TIMSS 2019 South African Item Diagnostic Report: Grade 5 Mathematics

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TIMSS 2019
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Grade 5
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Acronyms

CAPS	Curriculum and Assessment Policy Statement
CRQ	Constructed Response Question
DBE	Department of Basic Education
HSRC	Human Sciences Research Council
IEA	International Association for the Evaluation of Educational Achievement
LoLT	Language of Learning and Teaching
MCQ	Multiple Choice Question
M/S	Questions involving matching or selecting responses
TIMSS	Trends in International Mathematics and Science Study
TIMSS-SA	TIMSS in South Africa

Preface

The Human Sciences Research Council (HSRC) released the results of the 2019 Trends in International Mathematics and Science Study (TIMSS) in December 2020. TIMSS is a cross-national assessment of the mathematics and science knowledge and skills of Grade 4 or 5 and Grade 8 or 9 learners from the participating countries. TIMSS was developed by the International Association for the Evaluation of Educational Achievement (IEA) to allow participating nations to compare learners' educational achievement across borders.

Two reports containing the highlights of the Grade 5[1] and Grade 9[2] TIMSS 2019 results were published in December 2020. Two reports with the full analyses, The South African TIMSS 2019 Grade 9 Results and The South African TIMSS 2019 Grade 5 Results were published in 2022.

This report is one of four educator resource documents. The four reports contain diagnostic analyses of restricted use items for TIMSS Grade 5 Mathematics, TIMSS Grade 5 Science, TIMSS Grade 9 Mathematics and TIMSS Grade 9 Science.

These reports, together with additional resources, are available on the TIMSS SA website[3].

This report was compiled by Dr Lynn Bowie and Prof Hamsa Venkat with Sylvia Hannan and Dr Catherine Namome. This report is best described as a resource for educators that will contribute to their understanding of what mathematics our Intermediate Phase learners know and can do and, through the recommendations, how to support the successful teaching and learning of mathematics constructs.

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[1] https://www.timss-sa.org/publication/timss-2019-highlights-of-south-african-grade-5-results-in-mathematics-and-science
[2] https://www.timss-sa.org/publication/timss-2019-highlights-of-south-african-grade-9-results-in-mathematics-and-science
[3] https://www.timss-sa.org/

How do I use this report?

This report can be used by all educators, although it specifically focuses on Grade 5 learners. It does not replace or contradict any official Department of Basic Education (DBE) policies or documents, particularly those related to assessment and the delivery of the intended curriculum.

This report is presented in two sections:

1. Part A presents the Introduction and Background and highlights some broad performance trends from the analysis of the 2019 Grade 5 TIMSS mathematics restricted use items.
2. Part B presents the analysis of TIMSS 2019 individual restricted use items, as well as ideas for remediation to improve the teaching and learning of mathematics.

When an educator or DBE official receives this report, an easy way to navigate it is through the steps below. This sequence of steps has been outlined to assist educators in helping their learners and/or to assist DBE officials in their mentoring, coaching, training and support of educators.

STEP 1 Scan the table of contents and the two parts to familiarise yourself with this report.

STEP 2 Read through the introduction and background to TIMSS in Part A. This will provide you with an understanding of the context of the assessment.

STEP 3 Work through the item-by-item analysis in Part B. Both constructed response and multiple choice items are reported. In this part there is a detailed analysis of learner responses for each item.

STEP 4 Work through the remedial recommendations in Part B. We provide recommendations on how educators can improve the identified areas and incorporate the suggested strategies into your mathematics teaching.

STEP 5 Based on the item-by-item analysis, identify and pursue remedial actions specific to your learners and your schools.

Part A: Introduction and Background

A.1. Introduction

The purpose of this user-friendly item diagnostic report is to help educators improve their mathematics teaching. The report sets out to analyse learners' performance on the restricted use Trends in International Mathematics and Science Study (TIMSS) 2019 mathematics items, identify where learners are going wrong and provide guidance on how to help them.

We begin by giving you some background information about TIMSS. Further details are available on the TIMSS-SA website[4]. We then go on to comment on the ways in which TIMSS reports on mathematics items and how these items differ from the items that we have seen commonly used in South African assessments. This is followed by a summary of South African Grade 5 learners' overall patterns of performance in the TIMSS 2019 restricted use items.

In Part B of the report, we have clustered the 'restricted use' TIMSS items into some key strands that we can comment on. These strands represent important areas of mathematics. We do this by:

Introducing the strand and highlighting how it features and builds across the Foundation, Intermediate and Senior Phases.

Providing a summary item analysis for all the items falling within this strand in the test. This summary includes the Curriculum and Assessment Policy Statement (CAPS) Grade level of the item, how CAPS and TIMSS describe the difficulty of the item, and performance levels on the item.

Commenting on ways to help learners build towards answering this set of questions correctly through tasks, representations and educator talk that educators – across the Foundation and Intermediate Phases – can use to support their teaching.

To give a quick sense of learner performance on each item we have used colour coding of percent correct for the item numbering – this is shown in Part B.

Please note, in this report, for ease of reading, the learner frequency responses were rounded to whole numbers.

[4] https://www.timss-sa.org/

A.2. What is TIMSS?

TIMSS is an assessment of the mathematics and science knowledge and skills of Grade 4 or 5 (Intermediate Phase) and Grade 8 or 9 (Senior Phase) learners around the world. TIMSS was developed by the International Association for the Evaluation of Educational Achievement (IEA) to allow participating nations to compare their learners' educational achievement within and across borders. The goal of TIMSS is to help countries make informed decisions about how to improve teaching and learning in mathematics and science.

In South Africa, the Human Sciences Research Council (HSRC), with the support of the Department of Basic Education (DBE), has conducted the TIMSS since 1995, administering the test at the Grade 8 or 9 levels in 1995, 1999, 2003, 2011, 2015 and 2019. In 2015, South Africa participated in TIMSS-Numeracy at the Grade 5 level and in 2019 South Africa continued TIMSS participation at the same level, testing both mathematics and science.

A.3. Who participates in TIMSS?

TIMSS is meant to be written by learners in the fourth year of formal schooling, which is Grade 4 in South Africa. However, South African children wrote the test when they were in Grade 5, a year later than most other countries. In October and November 2018, 297 schools representing a cross-section of schools across South Africa took part in TIMSS 2019. The selected schools included rural and urban schools, and quintiles 1 to 5 and independent schools, from all nine provinces. Altogether 11 891 South African learners wrote the TIMSS assessment.

Worldwide, 64 countries and entities took part in TIMSS 2019. The learners wrote both a mathematics and a science test. In 2019, a less difficult mathematics test was offered to certain countries. South Africa, along with ten other countries, wrote the less difficult mathematics assessment and the regular science assessment. The TIMSS Mathematics Less Difficult instrument included some items that were less difficult, while the remainder of the items were the same as the regular mathematics assessment. The results from the less difficult and regular mathematics assessment are reported on the same TIMSS achievement scale, so the scale score results are comparable regardless of the version of the assessment that the learners wrote.

South African learners did not perform very well, even though they were in Grade 5 and the test is designed for Grade 4 learners. In fact, South Africa had the third lowest score out of the 64 countries and entities. You can read more about the South African learners' performance in the TIMSS 2019 Highlights of South African Grade 5 Results in Mathematics and Science[5]. Sixty-three percent of our learners did not achieve basic understanding of mathematics concepts and only five percent reached higher levels of understanding. This report aims to help you improve your teaching and through that, improve your learners' mathematical knowledge.

A.4. Who sets the TIMSS items and what are their key features?

The TIMSS achievement booklets contain both trend and non-trend items. The trend items are included in each cycle and form an anchor that allows for estimating achievement over time. The non-trend items are new items generated for each cycle and subjected to extensive validation processes. For more details on the assessment frameworks and matrix design, refer to the TIMSS 2019 Assessment Frameworks[6].

The TIMSS items are supplied in English. Expert translators translate the questions into the language of instruction in the participating countries. Most South African learners wrote the test in English, with a few writing the test in Afrikaans. Thirty-five percent of the TIMSS Grade 5 learners reported that they 'always or almost always' spoke the language of the test at home, while 53 percent reported 'sometimes' speaking the language of the test at home. Grade 5 is the second year most learners transition to English or Afrikaans as the Language of Learning and Teaching (LoLT) in schools.

There are three types of questions in TIMSS: multiple choice questions (MCQ), constructed response questions (CRQ) and questions involving matching or selecting (M/S) responses that fit a particular condition. The items are based on a curriculum decided by what is taught in most countries participating in TIMSS.

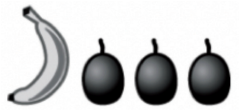
An item may consist of only one question, or it may involve sub-questions with the score sheet indicating the criteria for the partial or full allocation of marks.

[5] https://www.timss-sa.org/publication/timss-2019-highlights-of-south-african-grade-5-results-in-mathematics-and-science
[6] http://timssandpirls.bc.edu/timss2019/frameworks/

Item 2 is an example of an MCQ item with only one question:

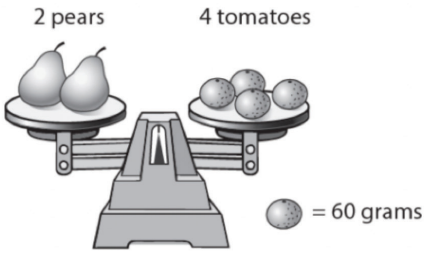
> Maria travelled by bicycle for 4 days. She travelled the same distance each day.
>
> Altogether she travelled 76 kilometers.
>
> How many kilometers did Maria travel each day?
>
> A) 18
> B) 19
> C) 20
> D) 24

Item 5 is an example of a CRQ item with two sub-questions with one mark awarded for each part:

> Caroline bought:
>
> 
>
> cost 22 zeds
>
> Nosipho bought:
>
> 
>
> cost 13 zeds
>
> How much do a  and a  cost together?
>
> Answer: _____zeds
>
> How much does a  cost?
>
> Answer: _____zeds

The TIMSS items – more often than we see in South African common assessments and workbooks – integrate ideas from different topic areas. For example, **Item 7** is identified by TIMSS as a 'Measurement and Geometry' item, but working out the answer here involves ratio equivalence, and multiplication and division. This is likely to be one part of what makes TIMSS items difficult for South African learners, as they are often less familiar with such items.

Item 7 is an example of an item that integrates across topic areas:



The 2 pears weigh the same amount as 4 tomatoes.

How much does 1 pear weigh?

Ⓐ 480 g
Ⓑ 240 g
Ⓒ 120 g
Ⓓ 60 g

Items in the TIMSS assessments are also more likely to be non-routine for children because of how they focus on concepts. For example, **Item 12** below asks learners to consider how the vertical axis needs to be labelled to produce a scale that matches the data presented in tabular and bar chart forms. This kind of question is unfamiliar in the South African landscape in terms of national workbook and common assessment tasks, where tasks requiring this kind of reasoning across representations tend to be rare.

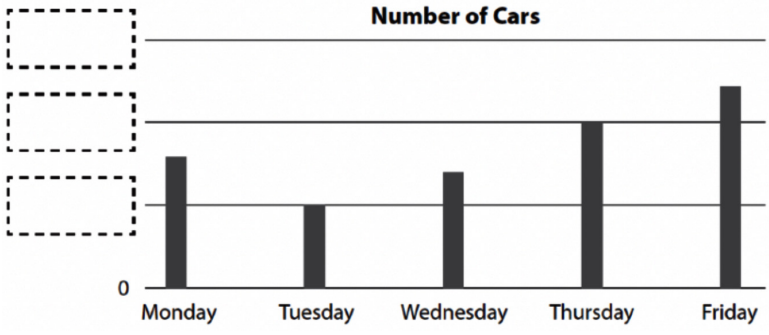
Busi recorded the number of cars that travelled along her street each morning.

Day	Number of Cars
Monday	8
Tuesday	5
Wednesday	7
Thursday	10
Friday	12

She started making a graph of her data.

What numbers should Busi use to label the horizontal lines on her graph?

Put the numbers in the boxes on Busi's graph.



A.5. What is the TIMSS curriculum for Grade 5 mathematics?

A.5.1. Content Domains

TIMSS Grade 5 items are drawn from the Content Domains of Number, Measurement and Geometry, and Data. The levels of overlap between the TIMSS Content Domains and the South African CAPS curriculum are generally high, though a little lower in the Measurement and Geometry areas. Reddy et al. (2022) report the levels of overlap for each of the content domains, alongside the average scale scores for each domain in Table 1 below.

Table 1: Percentage match between TIMSS and CAPS, and average mathematics score

	Percentage match between TIMSS and CAPS	Mathematics Scale Score (difference from overall score)
All Content (171 items)	88%	374
Number (83 items)	94%	370 (-4 points)
Measurement and Geometry (52 items)	79%	362 (-12 points)
Data (36 items)	96%	390 (16 points)

This means that Grade 5 learners should, in the case of most items, have encountered the topics in their schooling before taking the TIMSS test.

A.5.2. Cognitive Domains

Items are also spread across a range of what TIMSS refers to as 'Cognitive Domains'. These are a range of thinking skills that include attention to learners' ability to apply what they have learned, solve problems, and use analysis and logical thinking to reason through situations. The TIMSS Cognitive Domains are Knowing, Applying and Reasoning.

The balance of items in the overall test across the Content and Cognitive Domains are shown in Table 2 and Table 3.

Table 2: Percentage of TIMSS items by Content Domain

Content Domains	Percentage
Number	50%
Measurement and Geometry	30%
Data	20%

Table 3: Percentage of TIMSS items by Cognitive Domain

Cognitive Domains	Percentage
Knowing	45%
Applying	35%
Reasoning	20%

A.6. Restricted use items

After each TIMSS cycle the IEA releases a number of TIMSS assessment items called 'restricted use items.' Twelve Grade 4 items were released after the TIMSS 2019 cycle. Two items consisted of two questions, while the remaining items had only one question each. The final totals are four MCQ, six CRQ and two M/S.

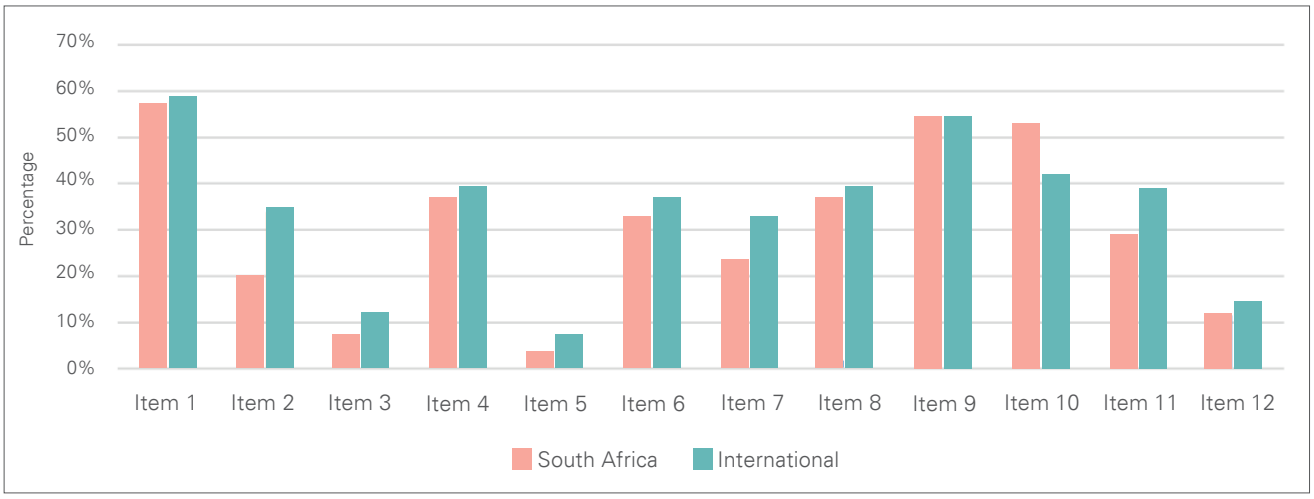
The restricted use items will not be used again in the TIMSS assessment, but this analysis can help us understand what types of difficulties learners have and where they have gaps in their knowledge.

A.7. Some broad performance trends based on restricted use items

A.7.1. Overall patterns of performance

The performance of South African learners on the TIMSS restricted use items was generally lower than the average performance across the 11 countries[7] that participated in the Mathematics Less Difficult Assessment (Figure 1).

Figure 1: South African and International performance on restricted use items



However, the patterns of performance across items were very similar. This suggests that across these countries, learners found similar problems easier or more difficult.

Girls' performance was marginally better than boys' performance across the items, but not substantially so. In contrast to the generally even pattern based on gender, learners from fee-paying schools (average percentage correct of 35%) performed substantially better on the TIMSS Grade 5 restricted use mathematics items than learners from no-fee schools (22%).

A.7.2. Multiple Choice Questions versus Constructed Response Questions and Match/Select Questions

Performance on MCQ questions in the test tended to be higher than on CRQ and Matching/Selecting type questions (Table 4).

Table 4: Item type and average percentage correct

Item type	Average percentage correct
Matching/Selecting questions (n=2)	19%
Free response questions (n=6)	22%
Multiple choice questions (n=4)	34%

This points to likely inflation of actual levels of performance on MCQ items, with random guessing leading to correct answers in some cases.

A.7.3. Making sense of the question

There was extensive evidence of a lack of sense-making in learners' responses. On **Item 3**, for example, the question showed the fractions: $\frac{1}{3}; \frac{3}{4}; \frac{5}{6}; \frac{4}{8}; \frac{3}{10}; \frac{7}{12}$. Learners had to circle the fractions greater than $\frac{1}{2}$. Only 1 in 20 learners were able to circle some fractions correctly, and none were able to circle all the fractions greater than a half. These findings indicate very little awareness of the meanings of mathematical terms and ideas, even those which – as in this case of 'half' – learners are likely to have encountered in the Foundation Phase grades.

[7] Albania, Bosnia and Herzegovina, Kosovo, Kuwait, Montenegro, Morocco, North Macedonia, Pakistan, Philippines, Saudi Arabia and South Africa.

A.7.4. Cued responses and guessing

Linked with the lack of sense-making, another common feature seen across responses was identifying terms or quantities in the question presentation, and then stating or selecting these terms for the answer. **Item 2** below provides a good illustration of this kind of 'cued' response:

> Maria travelled by bicycle for 4 days. She travelled the same distance each day.
>
> Altogether she travelled 76 kilometres.
>
> How many kilometres did Maria travel each day?
>
> A) 18
> B) 19
> C) 20
> D) 24

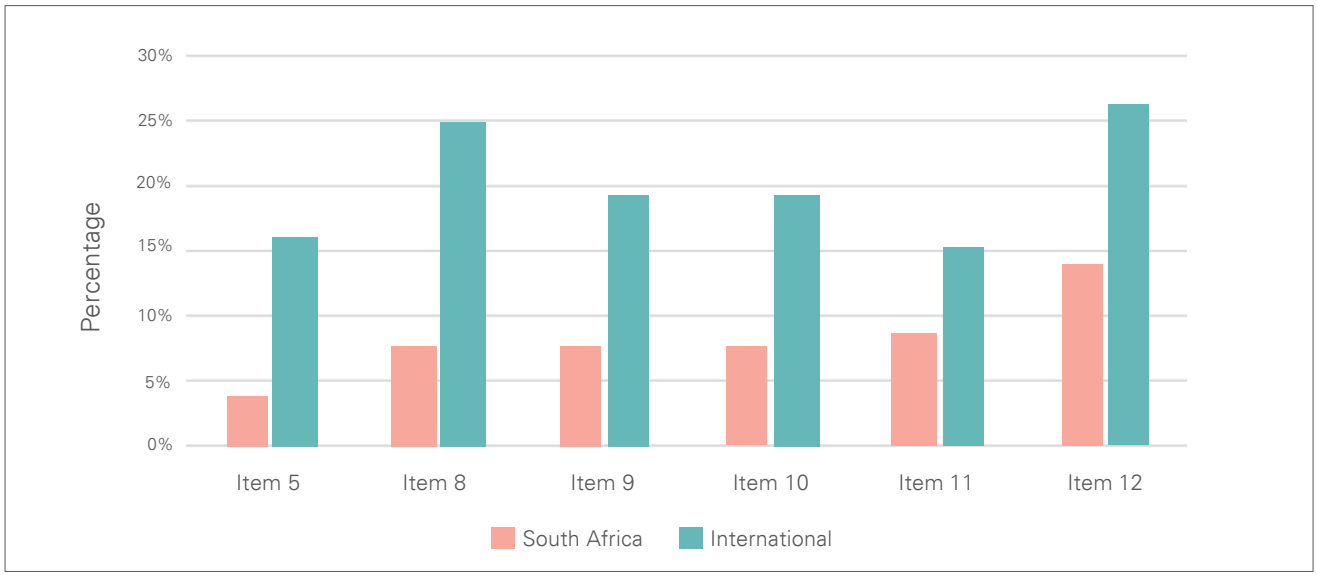
The inclusion of the word 'day' in this question corresponded with nearly half of all learners selecting option D, 24, as the correct answer here. This is likely linked to seeing a connection between the word 'day' and '24 hours', but ignores all other aspects of the problem-situation.

There was also evidence of random guessing of answers. On some MCQ items, this meant that all four options received approximately a 25 percent share, while there were several responses on CRQ items that did not follow any patterned common misconceptions or slips – they were, instead, simply random guesses at an answer.

A.7.5. Omitted questions

Despite South African learners performing a little below the international average performance levels on most items, our learners tended to write an answer for CRQ items where a written answer was required more often than their international peers, rather than omitting answers entirely (Figure 2).

Figure 2: South African and International proportions of omitted answers for CRQ items



This graph shows much lower proportions of omitted answers among South African learners. When coupled with the evidence above of lack of sense-making in learner responses, this finding points to random guessing of answers in many cases, rather than rational attempts at problem-solving.

In Part B of this report, we provide an item-by-item analysis of the Grade 5 mathematics restricted use items from TIMSS 2019.

Part B: Learnings from the restricted use items

In this section, we provide an analysis of each individual item. However, rather than simply dealing with individual items in isolation, we found that by grouping items according to Concept or Content Domains we could extract useful insights from these analyses for classroom use. We grouped the 12 restricted use items into the following content areas:

(i) Multiplication and Division,
(ii) Shape and Space (Geometry) and Measurement,
(iii) Representing and Interpreting Data, and
(iv) Place Value and Number Problem Solving.

From the error analysis we present the implications for teaching each of the content areas.

To give a quick sense of learner performance on each item we have used the following colour coding of percent correct:

0% - 15%
16% - 30%
31% - 45%
Above 45%

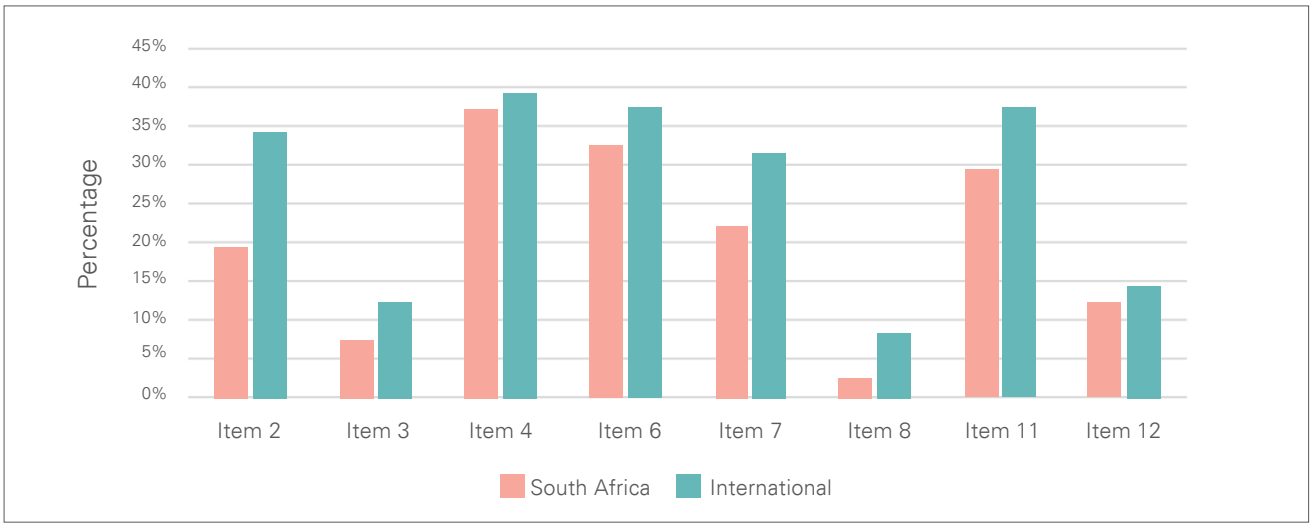
B.1. Multiplication and Division

While multiplication and division can be seen as stand-alone topics, we take them together here because within and beyond the Foundation Phase, a number of topics involve working with multiplication and division concepts. For example, ratio and proportion situations involve multiplication and division, as do fractions and percentages.

All these topics involve situations where two variables or quantities scale up or scale down in the same way. For example, in all fractions that are equal to one quarter, the numerator value is four times smaller than the denominator value. In the Senior Phase, gradients of a straight line also involve a multiplicative relationship – for each unit moved forward on the *x*-axis, the gradient tells us the extent (and direction) of the move on the *y*-axis. This means that we can look at a cluster of items that involve multiplication and division and use learner performance to understand how to improve these skills in ways that can improve outcomes on a substantial group of topics.

Eight Grade 5 TIMSS mathematics restricted use items involved a multiplicative situation. These are situations that require multiplication or division to solve the problem. Performance on these eight items, compared with the international sample (11 countries) taking the same test is shown in Figure 3.

Figure 3: Average percentage correct on multiplication and division restricted use items for South Africa and Internationally



Patterns of performance on these items reflect the South African overall pattern being slightly lower than international levels of performance. South African learners achieved more than 30 percent correct on two items only. Three items had between 15 and 30 percent correct responses, and three items had below 15 percent correct responses.

Next, we provide an item-by-item analysis of each of the eight items in this content area. In this analysis, we indicate the link to CAPS, the cognitive demand of the item and South African learners' performance on the item.

We then discuss the item and identify any common errors and begin to draw out possible implications for the classroom. In some cases, we pair items where this helps us to discuss contrasts related to the question's formulation and/or presentation.

We then draw these together in a discussion of two key ideas in multiplication and division for the Intermediate Phase, and the basic ideas that need to be introduced in the Foundation Phase: key representations for multiplication and division; and language for supporting understanding of multiplication and division.

B.1.1 Multiplication and Division item analysis

Item 2

Maria travelled by bicycle for 4 days. She travelled the same distance each day.
Altogether she travelled 76 kilometres.
How many kilometres did Maria travel each day?

A) 18
B) 19
C) 20
D) 24

Item 4

Thandi gave away 48 stickers. She gave an equal number to 4 friends.
Which expression shows how many stickers Thandi gave to each friend?

A) 48 + 4
B) 48 - 4
C) 48 x 4
D) 48 ÷ 4

TIMSS Domain and link to CAPS

Item 2		Item 4
Whole Numbers	**TIMSS Content Domain**	Expressions, Simple Equations and Relationships
Applying	**TIMSS Cognitive Domain**	Applying
Grade 3 Numbers, Operations and Relationships	**CAPS Content Strand**	Grade 3 Numbers, Operations and Relationships
Routine Procedure	**CAPS Cognitive Demand**	Routine Procedure

Percentages of learner responses

Item 2				Item 4		
Correct	Incorrect	Omitted		Correct	Incorrect	Omitted
19%	79%	2%	**South Africa**	37%	56%	8%
34%	60%	6%	**International average (n=11)**	39%	55%	7%

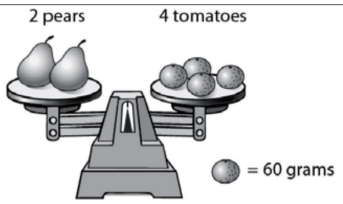
Error analysis

While both questions are about division in sharing situations, the lower performance on the first item (**Item 2**) seems linked to the word 'day' distracting or cueing nearly 50 percent of learners into choosing '24' (Option D).

In the second item (**Item 4**), the phrase 'equal number' supports the selection of division (Option D) as the appropriate operation in the second item.

This suggests that learners need support with more holistic ways of making sense of the language in problem-situations, rather than zooming in on particular cue words.

Item 7



The 2 pears weigh the same amount as 4 tomatoes.

How much does 1 pear weigh?

Ⓐ 480 g
Ⓑ 240 g
Ⓒ 120 g
Ⓓ 60 g

TIMSS Domain and link to CAPS

TIMSS Content Domain	Measurement and Geometry
TIMSS Cognitive Domain	Reasoning
CAPS Content Strand	Grade 4 Numbers, Operations and Relationships
CAPS Cognitive Demand	Problem-solving

Percentages of learner responses

	A	B	C	D	Omitted
South Africa	7%	11%	22%	58%	3%
International average (n=11)	6%	16%	31%	40%	6%

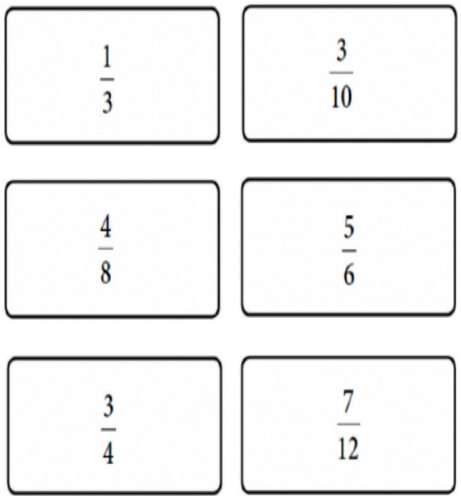
Error analysis

As in the previous pair of tasks, the high proportion of learners choosing the incorrect '60 g' (Option D) as the answer points again to a cued following of this number being shown in the item presentation.

Learners need to make sense of quantities and their relationships in visual image representations. This is an area that needs focus and strengthening.

Item 3

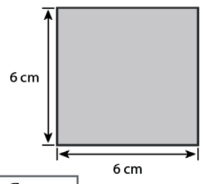
Circle **all** the fractions that are greater than $\frac{1}{2}$

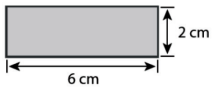
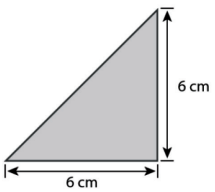
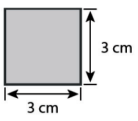


Item 8

The square above can be made by putting together smaller shapes.

Complete the table with the number of each shape that are needed to cover the whole square.



Shape	Number Needed to Cover the Square Above
	
	
	

TIMSS Domain and link to CAPS

Item 3		Item 8
Fractions and Decimals	**TIMSS Content Domain**	Measurement and Geometry
Knowing	**TIMSS Cognitive Domain**	Applying
Grade 5 Numbers, Operations and Relationships	**CAPS Content Strand**	Grade 4 Shape and Space
Knowledge	**CAPS Cognitive Demand**	Complex Procedure

Percentages of learner responses

Item 3				Item 8			
Correct	Incorrect	Omitted		Correct	Partially Correct	Incorrect	Omitted
6%	84%	9%	**South Africa**	2%	1%	90%	7%
11%	73%	15%	**International average (n=11)**	8%	3%	65%	24%

Error analysis

While drawn from different topic strands, both South African and international performance was very low on these items. Both items involve the idea of a 'whole' being made up of composite equal-sized parts – fractional parts in the first question and sub-shapes in the second question. Low performance on both items points to weak visual and symbolic understandings of iterated parts making up a whole.

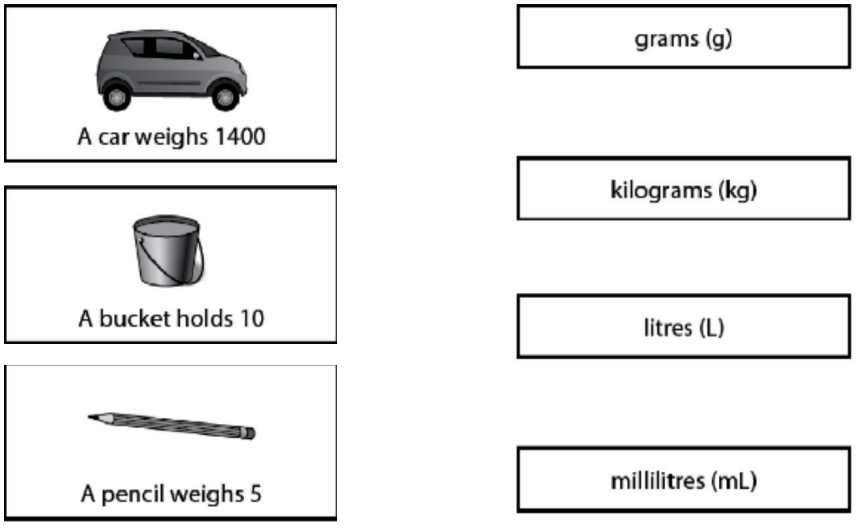
Useful initial tasks in the context of fractions might involve ordering fractions by size.

Follow-up tasks that lead into the idea of equivalence focus on questions like: 'How many times bigger is a $\frac{1}{2}$ than a $\frac{1}{6}$?

A variation of the same question is used in the shape context: 'How many times would the small rectangle/triangle/square fit into the large square?'

Item 6

What are the units for these measurements?
Draw a line to match each measurement to its units.



TIMSS Domain and link to CAPS

TIMSS Content Domain	Measurement and Geometry
TIMSS Cognitive Domain	Knowing
CAPS Content Strand	Grade 4 Measurement
CAPS Cognitive Demand	Knowledge

Percentages of learner responses

	Correct	Incorrect	Omitted/Not reached
South Africa	32%	58%	10%
International average (n=11)	37%	52%	10%

Error analysis

This item did show somewhat higher levels of performance than most other restricted items in the sample. However, only one-third of learners answered correctly, indicating relatively poor awareness of everyday measures.

We placed this item in the multiplicative reasoning strand because the idea here links with the same kind of question we suggested in the previous items: '1 400 of what kind of measure will tell us the mass of a car?'

Item 11

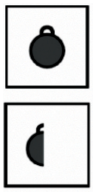
Complete the picture table of the weight of each animal.

Animal Weights

Animal	Weight (kg)
Cheetah	50
Lion	100
Leopard	75

The cheetah has been done for you.

Animal	Weight (kg)
Cheetah	
Lion	
Leopard	



Key:  = 50 kg

Item 12

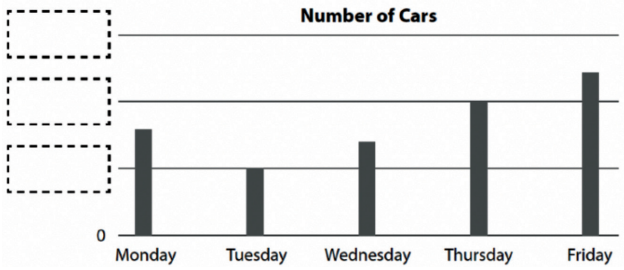
Busi recorded the number of cars that travelled along her street each morning.

Day	Number of Cars
Monday	8
Tuesday	5
Wednesday	7
Thursday	10
Friday	12

She started making a graph of her data.

What number should Busi use to label the horizontal lines on her graph?

Put the number in the boxes on Busi's graph.



TIMSS Domain and link to CAPS

Item 11		Item 12
Data Reading, Interpreting, Representing	**TIMSS Content Domain**	Data Reading, Interpreting, Representing
Reasoning	**TIMSS Cognitive Domain**	Applying
Grade 5 Data	**CAPS Content Strand**	Grade 4 Data Interpretation
Routine Procedure	**CAPS Cognitive Demand**	Complex Procedure

Percentages of learner responses

Item 11				Item 12		
Correct	**Incorrect**	**Omitted**		**Correct**	**Incorrect**	**Omitted**
29%	63%	8%	**South Africa**	11%	75%	13%
37%	48%	15%	**International average (n=11)**	14%	60%	26%

Error analysis

Both items involve data interpretation and representation, with some thinking – as in the earlier items – about units of measure. The topic of the first item (**Item 11**) is relatively familiar, with pictograms commonly seen in DBE workbooks and Common Assessment tasks from the Foundation Phase grades onwards. The inclusion of a graphic that represents 50 kg is only formally introduced in CAPS late in Grade 5, and the question requires working with both scaling up and scaling down 50 kg as the unit of measure to represent the dataset. This may help to explain the partially correct responses.

The performance on the second item (**Item 12**) is much lower, with a much less familiar question type involving deciding the units to label the axes in, with reference to the heights of bars. The higher proportion of omitted answers on the second item perhaps reflects a lack of attention to axes and their labelling in learners' classroom experiences.

B.1.2 Implications for teaching multiplication and division

The number of restricted use items that make use of multiplication and division concepts shows how important multiplicative thinking is for a range of different CAPS content areas. Across the set of multiplication and division-based items in TIMSS Grade 5, there were no items with more than a 40 percent level of performance, both in South Africa and the international group. The item analysis indicates problems with making sense of Foundation Phase-related multiplication and division situations, and then with using these fundamental understandings to build into fraction, ratio and proportion, percentages and area enlargement/reduction ideas in the Intermediate Phase.

There are implications for classroom teaching, linked to the introduction and use of **key language and key representations** in the Foundation Phase. These two aspects can then be carried through into the Intermediate Phase and beyond and used to help learners see the underlying multiplicative structure across a range of topics.

In this section, we show how multiplicative language and key representations of multiplicative situations can be introduced in the Foundation Phase, and then carried into the Intermediate Phase across multiple topic areas.

Foundation Phase

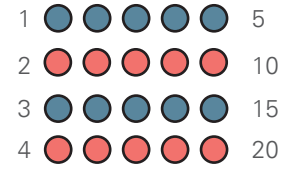
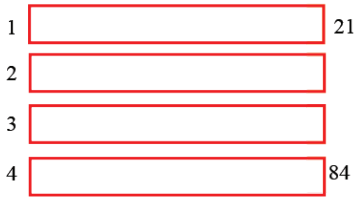
Multiplication and division are introduced in the Foundation Phase. The idea of 'equal groups' is central to multiplication and division situations. For example, we can think about:

- 4 groups of 5
- 3 crates containing 24 apples each
- 120 chairs arranged in rows with 12 chairs in each row
- 84 beads to share equally between 4 bags

It is important that learners can recognise when a situation involves multiplication/division, rather than addition/subtraction. An important question to ask learners to help them decide this is: 'Does this situation involve equal groups?'

In all the situations above, there are equal groups. In the Foundation Phase, children will often begin by drawing pictures of the situation, and they can be asked whether their drawings involve equal sized groups.

Over time, a representation that is useful to move on to that helps to illustrate the equal sized groups is the **array diagram**:

4 groups of 5	3 crates containing 24 apples each	84 beads shared equally between 4 bags
		

Arrays show that multiplicative situations contain a group that is iterated/repeated (in multiplication situations) or a whole that has to be broken down into equal sized groups (grouping division situations), or into a number of equal sized groups (sharing division situations).

Problems involving addition/subtraction do not have to have equal sized groups, so it is useful to include early sorting tasks using problem situations like the ones below, that ask children to decide which situations involve equal groups:

Three bags of potatoes contain 16, 14, and 19 potatoes. How many potatoes are there altogether?	Three bags of potatoes each contain 16 potatoes. How many potatoes are there altogether?
Thabi exchanges her R20 note for R5 coins. How many R5 coins does she get?	Thabi exchanges her R20 note for some coins. How many coins could she get?

The CAPS for Foundation Phase and Intermediate Phase make reference to clue boards. The version of the clue board that we suggest puts the numbers shown in an array diagram into a table format, allowing for more efficient representation and space for showing the 'how many times bigger/how many times smaller' relationships that underpin multiplication and division situations:

4 groups of 5	3 crates containing 24 apples each	84 beads shared equally between 4 bags
Number of groups: 1, 2, 3, 4 (x 4) → Total: 5, 10, 15, 20 (x 4)	Number crates: 1, 3 (x 3) → Total number apples: 24, ? (x 3)	Number bags: 1, 4 (÷ 4) → Number beads: ?, 84 (÷ 4)

The vocabulary of multiplication and division situations or problems in the Foundation Phase can start to emphasise 'size of group', 'number of groups' and 'total number', with questions asking which of these pieces of information are given in the task, and what needs to be worked out.

Comparative language in multiplication and division situations involves the questions:

How many times bigger?	How many times smaller?

This contrasts with addition and subtraction language, where questions ask:

How much bigger?	How much smaller?

Below are two examples of how representations and language can come together to support learners with a TIMSS test item using Foundation Phase content:

Representations and language

Key representations here are **bar** and **array** diagrams, leading into **clue boards**.

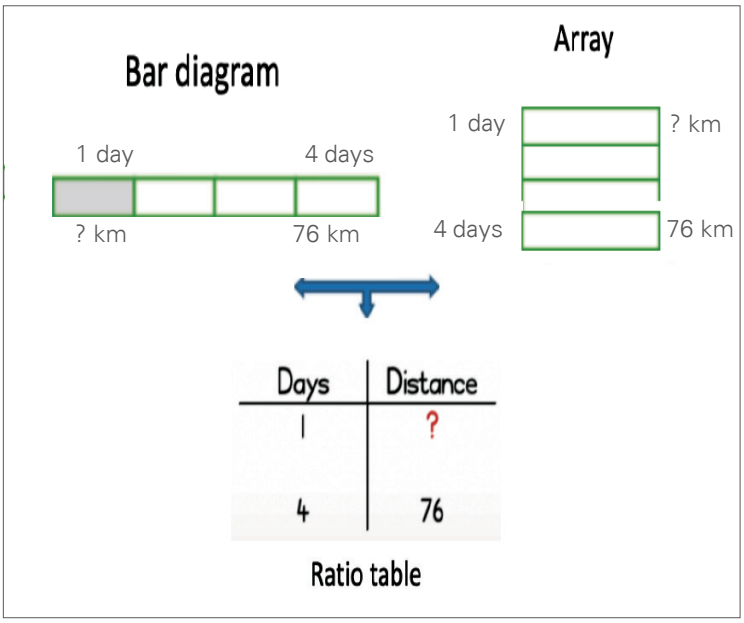
These diagrams show that multiplicative situations involve two dimensions:

- groups of a particular size or quantity;
- the number of these groups.

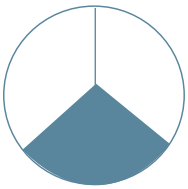
This is useful to share because it offers a way for learners to distinguish multiplicative situations from additive situations.

Core language for multiplicative situations are phrases like:

- Four of these units/groups make up the whole; the total is four times bigger than one group.
- Each of these units/groups is $\frac{1}{4}$ of the whole, or four times smaller than the whole.



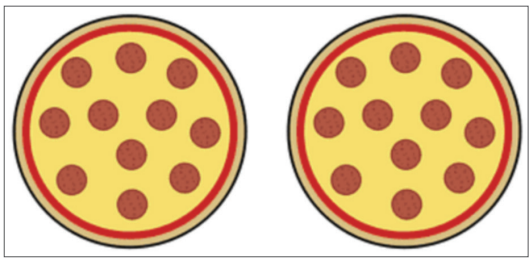
Fractions are often introduced in the Foundation Phase as a new topic and a new kind of number. A strong foundation in fraction understanding though, involves having a sense of the size of different fractions, and this means being able to think about the numerator in relation to the denominator. Centrally, a fraction like $\frac{1}{3}$ refers to any situation with **a part that is 3 times smaller than the whole**. Or, vice versa, the whole is 3 times bigger than the part. All of these situations can be represented as a $\frac{1}{3}$.



Shala shares the 6 biscuits in the tin equally between her 3 children. What fraction of the biscuits do they each get?

Tumi sleeps for 8 hours each night. What fraction of the day is Tumi asleep for?

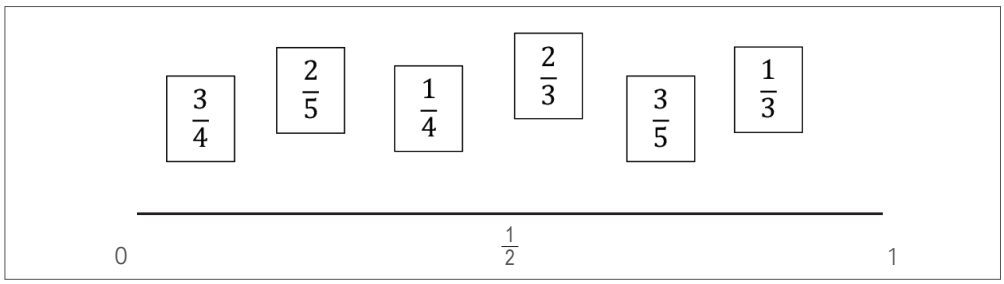
Children's understanding of this idea can be checked by asking questions like:



'Lebo orders 2 pizzas for her family. She eats one third of the pizzas. Cut the pizzas in different ways that give Lebo one third of the 2 pizzas.'

Item 5 asks learners to identify whether fractions are bigger or smaller than a half. This means looking at whether the numerator value is less or more than half of the denominator value. A task that supports the building of fraction sense involves placing fraction cards on a fraction number line, with learners explaining how they decided where to place the fraction along the line.

For example: 'Decide where to place these fractions on the number line below.'



Intermediate Phase

In the Intermediate Phase, the language and representations introduced in the Foundation Phase continue to be useful across a range of topics and over a number of years. Examples of how the core ideas of 'how many times bigger/smaller' can be adapted for fractions, percentages, and enlargement/reduction tasks are given below:

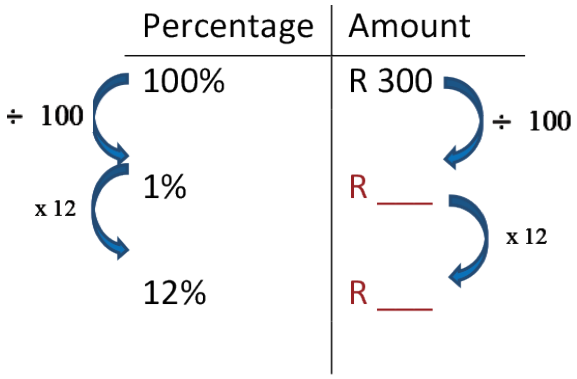
Connections and trajectories

The core language of multiplicative situations extends across multiple topics:

- She must have cycled a $\frac{1}{4}$ of the distance in one day.
- 1 eighth fits 4 times into 4 eighths. 8 eighths make a whole, so 4 eighths = $\frac{1}{2}$.
- The ratio of boys to girls in the school is 2:3. This is 5 parts altogether. There are 500 learners in the school. How many times bigger is 500 than 5? What does this mean for the number of boys and girls in the school?
- This shape fits 4 times into that shape, so the area of the big shape is 4 times the area of the small shape.

Extending the clue board representation

To work out 12% of R300, I can work out 1% by dividing the whole quantity by 100 (1% is a 100 times smaller than 100%), and then 12% by multiplying the result by 12 (12% is 12 times bigger than 1%).



The following video clip provides a short introduction to the key ideas of multiplication and division that we have highlighted through our analysis of the TIMSS items, and includes attention to how key representations and language can connect between topics across the Foundation and Intermediate Phases to strengthen learning.

Video clip 1: Multiplicative reasoning
https://youtu.be/NNVQgXix3bQ

B.2. Shape and Space (Geometry) and Measurement

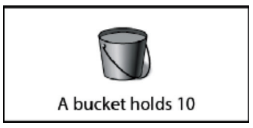
TIMSS assesses Measurement and Geometry in a single topic strand, so we consider these topics together in this report. Overall, the average scale score for all geometry and measurement items in the Grade 5 assessment was significantly lower than the overall mean (see the section on Curriculum in Reddy et al., 2022).

Two of the three items (**Item 7** and **Item 8**) have been discussed above from a multiplicative thinking perspective. Here, we deal with these three items from a geometry and measurement perspective. As before, items are paired or clustered where this is useful to draw attention to common topics and/or contrasts in responses.

B.2.1 Measurement and geometry item analysis

Item 6

What are the units for these measurements?
Draw a line to match each measurement to its units.



grams (g)

kilograms (kg)

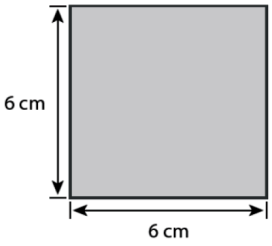
litres (L)

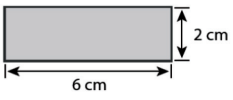
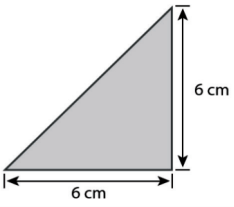
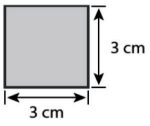
millilitres (mL)

Item 8

The square on the right can be made by putting together smaller shapes.

Complete the table with the number of each shape that are needed to cover the whole square.



Shape	Number Needed to Cover the Square Above
	
	
	

TIMSS Domain and link to CAPS

Item 6		Item 8
Measurement and Geometry	**TIMSS Content Domain**	Measurement and Geometry
Knowing	**TIMSS Cognitive Domain**	Applying
Grade 4 Measurement	**CAPS Content Strand**	Grade 4 Shape and Space
Knowledge	**CAPS Cognitive Demand**	Complex Procedure

Percentages of learner responses

Item 6				Item 8			
Correct	Incorrect	Omitted		Fully Correct	Partially Correct	Incorrect	Omitted
32%	58%	10%	**South Africa**	2%	1%	90%	7%
37%	52%	10%	**International average (n=11)**	8%	3%	65%	24%

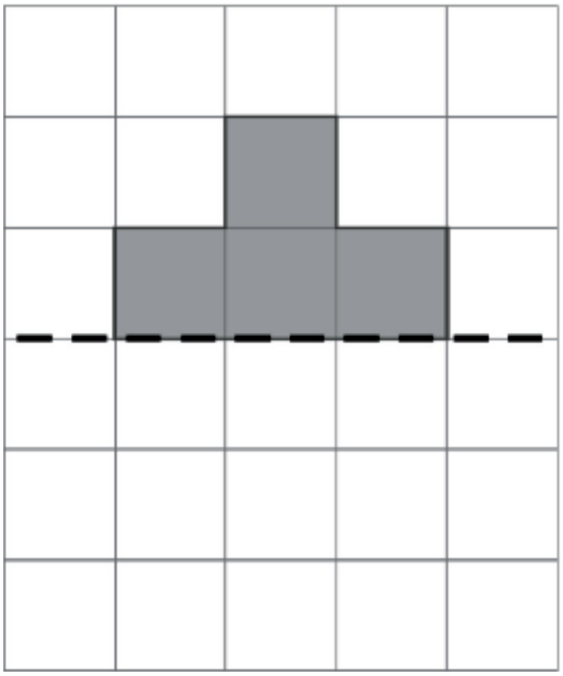
Error analysis

Although both items have been discussed in the section on multiplication and division as they encompass important aspects of multiplicative reasoning, they both also involve measuring in the sense that they ask, in **Item 8** about how many of a smaller item (different shapes in this case) will cover a larger shape, and in **Item 6** about what unit goes with particular numbers for the mass of some everyday objects.

Performance on both questions shows weaknesses, in South Africa and the international group, with a very small number of correct responses for the second question (**Item 8**) and close to one third of responses correct on the first question (**Item 6**). This suggests that there is insufficient attention to hands-on measuring in the Foundation Phase with informal and formal measures. This leads to difficulties with making sensible estimates about relative areas and the mass of everyday items.

Item 9

Complete this figure so the dashed line is a line of symmetry.



TIMSS Domain and link to CAPS

TIMSS Content Domain	Measurement and Geometry
TIMSS Cognitive Domain	Applying
CAPS Content Strand	Grade 4 Shape and Space
CAPS Cognitive Demand	Routine Procedure

Percentages of learner responses

	Correct	Incorrect	Omitted/Not reached
South Africa	54%	36%	9%
International average (n=11)	54%	27%	19%

Error analysis

Symmetry is a particular area of focus in the Space and Shape section of CAPS. From Grade 1 onwards learners are expected to be able to complete a drawing when given half the drawing and a line of symmetry. This should, thus, be a familiar item for learners. Of the restricted use items, this one had the second highest performance. However, it is worth noting that only just over half of the Grade 5 sample were able to get this correct. The lack of data on common errors makes it unclear what learners struggled with here.

B.2.2 Implications for teaching geometry and measurement

Below, we offer examples of tasks and activities that can be used across the Foundation and Intermediate Phases to support children's learning of Geometry and Measurement.

Foundation Phase Measurement

Practical measurement is important in the Foundation Phase, and it can be followed up by challenging learners to improve their skills to imagine shapes and their attributes.

For example, if learners have done some work where they have weighed themselves on a bathroom scale one could ask them question like:

- What do you think a cat might weigh?
- What do you think an elephant might weigh?
- What do you think a car might weigh?
- If I put my pencil on the bathroom scale what do you think would happen?

Formal or standard measuring units are also introduced in the latter half of the Foundation Phase after learners have had some experience with practical measurements. Ask learners to show you (with their hands) what:

- A cup that holds 300 ml would look like.
- A length of 5 cm would look like.
- A length of 1 m would look like.

Ask learners to talk about appropriate units of measurement directly, for example, ask learners to say whether they would use the units mm, cm, m or km to measure:

- The length of their pencil.
- The length of their desk.
- The length of their classroom.
- The distance to the supermarket.
- The distance to the next town.

As there are more than one possible correct answer to these questions, asking learners to justify their answer would be important.

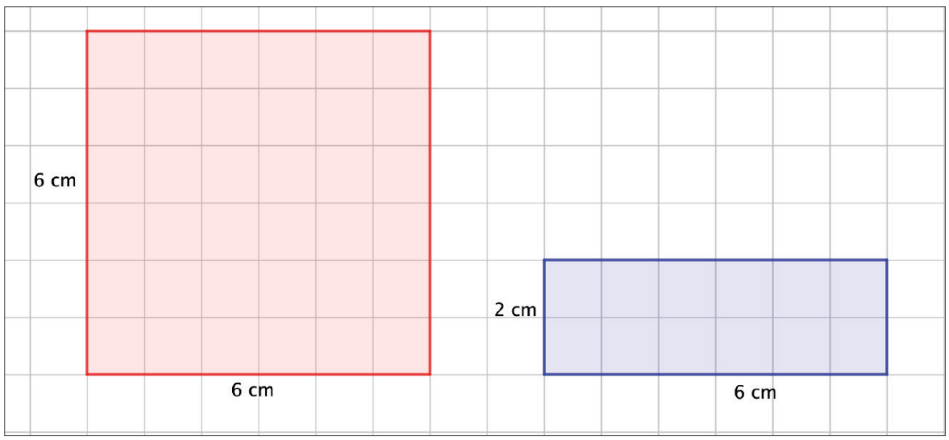
Intermediate Phase Measurement

Experiences with informal and formal measurements form a solid base for leading into Intermediate Phase emphasis on measuring, comparing and converting between measures.

Tasks can include asking what units would be correct to describe the length of a pencil as 11 __ and 110 __, or the mass of a bag of apples as $1\frac{1}{2}$ __ or 1 500 __. This can lead to a more formal emphasis on converting between measurements and the reasoning underpinning the conversion operations.

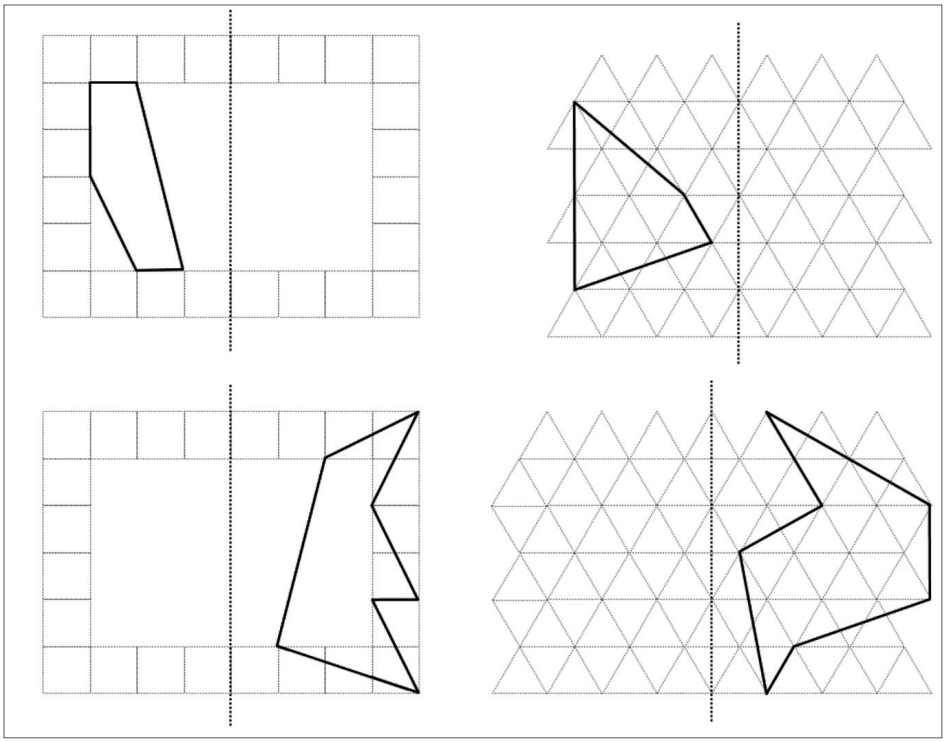
Foundation Phase Geometry

On shape and space, experiences in playing with and talking about physical shapes is important – with tasks like seeing how many smaller rectangles or triangles are needed to cover a larger square. Moving these kinds of tasks to work on grid paper allows for attention to composing shapes from smaller pieces, and paying attention to properties like lengths, areas and orientations. This is sometimes described as developing a geometric eye.



Intermediate Phase Geometry

Similarly, the symmetry task can also be extended in ways that further develop the geometric eye. Using different types of grid paper can focus learners' attention on particular attributes of the shape. Vertical and slanted lines of symmetry can also be incorporated.



Source for task: Don Steward found at https://donsteward.blogspot.com

Focusing attention on attributes of shapes such as area and length helps to connect geometry and measurement topics. Given that these kinds of integrated tasks are common in TIMSS, inclusion of such connections is also an important part of helping to support learners with the style of TIMSS questions. Part of doing this work is developing the vocabulary to describe these attributes. This language begins with descriptions of edges/sides and corners (vertices), equal or unequal lengths, and grows over time to include a range of orientations (horizontal, vertical, slanted, diagonal), and descriptions of areas.

Some of the key ideas for teaching Geometry and Measurement that emerge from the item analysis in this cluster are discussed in this short video clip.

Video clip 2: Area and perimeter
https://youtu.be/hI2THNekb_E

B.3. Representing and Interpreting Data

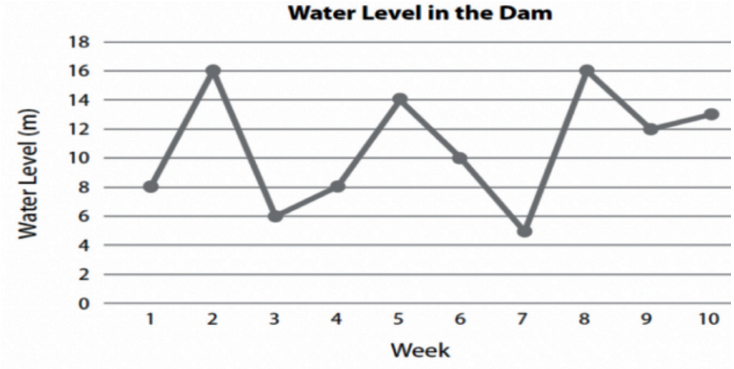
Data handling in the Intermediate Phase includes attention to collecting, representing and interpreting data, as well as attention to probability. There were no probability items in the released item set, so we restrict our analysis to the data topics here. Three restricted items in the TIMSS Grade 5 assessment were drawn from the data strand. While two of the items have been discussed as part of the Multiplication and Division topic strand, here we look across these three items from a data topic strand perspective.

B.3.1 Representing and interpreting data item analysis

This set of items includes one question focused on reading data, a second item focused on representing data and a third item that emphasises interpretation of the way data is presented. Performance drops across this sequence of data-handling items.

Item 10

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



A. What was the water level for week 8?

Answer:_____m

TIMSS Domain and link to CAPS

TIMSS Content Domain	Data Reading, Interpreting and Representing
TIMSS Cognitive Domain	Knowing
CAPS Content Strand	Grade 4 Interpreting Data
CAPS Cognitive Demand	Knowledge

Percentages of learner responses

	Correct	Incorrect	Omitted/Not reached
South Africa	52%	41%	7%
International average (n=11)	40%	41%	19%

Error analysis

This item involved reading off the water level for the appropriate week on the graph. It was relatively well answered by South African learners, with just over half of all responses being correct and higher than the international average. However, almost half of the cohort were unable to identify the appropriate week on the horizontal axis and read the water level corresponding to that week. This suggests the need for more varied experiences with data representation and interpretation.

Item 11

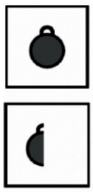
Complete the picture table of the weight of each animal.

Animal Weights

Animal	Weight (kg)
Cheetah	50
Lion	100
Leopard	75

The cheetah has been done for you.

Animal	Weight (kg)
Cheetah	
Lion	
Leopard	



Key: = 50 kg

Item 12

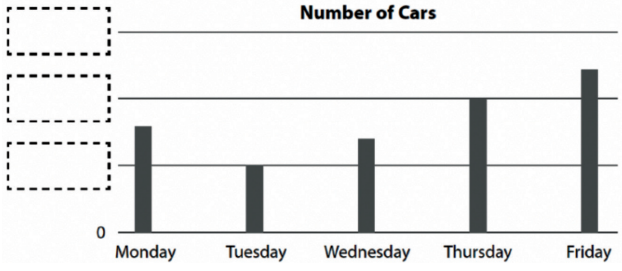
Busi recorded the number of cars that travelled along her street each morning.

Day	Number of Cars
Monday	8
Tuesday	5
Wednesday	7
Thursday	10
Friday	12

She started making a graph of her data.

What numbers should Busi use to label the horizontal lines on her graph?

Put the numbers in the boxes on Busi's graph.



TIMSS Domain and link to CAPS

Item 11		Item 12
Data Reading, Interpreting and Representing	**TIMSS Content Domain**	Data Reading, Interpreting and Representing
Reasoning	**TIMSS Cognitive Domain**	Applying
Grade 5 Representing Data	**CAPS Content Strand**	Grade 4 Representing Data
Routine Procedure	**CAPS Cognitive Demand**	Complex Procedure

Percentages of learner responses

Item 11				Item 12		
Correct	Incorrect	Omitted		Correct	Incorrect	Omitted
29%	63%	8%	**South Africa**	11%	75%	13%
37%	48%	15%	**International average (n=11)**	14%	60%	26%

Error analysis

Both these items have already been discussed in the section on multiplication and division as multiplicative reasoning is an important component in these questions. However, both items clearly involve the representation and interpretation of data. Performance on both these items is lower than on the initial reading data item **(Item 10)**.

On both items information from different sources – textual, tabular and graphical – needs to be brought together to complete the task.

In the pictograph question **(Item 11)**, this completion is relatively familiar with pictogram work in CAPS from the Foundation Phase grades.

The second question **(Item 12)** is less routine – rather than asking for completion of the bar chart, it asks for reasoning about the scale on the vertical axes that would fit the bars in the chart in relation to the tabular data. This lack of familiarity contributed to very low performance on this item.

B.3.2 Implications for teaching data representation and interpretation

While overall performance on the data items was better than in the other Content Domains, there remain areas where learner understanding needs improvement (see Chapter 4 of Reddy et al., 2022). Performance on this small set of items points to the need for more explicit attention to the processes of creating data representations, and reading information from data representations, alongside reading off from data representations.

Foundation Phase

In the Foundation Phase, CAPS emphasises the need for learners to experience the full data cycle. This means giving learners access to working with collecting and organising data; representing data; analysing, interpreting and reporting data. The reason for emphasising the full process is that this provides learners with access to why data representation is useful, and how it can provide easy access to the highlights of a dataset.

There are many questions that can be asked that lead to the need to collect and then represent data:

- How many children are present in class each day across the month?
- How do children in the class get to school: walk/taxi/car/other?
- What snacks were sold in the tuck shop that day?

Sharing collected data on the chalkboard can then lead to questions about the day with lowest attendance, or the most and least popular snack. Finding the answers to these questions in a large dataset is hard but sorting the data in order and then representing the data in a bar chart or pictograph helps us see the answers much more easily.

Discussions about the graph format draws attention to how best to represent data and can be used to introduce some key vocabulary of data representation such as tables, pictographs, tally marks and bar graphs. Checking whether all data has been represented and whether different data representations match each other is an important part of data representation activity.

Intermediate Phase

Alongside ongoing attention to the full data cycle in the Intermediate Phase, the range of data representation formats that learners need to be aware of is expanded to include double bar graphs and pie charts. As datasets become more complex, it is important to spend some time checking learners' understanding of the context.

For example on the dam levels item **(Item 10)**, teachers can include some checks of sense-making of the context to start the discussion:

- What is a dam? What are dams for?
- What makes the water level in a dam rise?
- And what would make the water level fall?

These understandings are important to being able to represent and interpret data. Making sense of data can be checked using **Item 10** through questions like:

- In which weeks was the water level higher than 10 m?
- How much did the water level drop between weeks 2 and 3?
- In week 11 the water level increased by 2 metres, and then in week 12 it increased by 3 metres. Extend the graph to include this information.

These basic questions can then lead into more complex questions such as:

- From which week to the next did the water level drop the most?

Alongside the broader range of representations and their names, attention should be given to:

- vocabulary about **axes** and their labelling,
- the **scale** to be used,
- questions about the most frequent and least frequent outcomes.

This vocabulary provides the foundations for later work on the different measures of averages.

B.4. Remaining items: Place Value and Number Problem Solving

Two restricted use items were not picked up within the clustered topic areas in this report. These two items are dealt with here. They are both single items in two different topic strands, so our analysis comments more generally on the foundations and forward trajectory of these topics.

B.4.1. Place value item analysis

Item 1

Whitch number has 7 in the hundreds place and 6 in the units place?

A) 167
B) 176
C) 716
D) 761

TIMSS Domain and link to CAPS

TIMSS Content Domain	Whole Numbers
TIMSS Cognitive Domain	Knowing
CAPS Content Strand	Grade 3 Number, Operations and Relationships
CAPS Cognitive Demand	Knowledge

Percentages of learner responses

	Correct	Incorrect	Omitted/Not reached
South Africa	57%	40%	4%
International average (n=11)	58%	37%	5%

Error analysis

This item drawn from Foundation Phase content on place value has relatively high levels of performance with more than half of all responses correct (Option C). Nearly a third of all responses on the item chose options where only one of the digits in the question was in the correct position but not the other. This points to difficulties with holding all the textual information.

Broader research evidence from learners' work with column algorithms for the four operations – and the ongoing use of counting in ones – points to weak conceptual understanding of place value (Graven et al., 2013).

B.4.2. Implications for teaching place value and number system awareness

Once again language and representation that draw attention to the relative size of units such as tens and hundreds is important. A key idea to appreciate here is that the decimal system is based on objects that are ten times bigger than each other as we move across from units to tens to hundreds and beyond. Place value blocks provide a useful sense of the relative size. Using these blocks to make up 2-digit and then 3-digit numbers is a useful way of building experience of the relative size of numbers, and can be coupled with tasks about which number is bigger/smaller in a pair, or ordering numbers from smallest to largest. This appreciation of the size of numbers leads to and supports work on problem-solving tasks like the one below:

☐ 7 x 3

What digit should go into the empty box to give the answer nearest to each of the following numbers:

- 60
- 150
- 210

A second idea to appreciate is how to exchange between places. This involves going beyond, for example, breaking down 72 into 7 tens and 2 units or 70 and 2, but also asking questions like this:

72 = 6 tens and _____units

Language in the context of place value involves awareness of the specific meaning of words like 'digit', 'place' and 'value'. Tasks like this are useful, with details on the kinds of responses to listen for:

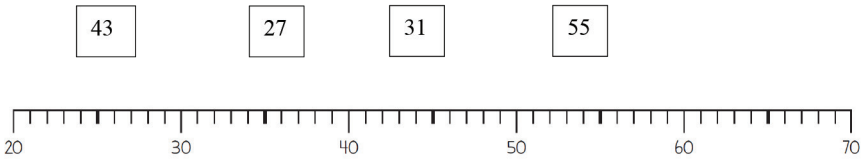
347

- What place is the digit 4 in within 347? [4 is in the tens place]
- What is the value of the 4 in 347? [4 in 347 has a value of 40]

Finally, having an appreciation of where particular numbers fall in relation to multiples of 10 and multiples of 100 is very useful for efficient calculation. This appreciation can be developed using tasks and number line representations with questions like the ones below:

Place the numbers below in the right place on the number line:

- Which tens does each number fit between? E.g. 43 is between 40 and 50.
- How far is 43 from 40?
- How far is 43 from 50?



These foundations, based on strong number sense, feed into efficient calculation in the Intermediate Phase and should help improve performance on questions like the one in the Grade 9 TIMSS assessment shown below, which was very poorly answered – 14 percent of responses were correct. Questions like this depend on an understanding of the relative value of different digits, and the much bigger impact of multiplying by a large number of tens rather than small numbers of tens.

Write each of the digits 1, 2, 3, and 4 in a box below to make the smallest product.
Each digit may only be used once.

☐ ☐ X ☐ ☐

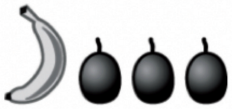
B.4.3. Number problem-solving

Item 5

Caroline bought:

cost 22 zeds

Nosipho bought:



cost 13 zeds

How much do a  and a  cost together?

Answer: _____zeds

How much does a  cost?

Answer: _____zeds

TIMSS Domain and link to CAPS

TIMSS Content Domain	Whole Numbers
TIMSS Cognitive Domain	Reasoning
CAPS Content Strand	Grade 4 Patterns, Functions and Algebra
CAPS Cognitive Demand	Problem-solving

Percentages of learner responses

	Both parts correct	Part 1 correct	Part 2 correct	Incorrect	Omitted/Not reached
South Africa	3%	1%	5%	89%	3%
International average (n=11)	6%	3%	5%	70%	16%

Error analysis

This item is non-routine in its formulation of a problem with a number of problem-solving routes that can be taken. Performance on both parts was very low and nearly 90 percent of responses pointed to random guessing. This, in turn, points to a reluctance to work with either trial and error approaches where values for the prices of each of the two fruits are tried out, or with reasoning-based methods.

B.4.4. Implications for teaching problem-solving

Getting better at open-ended problem-solving can only happen by giving learners more experience with non-routine problems to solve. Research suggests it is important to give learners access to problem-solving from the early grades (Askew, 2015). It is important to match problems to the age and experiences of the learners. In the early grades for example, a problem to ask learners alongside building some fluency with bonds of single-digit numbers is:

- How many different ways are there of making the number 7?

For children to be able to work on this kind of problem, teaching can draw whole class attention to the advantages of working systematically, forms of representation of working, and checking for completeness of results. As children build these skills, further questions might focus on:

- What happens with bonds of 8? Or 9?
- How many different bonds do you think there would be for 15? Or 54?

Experiences of working independently on open-ended problems, making decisions on how to approach problems, likely taking some unproductive routes and then starting over are all important parts of the problem-solving process for children to have some familiarity with, if they are to attempt TIMSS reasoning level items more successfully.

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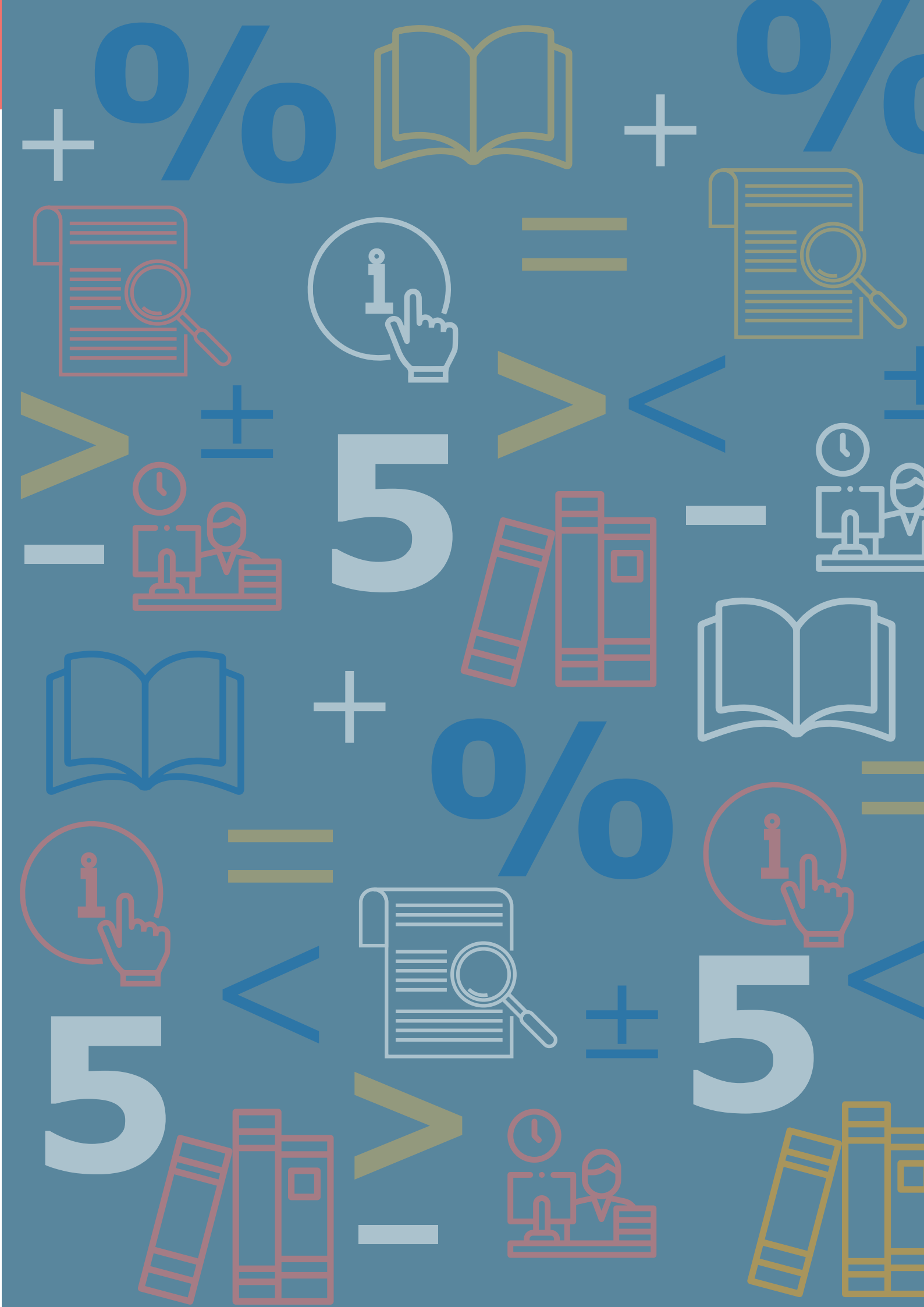

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