A resource for schools

Demystifying numeracy demands in the NCEA Common Assessment Activity

Te Tāhuhu o te Mātauranga
Ministry of Education

The purpose of this resource is to unpack the numeracy demands on students found in the Numeracy Common Assessment Activity (CAA). This resource aims to identify and offer solutions that tackle those numeracy demands in classroom teaching and learning.

Please note: This resource aims to summarise information contained in Beyond right or wrong: What student responses reveal about numeracy, written by Dr Vince Wright and Dr Charles Darr. We encourage you to read the article in full for the greatest benefit.

Numeracy involves the application of mathematics in real-world contexts. Therefore, numeracy requires more than the ability to perform mathematical calculations. To be numerate students must also:

- interpret situations
- plan an approach
- make judgements
- and sometimes consider broader social or ethical dimensions.

"Numeracy and mathematics are closely related, but they are not the same. Numeracy focuses on the purposeful use of mathematics. A learner may know a mathematical procedure, but numeracy requires deciding whether that procedure is useful and whether the resulting answer makes sense for the situation."

Beyond right or wrong: What student responses reveal about numeracy

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The items in the Numeracy Common Assessment Activity (CAA) are designed to assess numeracy capability and therefore reflect mathematical calculations required in everyday situations. Numeracy attainment requires that students:

1. Formulate mathematical and statistical approaches to solving problems in a range of everyday situations.
2. Apply mathematical and statistical procedures correctly in those situations.
3. Explain their mathematical and statistical responses.

Even students who are comfortable with mathematical procedures in familiar classroom settings can find the demands of numeracy to be a challenge.

A helpful way to understand the demands of a numeracy item is provided by the Numeracy Task Complexity Schema (NTCS). The NTCS has proven to be a robust framework for estimating the difficulty of a numeracy assessment item (Tout et al., 2020) and provides a practical way to analyse the demands of an item and predict where students may face challenges.

The schema identifies five interacting factors that together shape the difficulty of numeracy items. Two of these factors relate mainly to textual features of the task, and three relate more directly to the mathematical demand[1].

Teachers of numeracy are also teachers of context, literacy, and critical thinking.

Implications for teaching as a result of the Numeracy Task Complexity Schema

The first four columns of the table over the page are extracted from the NTCS. The final column has been added to show the teaching and learning implications when preparing for the NCEA Numeracy Co-requisite.

[1] It is important to note that performance on a numeracy item can also be influenced by factors that are not necessarily covered by the schema, such as a student's familiarity with the context, general reading demands, or confidence in test situations. In a school setting, additional influences may include students' prior classroom experiences, their expectations of what "counts" as mathematics, or their willingness to persist with unfamiliar problem types.

Factor	What this means in practice	When demand is lower	When demand is higher	Implications for teaching and learning provided by the NTCS
1. Type of match/Problem transparency	How easy it is for students to work out what they need to do and where to the find the relevant information.	The task clearly states what to calculate or decide. The relevant numbers or data are obvious. Little reading or interpretation is required.	Students must interpret language, search through text or visuals, decide what action is needed, or bring in outside knowledge (e.g., knowing a formula). The required action is not explicitly stated.	• Students need to practice evaluating a statement and selecting the correct information and/or operation to use. • Students need to be explicitly taught the kind of vocabulary used in mathematical contexts e.g. fewer. Particular attention should be given to the mathematical meaning of words that are sometimes different from common meaning. See 'The language of Mathematics and Statistics' in each phase of the NZC - Mathematics and statistics Phases 1–4 (Years 0–10) and the vocabulary table below created from the Numeracy CAAs. • Students need opportunities to practise translating comparative language into mathematical relationships and identifying the quantities being compared before selecting an operation. • Students need experience completing test items, particularly those requiring a written response in a digital environment. The literacy demands of numeracy items mean that many students need explicit support with interpreting questions, planning and executing the required mathematical procedures, and representing the results in text. Teachers of numeracy are also teachers of literacy (Gomez et al, 2001). For more information on the numeracy digital assessment see: Literacy and Numeracy assessment information - NZQA

Examples of numeracy vocabulary that may be used in the Numeracy Common Assessment Activity

Time	Numbers	Statistics	Measurement	Money	General
how long does it take arrival/departure times on time early / late to the nearest hour	minimum / maximum on average overall score highest / lowest what is left	numbers over time matches the probability reasonable / acceptable a good estimate start / finish picked at random dashed line	weigh 2 times weight fewer greater along the path cubic metres heavier lighter area non-stop kilometres per hour temperature-range output longer shorter furthest scale	just over best buy or best deal using price information save money about how many to the nearest cent/$ cheapest dearest most expensive least expensive on sale sale price what is left	makes sense estimate based on most wide long higher / lower more / less round your answer the same as make a total oldest / youngest newest at least left / right smallest / biggest largest take away, cutting (referring to minus)

Factor	What this means in practice	When demand is lower	When demand is higher	Implications for teaching and learning provided by the NTCS
2. Plausibility of distractors	How much irrelevant or potentially misleading information is present?	Only the needed information is provided. No extra numbers or data compete for attention.	Extra numbers, labels, or data are included. Some look relevant but are not. Students must select carefully.	• Students need to practice selecting the relevant information to a context and discarding irrelevant information. Encouraging students to slow down and check they have the relevant quantities before calculating may help reduce errors. Tools such as the CUBES Math Strategy may prove useful here.

3. Complexity of mathematical information/data	How familiar, abstract, or symbolically demanding is the mathematics?	Familiar contexts. Whole numbers or simple decimals. Clear tables or simple graphs. Everyday units.	Large numbers, fractions, percentages, rates, algebraic expressions, dense tables, or complex graphs. Unfamiliar representations or symbolic notation.	• Students need to practice using familiar quantities to interpret and operate in other contexts. For example, using decimals to calculate time.
4. Type of operation /skill required	What kind of mathematical thinking is needed?	A single straightforward calculation or direct reading from a graph/table.	Multi-step reasoning. Interpreting trends. Using formulas. Comparing quantities. Explaining reasoning. Making judgements about reasonableness.	• Students must state a clear position and justify it using evidence. Some students do not indicate whether they accept, reject, or are uncertain about a statement. Absence of a comment related to the correctness of the statement can be the only missing feature in otherwise competent answers. • Students need to practice evaluating statements, calculating their numerical result back to an original statement. • Students need practice communicating their reasoning and linking in their calculation. • Students need to sense check their answers. • Students need to be taught that when interpreting data, it can be valid to say a trend is unclear, especially in the face of variation that naturally occurs in the real world. • Students need to understand the importance of using correct units of measurement. Making explicit connections between decimal place value and metric prefixes (for example, linking hundredths to *centi-* and thousandths to *milli)* can help students see how decimal structure and measurement units align.

Factor	What this means in practice	When demand is lower	When demand is higher	Implications for teaching and learning provided by the NTCS
				• Students need to practice when it is appropriate to use personal contextual knowledge and when it is not. Contextual knowledge is crucial to reasoning *about* data that involves explaining why data is the way it is. However, evaluating the claims of others involves reasoning *from* the given data. That requires suspension of personal beliefs and examination of whether, or not, that data supports the statement being made. Sometimes students give opinions related to a claim without considering the data presented to them, based purely on what they believe to be true.
5. Expected number of operations /processes	How many coordinated steps are required to complete the task?	One clear step (e.g. calculate a difference, read a value).	Several linked steps (e.g. select data, calculate, compare, justify). May involve different types of processes (calculation + interpretation + explanation).	• Students need to practice tasks with a range of mechanical steps. For example, selecting the correct data, identifying the calculation, making a judgement about the result, and articulating the response. • Success depends on integrating multiple processes: selecting relevant information, applying mathematical or statistical reasoning, and communicating a justified conclusion. Students who perform individual components in isolation are not always successful when those components need to be coordinated.

Supporting numeracy development requires attention not only to procedural fluency, but also to interpretation, the careful use of evidence, argument construction, and clear communication. Numeracy tasks are, in effect, small acts of structured reasoning.