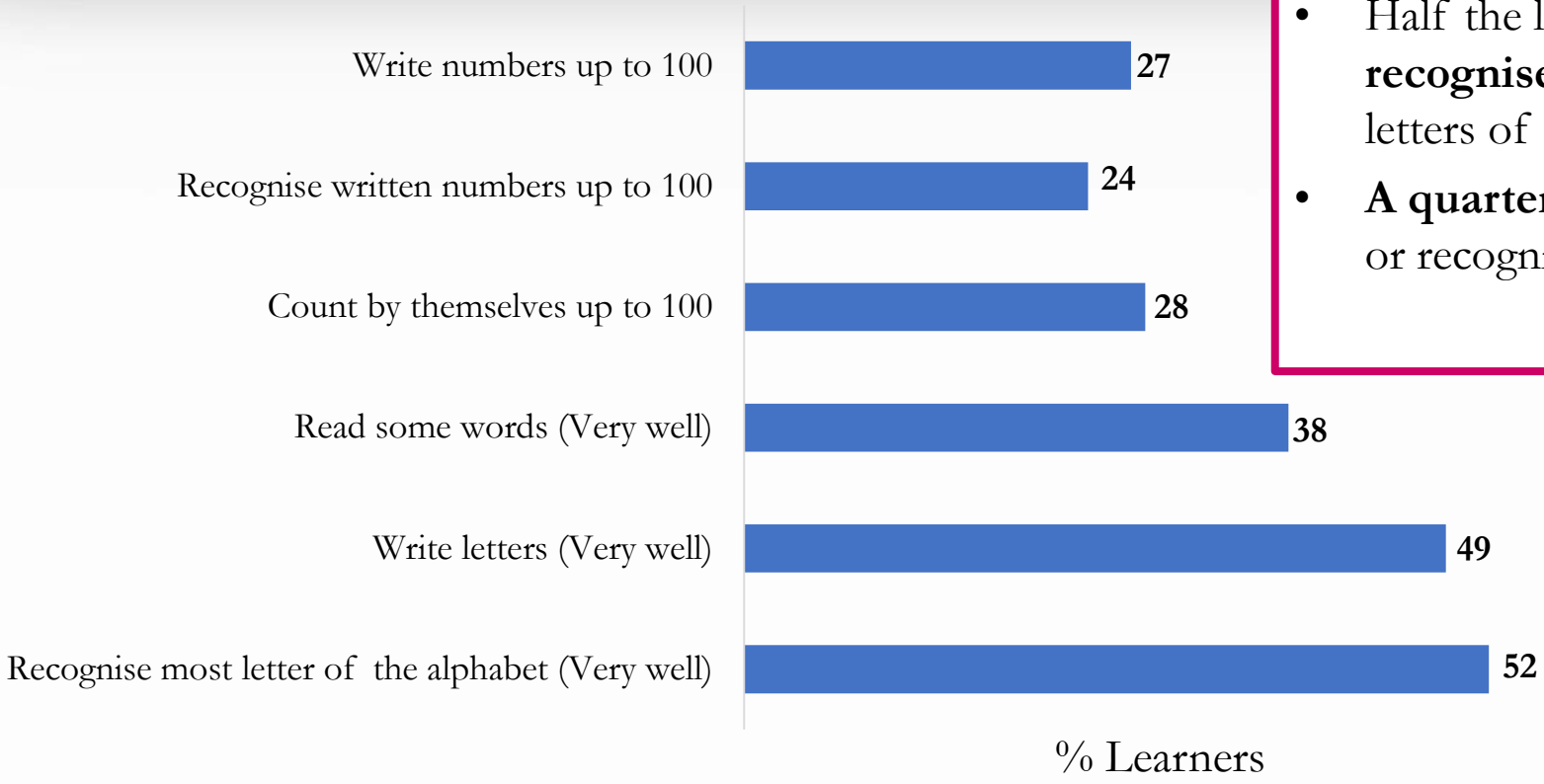
School Readiness: What learners can do well before school



- Half the learners could **recognise** and **write** letters of the alphabet
- **A quarter** could write or recognise numbers

The results show no frequency difference between learners in fee-paying and no-fee schools

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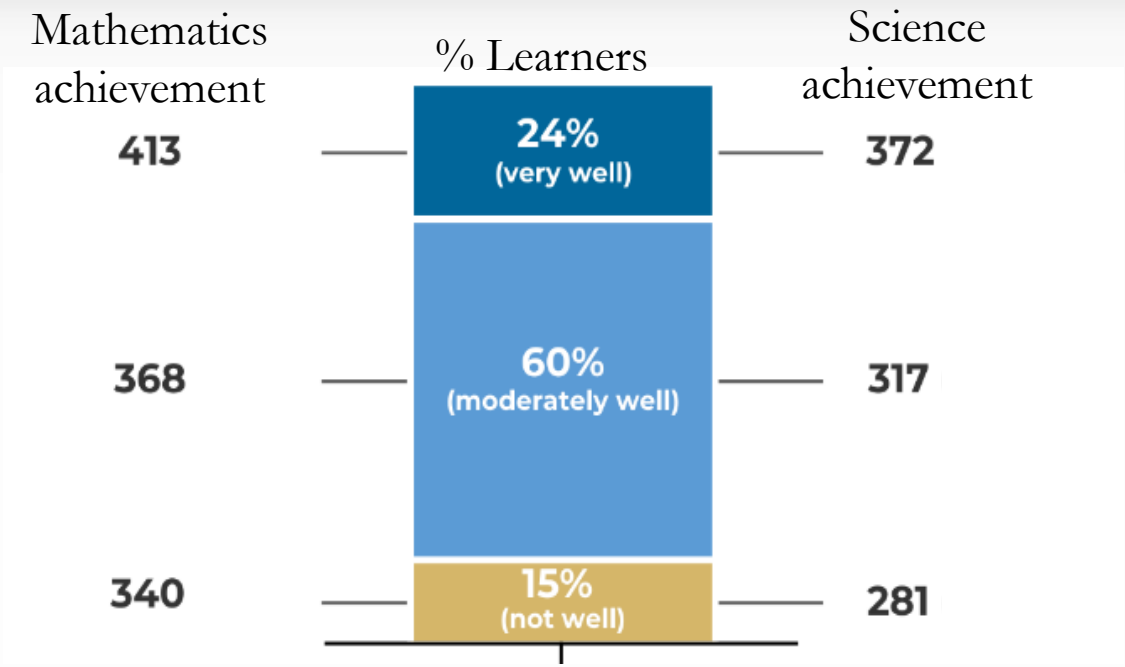
Literacy and numeracy school readiness



- Learners well prepared: 22% in No-fee; 28% Fee-paying schools
- Learners 'very well prepared' before entering Grade 1 achieve significantly higher achievement.
- More than 90% of learners attended Grade R.

Educator preparation, experience

Parents and society view schools as an equalizing opportunity for learners from low SES households

Grade 5

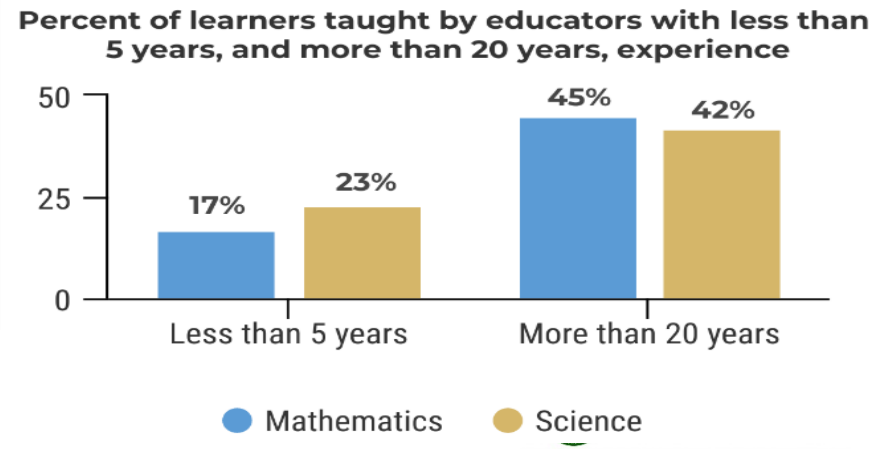
of learners were taught by mathematics and science educators with, at least, a Bachelors degree

Two thirds

of learners were taught by educators with a mathematics specialisation

Half

of the learners were taught by educators with a science specialisation

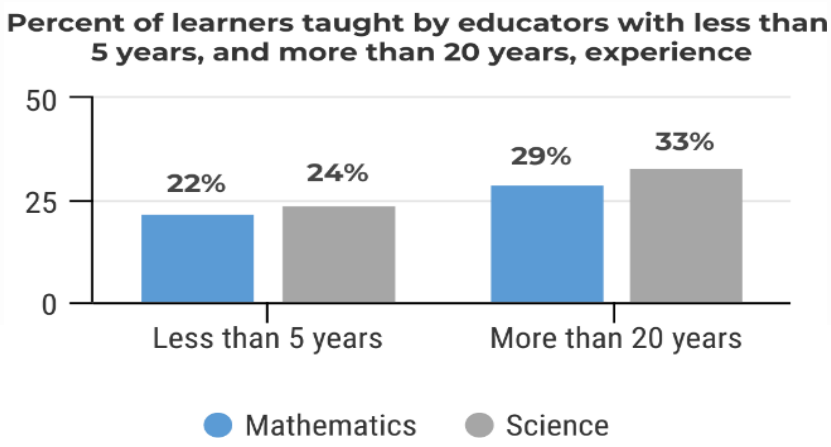


Grade 9

of learners were taught by mathematics and science educators with, at least, a Bachelors degree

Four of five

learners were taught by educators with a mathematics or science specialisation



Professional Development participation and needs

Educators require continual **professional development** to provide the best possible instruction

South African educators attend a higher number of professional development courses than the international average.

	GRADE 9	
Professional Development Activities	Educators **participation** in professional development	Educators indicating a **need** in professional development
Mathematics Content	84	77
Mathematics Curriculum	74	71
Mathematics Assessment	70	77
Improving Learners' Critical Thinking or Problem-Solving Skills	56	89
Addressing Individual Learner Needs	50	86
Mathematics Pedagogy/ Instruction	58	81
Integrating Technology into Mathematics Instruction	46	88

Focus must be placed on translating these development activities into higher achievement levels.

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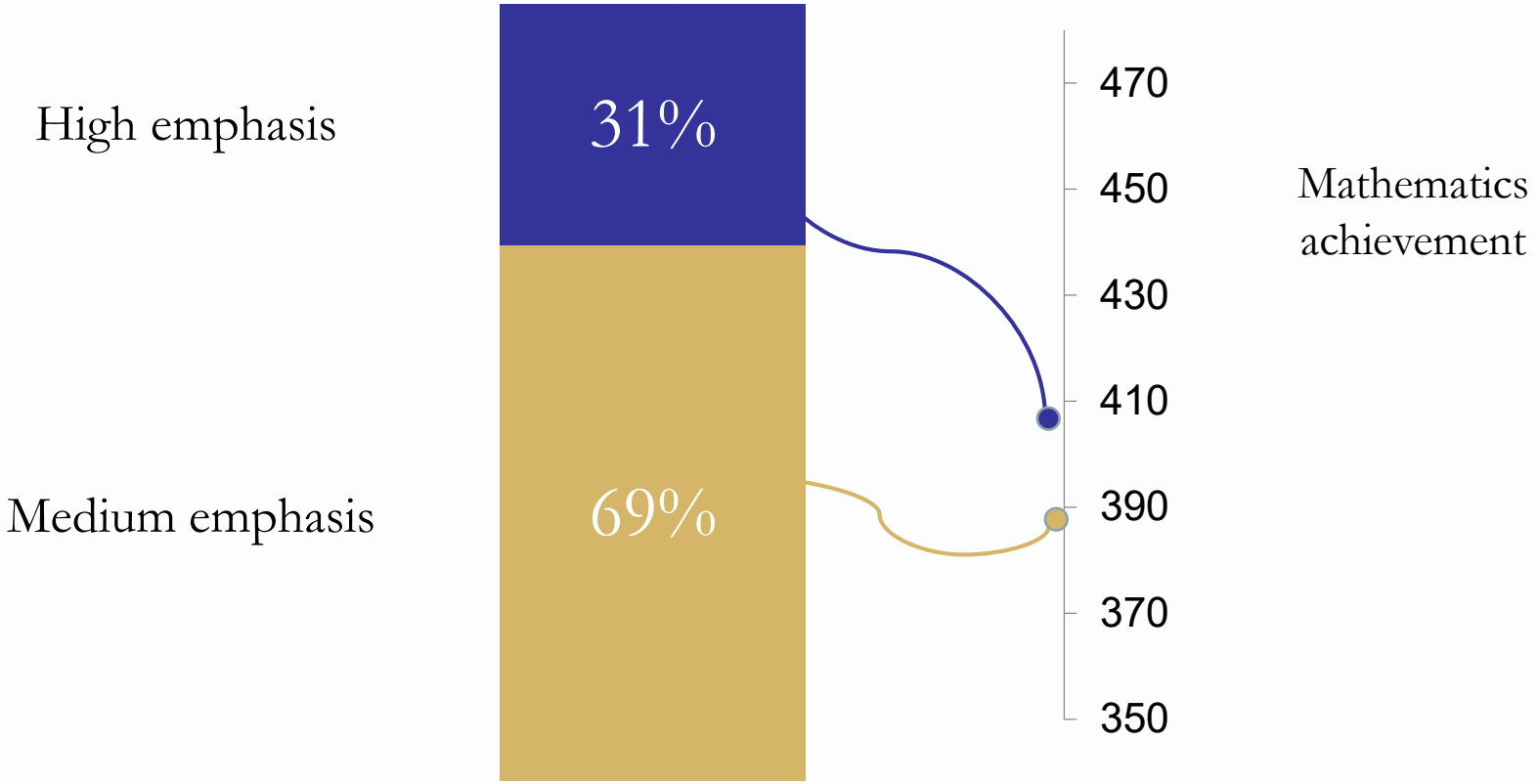
School emphasis on academic success and mathematics achievement (Grade 9)

Positive and healthy school climates – foundations of quality learning environments



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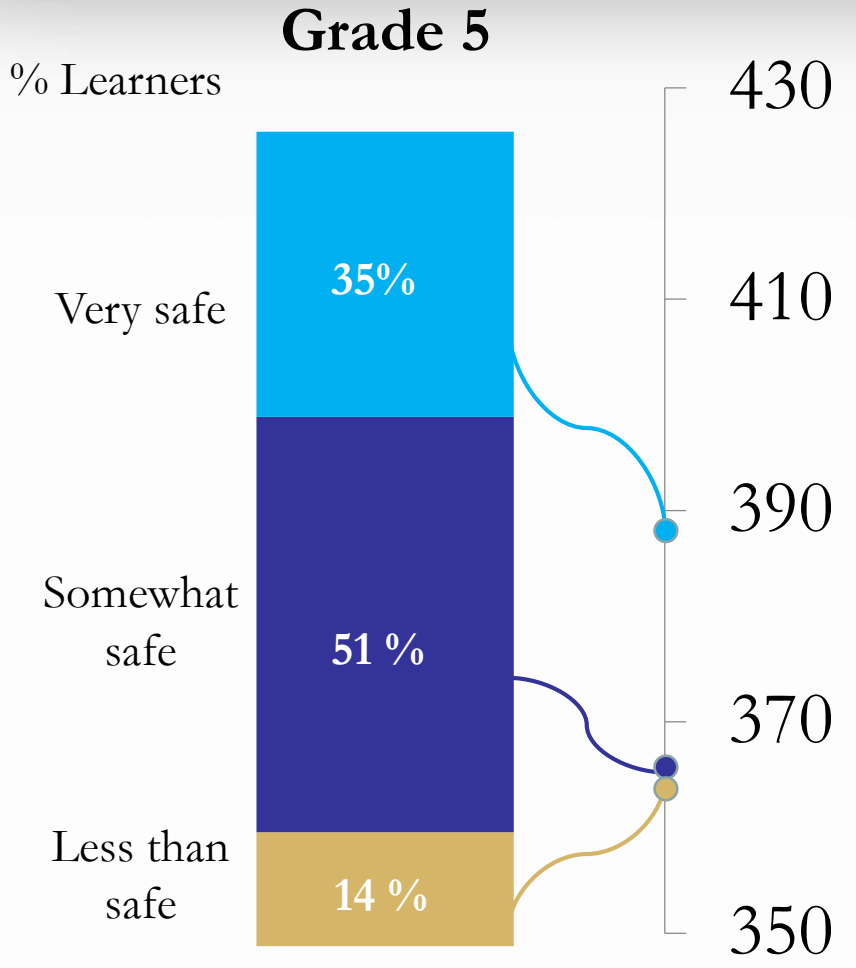
Mathematics achievement and safe and orderly schools



29% of Grade 5 learners and 18% of Grade 9 learners reported being bullied weekly

The most cited form of bullying is verbal, followed by physical then cyber.

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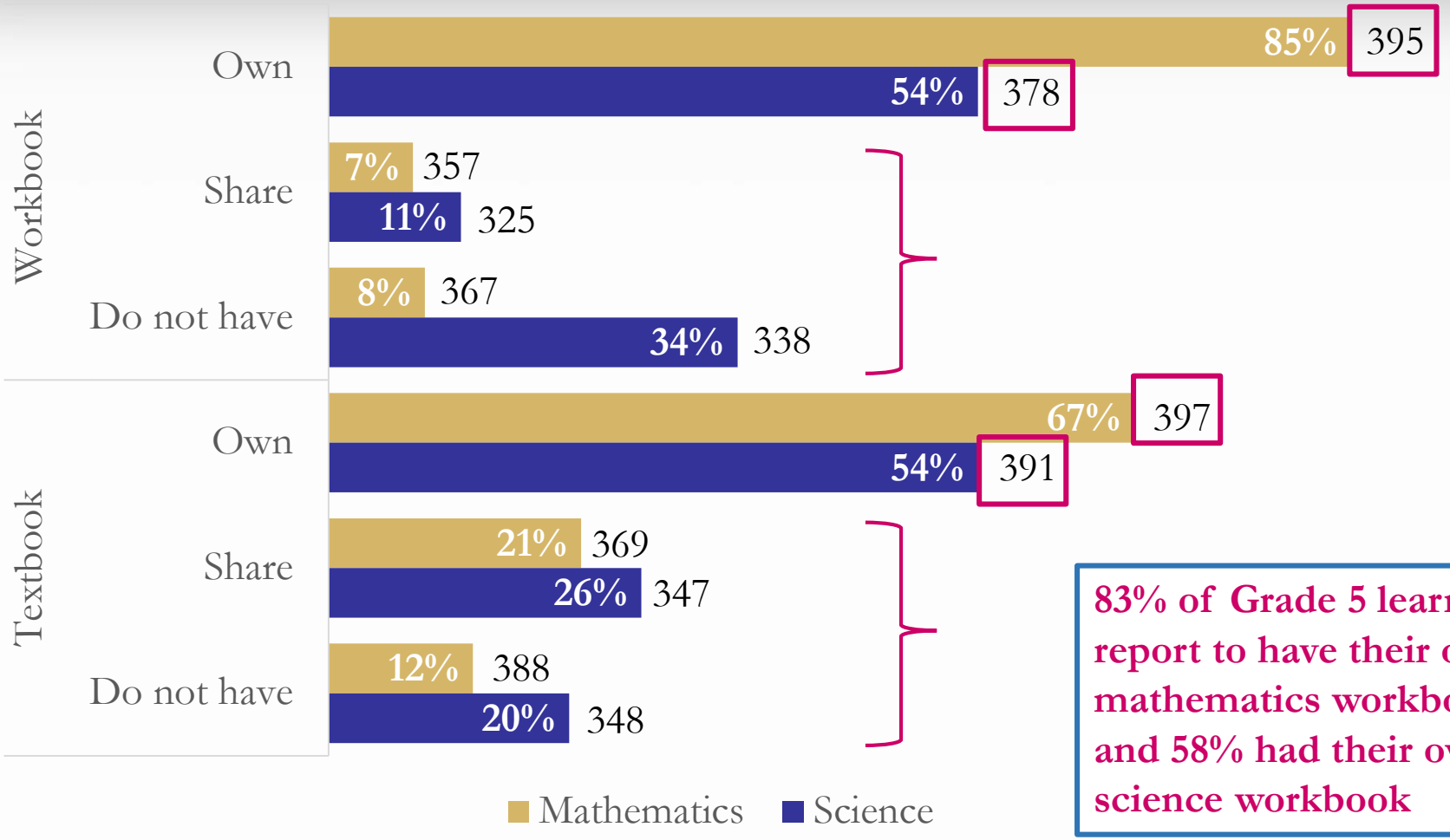
Grade 9: Textbooks and workbook access and achievement



83% of Grade 5 learners report to have their own mathematics workbook, and 58% had their own science workbook

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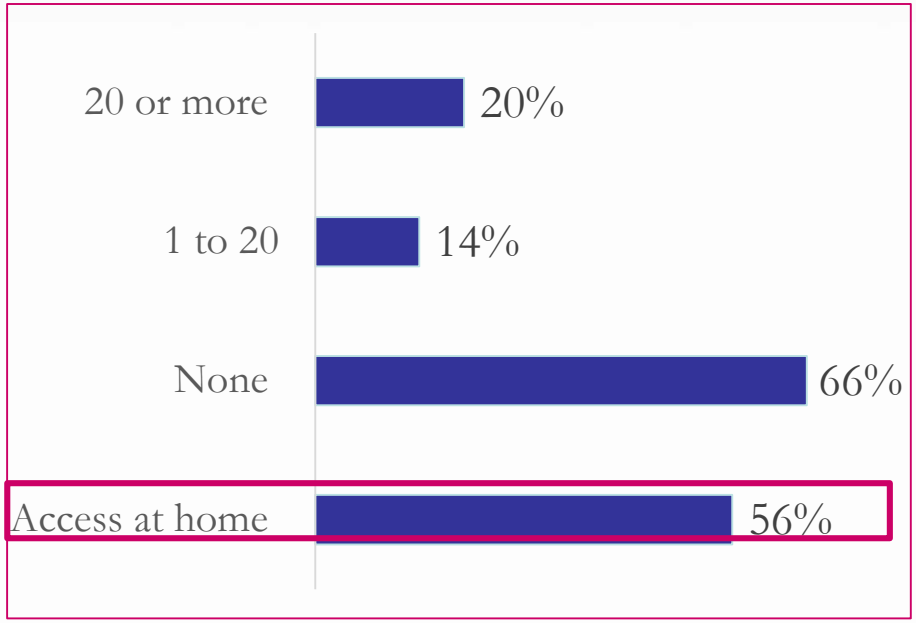
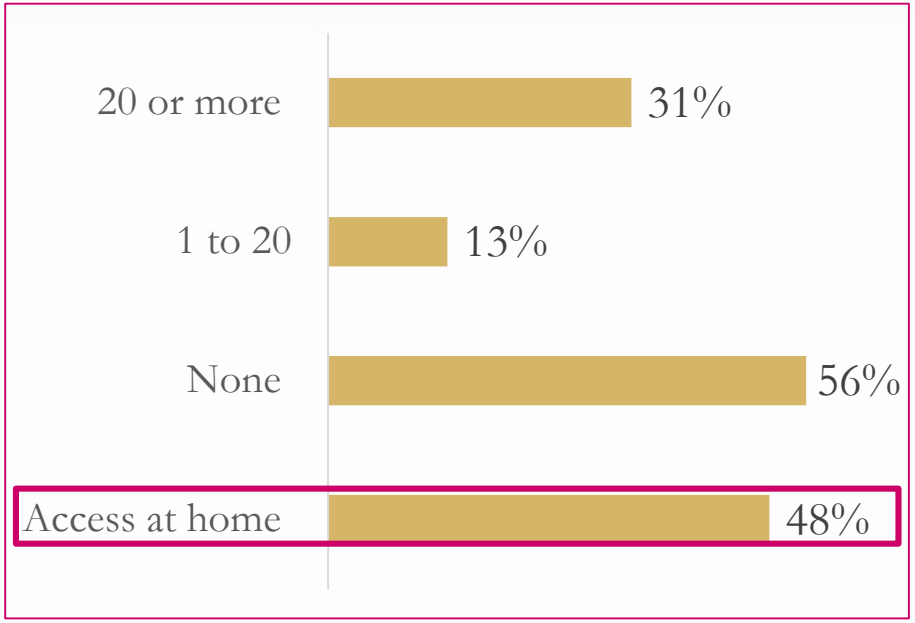
Computers available for use by learners

Grade 5



Grade 9



More Grade 5 and 9 learners have access to a computer at home than at school