Te Poutāhū
Curriculum Centre

Supporting NCEA Literacy in the Mathematics and Statistics classroom

The Mathematics and Statistics Key Competencies provide a useful starting point to think about how literacy relates to you, a teacher of Mathematics and Statistics, and how you can play a role in supporting the development of literacy in ākonga.

Mathematics and Statistics acknowledges the importance of literacy specifically in its Key Competencies related to language, symbols and text. These state that students in Mathematics and Statistics will:

- develop their ability to make meaning of mathematical and statistical symbols, equations, expressions, and graphs
- explain working and reasoning when solving mathematical or statistical problems
- interpret and communicate mathematical and statistical ideas for varied purposes and to solve problems.

A number of Key Competencies that have a strong communication theme (from Relating to others and Participating and contributing) also present opportunities for literacy integration. These include:

- understanding how to express mathematical and statistical information for different purposes and audiences
- being actively involved in communities through analysing local mathematical and statistical information, and building upon their knowledge to participate in discussion and discourse

The competencies point to the importance of "reading" aspects of mathematical language such as symbols, being able to explain a process, being able to communicate reasoning, and being able to shape information for different purposes and audiences.

Kaiako, looking through a literacy lens, can improve teaching and learning in Mathematics and Statistics; they can also make a significant contribution to supporting learning for NCEA Literacy. Literacy skills are powerful predictors of word problem performance (Kyttälä & Björn, 2017, p.63).

The Literacy corequisite has a reading and a writing strand, each of which has a small number of Big Ideas. These are unpacked further by the Significant Learning statements, many of which can be seen to connect with the Key Competencies related to language, symbols and text. They share, for example, the perspective that ākonga need a deep understanding of key concepts or vocabulary, and they need to shape their language

The Literacy Pedagogy Guide (LPG) below for Mathematics and Statistics takes the Big Ideas and Significant Learning from the Literacy Learning Matrix, and poses two questions:

- *What can this look like in Mathematics and Statistics?*
- *What can I do as a teacher of Mathematics and Statistics?*

The LPG is not exhaustive, but illustrative of small but effective steps that any teacher of Mathematics and Statistics can target, trial, and eventually embed in their teaching practice.

Mathematics and Statistics Literacy Pedagogy Guide

Reading

	Significant Learning	What can this look like in Mathematics and Statistics?	What can I do as a teacher of Mathematics and Statistics?
Big Idea 1: Learners make sense of written texts.	Learners use: » a processing system to decode and comprehend text. Readers develop expertise in using sources of information and comprehension strategies to make sense of text. » knowledge of text structures and features. Readers develop their knowledge of text features and use this to navigate and understand texts. » vocabulary knowledge. Successful comprehension depends on understanding most of the meanings of the words in the text.	Decoding and comprehending numeric and symbolic texts "where each mark bears significant informational weight, each symbol is understood according to a strict set of conventions. . ." Analysing and comprehending word problems. This requires: » ākonga to know the meaning of the words, and to see them in the context of the whole problem » ākonga to identify the problem type to activate the existing mathematical knowledge structures . Language needs to map onto symbolic and visual representations of mathematical and statistical concepts. Longer texts including the following text types. These include spoken, written and visual texts: » A sequence of stages or events explaining the mathematical and statistical processes to solve a problem (these can be diagrammatic, or in text form) » Explanations of methodology used to collect data in a report. » Communicating mathematical and statistical thinking and justifying your conclusions, using, processes including clarifying, reasoning, and modelling wait time Reading and interpreting diverse visual texts such as graphs, tables, and diagrams.	» Model and develop skills for analysing and comprehending word problems by supporting ākonga to identify key words in the context of the problem » Model and practise a problem-solving strategy, using e.g. › Plan, Solve, Check › A word problem checklist » Provide manipulatives to help ākonga to visualise the problem. » Use Turn and Teach – ākonga orally explain their thinking and their problem-solving process to a partner. » Use graphic organisers (a framework of the structure and content) to support learners to predict text structure and content, make notes, summarise information, and as a guide to writing a text. » Use PPDAC framework: pose a problem, make a plan, collect your data, analyse results, conclusion » Use graphic organisers that are consistent with the type of text e.g. a Venn diagram, a double bubble map for comparing and contrasting, a Plus, Minus or Interesting (PMI) grid for reasoning. Techniques for graphs and tables can be found at Tables and graphs | Assessment Resource Banks (nzcer.org.nz)

		Knowing the special meaning of subject-specific vocabulary their range and their meanings. A subset of this vocabulary: » is only found in Mathematics and Statistics e.g. quotient, denominator » has everyday meanings as well as subject-specific meanings e.g. plane, radical, odd, mean, table, significant » has more than one mathematical meaning e.g. round, square	» To support ākonga to develop depth of understanding of technical words use concept frames. An example of a specific concept frame is the Frayer Model. » To support ākonga to broaden their vocabulary, they can: › circle the words they don't know › underline the words they have some understanding of › predict/identify which words are necessary for the topic › predict/identify which words are useful for mathematics and statistics and across subjects. » Co-construct lists of topic-specific vocabulary with ākonga, and revisit often. » Use a tool like Word Hippo or a more specialised Mathematics and Statistics glossary to support ākonga research into word meanings and forms. See for example this Mathematics Glossary.
Big Idea 2: Learners read critically	Learners: » develop a critical awareness that enables them to consider who wrote a text, for whom, why, and whether it may have purposes that are not immediately apparent.	Ākonga need to engage in close reading to: » recognise when seemingly objective texts are written in order to present a point of view (e.g. as in an argument text). » be able to evaluate the reliability of the data analysis and interpretation in Statistics reports. » be able to differentiate irrelevant information from relevant information. » be able to compare and contrast information presented in different modes e.g. visual texts with verbal texts	» Support ākonga to use specific questions about purpose and audience. » For author's purpose, use a strategy like Question the Author (QtA). » Interrogate the validity of claims using Mathematics and Statistics. » Support ākonga to read text closely by: › identifying argument indicators: e.g. thus, hence, and so › recognising any emotive vocabulary › identifying and evaluating the validity of claims and evidence › analysing reader-oriented features e.g. you, we. » Teach ākonga how to annotate word problems: circle numbers, cross out information you don't need, underline key words.

Big Idea 3: Learners read for different purposes	Learners: » are clear about their purpose for reading and have appropriate strategies to meet that purpose » understand and use ideas in texts » locate and evaluate the ideas and information within and across a range of print and digital texts to meet their purpose.	Word problems can differ in a small way linguistically, but this can change the type of operation required to solve them. Visual texts such as graphs need to align closely with written text reporting results. Visual representations of mathematical operations must parallel word problems.	» Model how you compare word problems that differ in a small way. » Give ākonga practice in working out seemingly similar word problems but altering them in small ways. » Use KWL (Know/Want to know/Learned) charts to track and represent conceptual understanding of key concepts over the period of a lesson or unit. » Compare visual texts with their accompanying written texts (e.g. a data table with the written description). » Explicitly teach note taking and summarising by modelling, listing key words and elaborating on them; or use graphic organisers focusing on categories of important content.

Writing

	Significant Learning	What can this look like in Mathematics and Statistics?	What can I do as a kaiako of Mathematics and Statistics?
Big Idea 1: Learners write meaningful texts for different purposes and audiences.	Learners: » use strategies within a writing process to plan and create texts » select content, text structure and language choices appropriate to purpose and audience » select and use vocabulary that is specific to their topic, purpose and audience » revise and edit their work.	Drawing diverse visual texts such as graphs, tables and mathematical diagrams. Many texts are short and concise e.g. when asked to justify outcomes. Here, the focus is on expressing logical relationship between ideas in phrases or sentences. Ākonga need to use appropriate devices "discourse markers" e.g. but, then, because, however), or nouns (e.g. the reason), and verbs (e.g. this causes). One common text type that learners are asked to write is an explanation A prompt might be: "Explain why the direction of the inequality sign reverses when multiplying an inequality by a negative number". Another short common text type is a definition. A good definition is concise, has a basic defining property, is complete and grammatical. A longer and common text form in Statistics is the statistical report. Posing and forming questions are an essential part of planning a Statistics project. Knowledge and selection of subject specific or technical words allows ākonga to write with precision about mathematical and statistical topics. General academic words (see the Academic Word List), that are used across all curriculum areas, such as investigate are important for writing. As well as knowing their meaning, ākonga must know their forms.	» With ākonga, identify the audience and purpose for each piece of writing. Use some of these questions on Purpose and Audience. » Manipulate audience and purpose to encourage learners to write in more detail. » Give ākonga frequent opportunities to write about mathematical and statistical concepts to develop writing fluency. » Give ākonga opportunities to use writing to clarify ideas. » Provide opportunities to discuss and rehearse ideas in pairs or in small groups before writing. » Encourage ākonga to create written records of ideas, notes, discussion points and questions which they may want to call on for later use. Model this behaviour. » Provide or co-construct checklists for ākonga to revise and edit their work. For example, use the definition checklist » Use graphic organisers or templates as a guide to writing both short texts (e.g. a definition) and long texts (e.g. a statistics report). » Practise generating questions that correspond to different types of statistical investigations. eg. A comparison investigation will be framed differently from a summative investigation. » Generate word family members for AWL words e.g. investigate, investigated, investigation.

Big Idea 2: Learners use written language conventions appropriately to support communication.	Learners: » develop their expertise in sentence construction, grammar, punctuation, spelling, word choice.	Sentence structures, including: » Simple sentences » Compound sentences that use coordinating conjunctions e.g. “but”, “as”, “yet” which allow the reader to unify two related points often for greater detail. » Complex sentences e.g. those that use “because”, “while” to combine two different but connected ideas Challenges related to grammatical structure include: » Modal verbs, which are important ways to signal: › Possibility e.g. “could impact” › Probability e.g. “might mean” › Deduction e.g. “may mean” › Expectation e.g. “will mean that” » Other features: › Punctuation marks are meaning-making devices. › Some mathematical terms have a different spelling from their everyday forms e.g. arc vs. ark, sum vs. some, Pi vs. pie, whole vs. hole.	» Deconstruct and reconstruct sentences so ākonga can see what complex sentences and their parts do. » Plot modal verbs on clines eg. highly likely to unlikely, etc. » Draw attention to words that are difficult to spell. Co-construct a list of these as they arise. » Encourage ākonga to mark words for later checking. » Use short dictations (e.g. dictate word problems) on a regular basis for practice in encoding words and using punctuation appropriately.

References and sources of further information

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