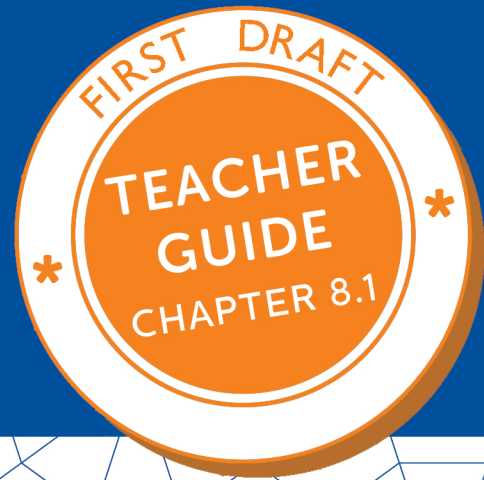


ASSESSMENT

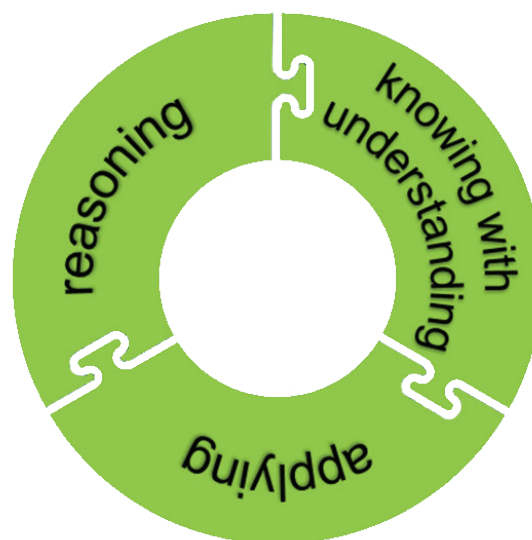


Brombacher
& Associates

Assessment in the NumberSense Programme

The underlying philosophy of the NumberSense Mathematics Programme is that we want children to experience mathematics as a sense-making, problem-solving activity.

Furthermore, the programme is designed to develop knowledge with understanding, that children can apply in unfamiliar situations, all the while being able to reason about what they are doing.



Assessment of children using the NumberSense Mathematics Programme should be aligned with these aims. This should be reflected in the use of appropriate assessment tasks and in the nature of the items (questions) in the tasks.

Recognising that giving no education is better than giving it at the wrong time (Piaget, 1953), an important role of assessment is for teachers to gather information. This information should then be used to make teaching decisions that improve learning. While assessment also serves the role of measuring and reporting on children's achievement at the end of a unit of work to inform decisions about promotion etc., the key role of assessment in the NumberSense Programme is for teachers and children to get feedback on learning.

What is Assessment?



Assessment is a continuous planned process of identifying, gathering and interpreting information regarding the performance of children, using various forms of assessment.

Assessment should be both *informal* and *formal*. In both cases, regular feedback should be provided to children to enhance the learning experience.

Assessment Tools

Table 1 provides a list of traditional assessment tools with a description of each as well as the nature of the marking instrument typically associated with the task. The reader is encouraged to review this list and reflect on the appropriateness of each tool in the context of the grade that they teach. Figure 1 provides a suggested distribution of assessment tasks by grade for assessment in the NumberSense Mathematics Programme.

Assessment Tool	Description	Marking instrument	Relevance
Observations	<p>Observations are one of the most important tools available to teachers of young children who are unable to read and write. Observations are used by teachers as children engage in play and routine activities to determine progress regarding the learning outcomes. In addition, observations enable teachers to observe and report on children's developmental progress, social interactions, and learning behaviours in a natural context.</p> <p>In the context of the NumberSense Programme, teachers are continuously observing young children as they work with the teacher on the mat on a range of tasks.</p>	<p>Informal and formal observation notes</p> <p>Checklist</p>	0 1 2 3 4 5
Interviews	<p>Interviews can be both formal and informal.</p> <p>In a formal interview, the teacher interacts with the child using a set of predetermined questions. Formal interviews can be used to assess specific knowledge or skills. They are very useful in gathering direct evidence of a child's conceptual understanding.</p> <p>Informal interviews are semi-structured, with the teacher adapting their questions based on a child's responses.</p> <p>Interviews can be conducted in both one-on-one and in small groups situations.</p> <p>In the context of the NumberSense Programme, teachers are in effect interviewing children when they ask them to explain how they determined their response/solution to a task.</p>	<p>Interview guide</p> <p>Checklist</p>	0 1 2 3 4 5

Assessment Tool	Description	Marking instrument	Relevance
Practical tasks	<p>Practical tasks involve children in hands-on activities that assess the application of knowledge, skills, and reasoning in a realistic context.</p> <p>In the context of the NumberSense Programme, practical tasks are particularly useful for assessing Measurement, Space and Shape, and Data Handling activities.</p>	<p>Checklist</p> <p>Rubric</p>	<p>0 1 2 3 4 5</p>
Presentations	<p>Oral and multimedia presentations by children allow them to demonstrate their understanding of a topic, to explain their work, and to justify their conclusions. Presentations also allow the teacher to assess children's ability to organise their thoughts and communicate ideas.</p> <p>In the context of the NumberSense Programme, presentations could be used to have children (individually or in groups) report on projects, investigations and research activities.</p>	Rubric	<p>0 1 2 3 4 5</p>
Investigations	<p>Investigations require children to conduct research, analyse data, and present findings. They assess critical thinking, problem-solving, and the ability to apply knowledge in practical scenarios.</p> <p>Investigations are particularly relevant in the NumberSense Programme in that they have children apply their knowledge in unfamiliar situations while compelling them to demonstrate reasoning. The structure of the NumberSense workbooks assumes an investigative approach to learning.</p>	<p>Rubric</p> <p>Memo</p>	<p>0 1 2 3 4 5</p>
Projects	<p>Projects are extended tasks typically completed in groups. Projects may involve researching a topic or designing and conducting an experiment, observing and then reporting on the work either through an extended write up or sometimes by means of a poster.</p> <p>In the context of the NumberSense Programme, projects are an ideal tool to use with extended data handling tasks which involve developing research questions, collecting data, summarising and presenting the data and providing answers to the questions posed.</p>	Rubric	<p>0 1 2 3 4 5</p>

Assessment Tool	Description	Marking instrument	Relevance
Written tasks or assignments	<p>In written tasks or assignments, children complete an individual task often to assess their understanding of a topic or to demonstrate their readiness for a more formal written assessment. In the completion of a written task, children will have access to a range of resource materials, including their notebooks.</p> <p>In the context of the NumberSense Programme, written tasks or assignments are useful for the revision of topics.</p>	Memo	0 1 2 3 4 5
Class tests	<p>Class tests are the most familiar form of assessment conducted throughout the year, often on the completion of a topic or at fixed intervals throughout the year. Tests usually consist of a series of questions covering specific mathematical content. The fundamental purpose of a test is to measure children's knowledge and understanding on a topic or series of topics. Questions will cover the three cognitive domains (knowing, applying, and reasoning) in a proportion that is appropriate for the grade level.</p> <p>In the context of the NumberSense Programme, class tests are typically used from Grade 4 onward although they may also be used in Grade 3.</p>	Memo	0 1 2 3 4 5
Examinations	<p>Examinations are more extensive than class tests in that they will typically cover more topics and will take longer to complete. Examinations are usually conducted in the middle and at the end of the year.</p> <p>In the context of the NumberSense Programme, examinations are used in line with the school's examination policy.</p>	Memo	0 1 2 3 4 5

Table 1: Assessment tools used in the NumberSense Mathematics Programme

The type of assessment used should be age and developmental level appropriate.

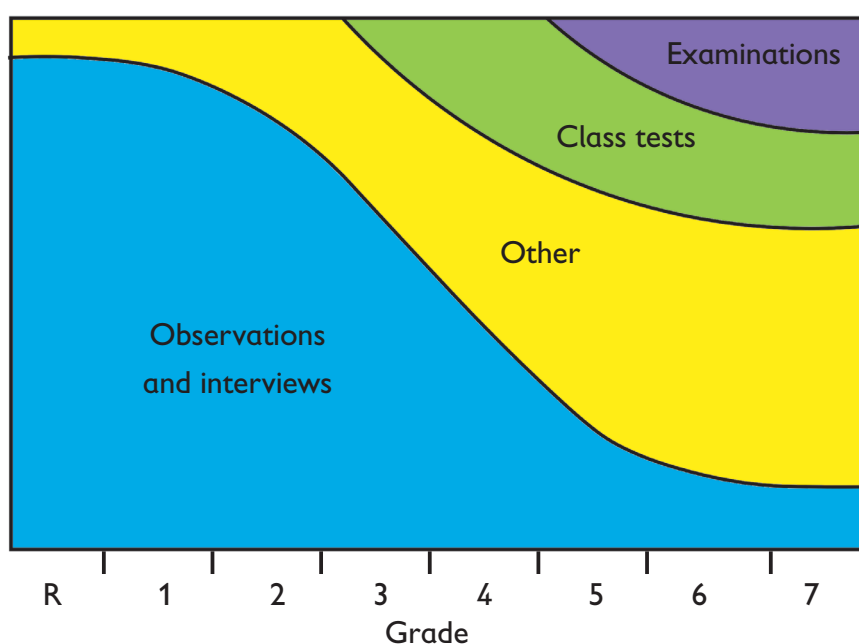


Figure 1: Types of assessment used

Annual assessment plans

It is important that teachers plan for assessment and develop an annual assessment plan. Assessment plans should consider and be aligned to the proportion of teaching and learning time dedicated to each topic as well as the sequencing of topics over the year (across the NumberSense workbooks for the year). The plan also needs to identify the tools to be used. Finally, an assessment plan should ensure that assessment is evenly distributed across the year.

Distribution of content in the NumberSense Programme

Table 2 summarises the proportion of workbook pages allocated to each of the five learning outcomes over the year for each grade. This distribution of content should guide the development of the annual assessment plan.

In the case of Grade R, there are no pages (written work) assigned to Space and Shape, Measurement, and Data Handling. This is because it is not possible to do written work for these learning outcomes in Grade R. Instead, Space and Shape, Measurement, and Data Handling are typically playful activities assessed by means of observation.

Learning Outcomes	Grade							
	R	1	2	3	4	5	6	7
Numbers, Operations and Relationships	90%	67%	62%	59%	50%	50%	50%	30%
Patterns, Functions and Algebra	10%	10%	10%	10%	8%	10%	10%	25%
Space and Shape	Activity-based	11%	12%	12%	16%	17%	18%	25%
Measurement		8%	10%	13%	15%	14%	12%	10%
Data Handling		4%	6%	6%	11%	9%	10%	10%

Table 2: Distribution of Content Areas in the NumberSense Comprehensive Workbooks

Developing an annual assessment plan

The reader is encouraged to use Table 3 to develop an annual assessment plan for their grade, indicating the learning outcomes to be assessed in each term and selecting the most appropriate assessment tool for each. It goes without saying that each learning outcome will be assessed more than once a year and typically by means of a range of different tools.

	Learning Outcome being assessed			
Assessment tool	Term 1	Term 2	Term 3	Term 4

Table 3: Assessment plan

Cognitive domains

The NumberSense Mathematics Programme has been designed so that children will develop knowledge with understanding, that they can apply in unfamiliar situations, all the while being able to reason about what they are doing. Against this background, assessments should be deliberately structured to address each of these domains.

In the context of assessment these domains can be described as follows:

- **Knowing** involves understanding the mathematical concepts, facts, and procedures children need to know. It is the foundation of mathematics, encompassing the comprehension of mathematical language and symbols.
- **Applying** is about using mathematical knowledge and conceptual understanding in a range of situations. It includes the ability to manipulate mathematical expressions, solve problems, and use mathematical tools and techniques in practical situations.
- **Reasoning** involves logical, systematic, and analytic thinking in mathematics. It is the ability to use, generate and justify solutions to problems, identify patterns, and make conjectures based on evidence or established premises.

Table 4 from the TIMSS Assessment Framework (Mullis et al., 2023) provides a useful description of cognitive skills particular to each of the three cognitive domains. These descriptions should assist teachers when developing assessment tasks.

Knowing	Recall	Recall definitions, terminology, number properties, units of measurement, geometric properties, and notation (e.g. $a \times b = ab$, $a + a + a = 3a$).
	Identity	Identify numbers, expressions, quantities and shapes. Recognise when entities are mathematically equivalent. Read information from graphs, tables, texts or other sources.
	Order	Order and classify numbers, expressions, quantities and shapes by common properties.
	Compute	Compute arithmetic operations with whole numbers, fractions, decimals and integers using algorithmic procedures. Carry out straightforward algebraic manipulation.
Applying	Formulate	Determine efficient/appropriate operations, strategies and tools for solving problems.
	Implement	Implement suitable strategies and operations to produce solutions to problems.
	Represent	Represent data in tables or graphs; create equations, inequalities, geometric figures or diagrams that model problem situations and generate equivalent representations for a given mathematical entity or relationship.
Reasoning	Analyse	Analyse, describe or use relationships among numbers, expressions, quantities and shapes.
	Integrate	Link different elements of knowledge, related representations and procedures.
	Generalise	Make statements that represent relationships in more general and more widely applicable terms.
	Justify	Provide mathematical arguments to support a strategy or solution.

Table 4: Question types in each of the cognitive domains.

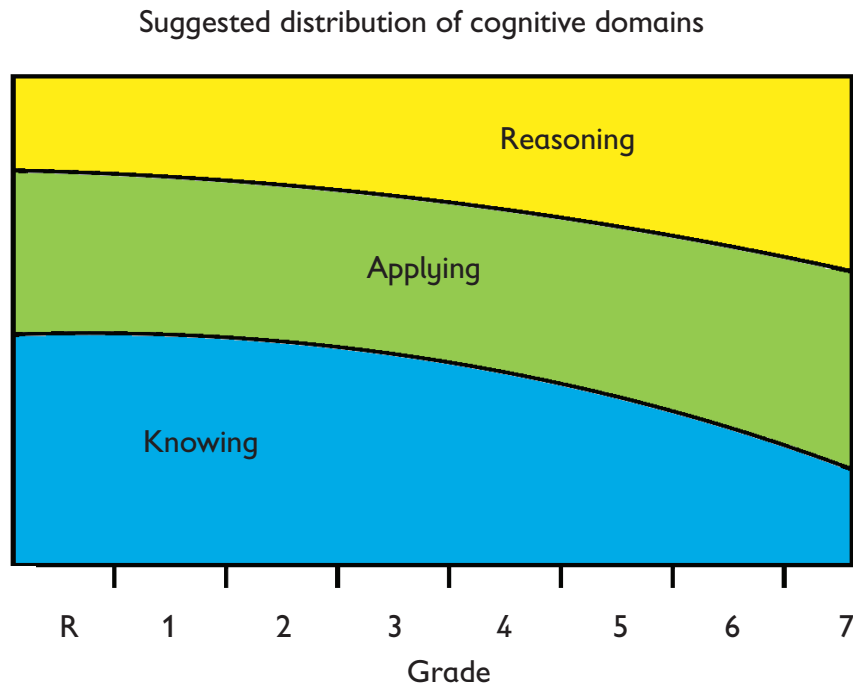


Figure 2: Proportion of questions in each cognitive domain.

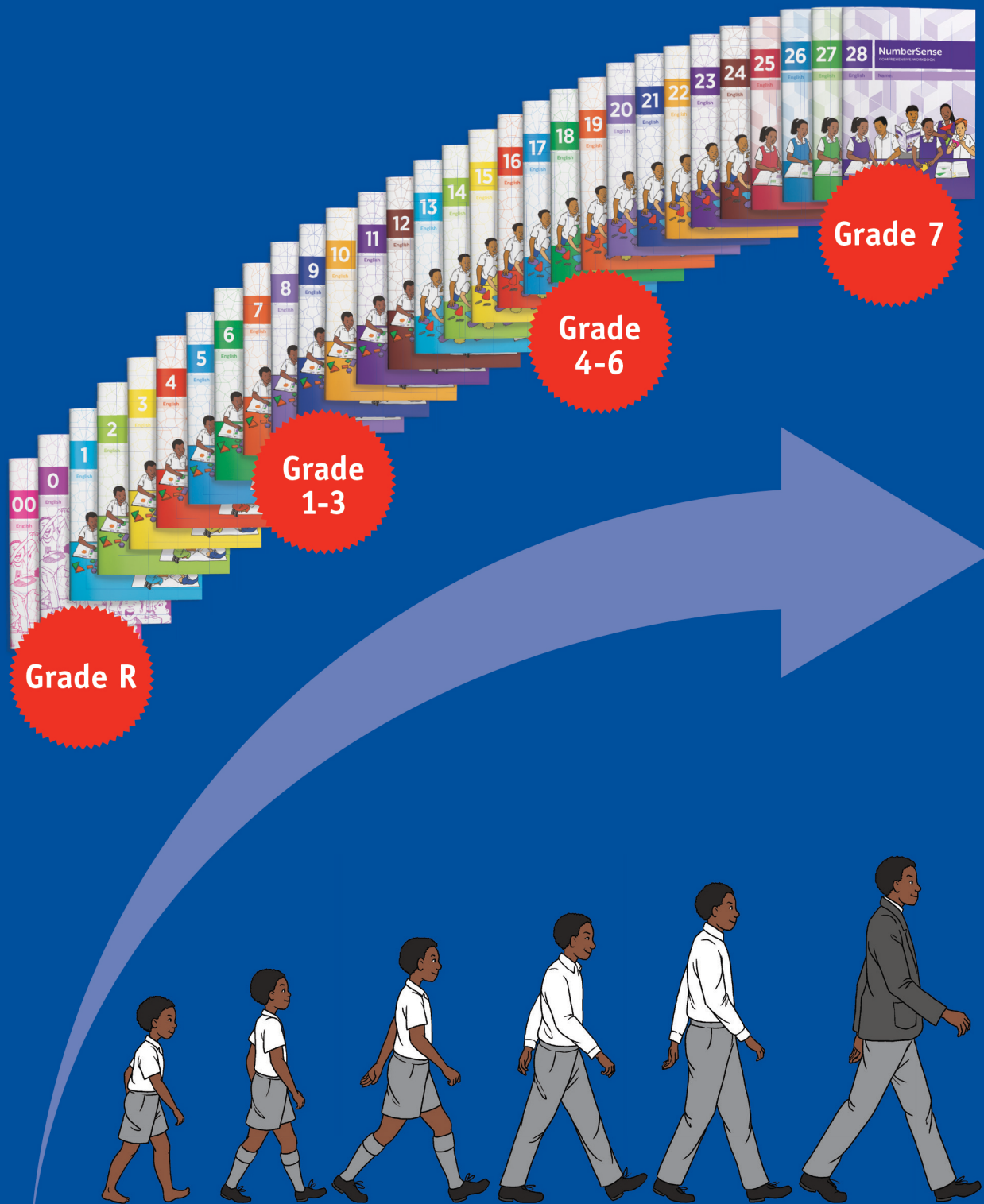
The proportion of assessment tasks allocated to each of the cognitive domains should be appropriate to the age and grade of the learner. *Figure 2* provides a suggested proportion of task allocation to each of the domains in relation to the grade level of the children being assessed.

Using the NumberSense Workbook activities as assessments

The NumberSense Workbooks have a wide range of activities that can either be used as assessments, investigations, projects, or even test items. In some instances, the activities can be used as they are, in other instances it may work better for the teacher to use the activity in the workbook as an introduction to a related assessment task.

In this section we will illustrate how existing activities can both lead into a separate task, or be used as the task. For two of the examples, a suggested marking rubric is provided. For the other two examples, the reader is left to develop their own marking rubric/memorandum.

NUMBERSense COMPREHENSIVE WORKBOOK JOURNEY



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