Unpacking Numeracy

Whiria te kaha tūātinitini, whiria te kaha tūāmanomano

This whakatauākī speaks to the many threads – academic, social, emotional, and cultural – that learners experience when they make mathematical and statistical decisions about situations in their daily lives.

These threads include the satisfaction learners experience when they use mathematics and statistics to understand situations; the joy in using mathematical and statistical ideas to improve the lives of others; and the experience of mathematics and statistics as creative and empowering human endeavours.

Being numerate in Aotearoa New Zealand today involves recognition of tino rangatiratanga, where our cultural worldviews (e.g. Māori and Pacific people) influence how we weave together the many threads of mathematics and statistics. This demonstrates that mathematics and statistics are bodies of knowledge which are created and used by people themselves and their communities.

Process Ideas

Learners formulate mathematical and/or statistical approaches to solving problems in a range of meaningful situations

Learners use mathematics and statistics to meet the numeracy demands of a range of meaningful situations

Learners explain the reasonableness of mathematical and statistical responses to situations

Content Ideas

Operations on numbers

Mathematical relationships

Spatial properties and representations

Location and navigation
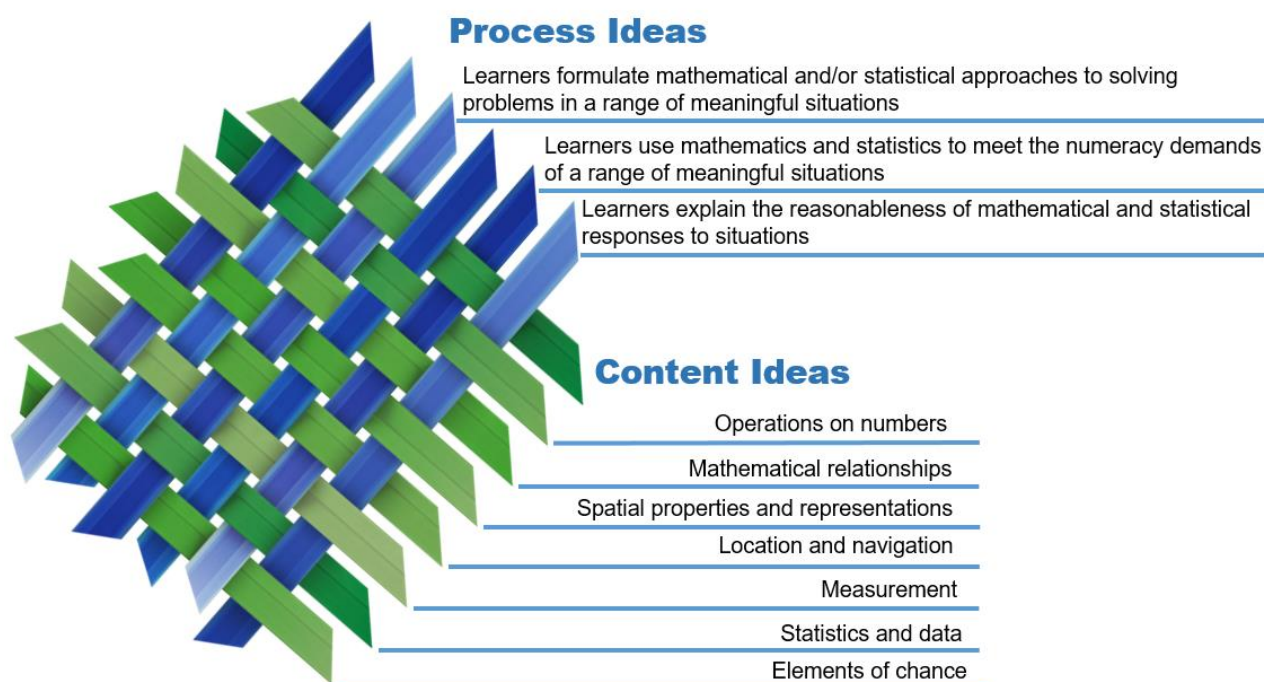
Measurement

Statistics and data

Elements of chance

Fig. 1: Interweaving of the Process Ideas and Content Ideas

Foundational numeracy refers to the knowledge and capabilities that enable learners to access further learning, develop important life skills, engage in employment and in their communities. In Aotearoa New Zealand, this includes an understanding of how to participate in a society with bicultural foundations.

Numerate people can interweave mathematical and statistical processes with content knowledge. This interweaving allows them to manage the numeracy demands of a range of situations, and supports them to find solutions that serve others, promote innovation, empower communities, and care for our planet.

Fig.1 (above) illustrates whiriwhiri – interweaving – in relation to the whakatauākī.

Purpose

This document accompanies the Numeracy Unit Standard and Numeracy Learning Matrix. Together, these materials outline and unpack the kaha tūātinitini and the kaha tūāmanomano – the many threads to be woven together – at the numeracy benchmark.

Frameworks

The NCEA numeracy benchmark is aligned to the following frameworks:

1. **Upper level 4 and lower level 5 of the mathematics and statistics learning area of the New Zealand Curriculum (NZC).**

   This means that learners have full mastery over Curriculum Level 4 and are ready to work at Level 5.
   This benchmark broadly aligns with scale descriptors in the range 750-850 on the PaCT scale for mathematics. The PaCT is a tool which locates learners on a learning progression, provides exemplars of their progression, and is aligned to the levels of the NZC.

2. **Upper Step 5 of the Learning Progressions for Adult Numeracy (LPAN)**

   The LPAN outlines numeracy progressions for Aotearoa New Zealand adults to work and participate effectively in a modern knowledge society.
   (see: https://ako.ac.nz/assets/Knowledge-centre/ALNACC-Resources/Learning-progressions/Learning-progressions-numeracy.pdf)

3. **Upper level 2 and lower level 3 on the PIAAC framework**

   The Programme for the International Assessment of Adult Competencies (PIAAC) analyses and assesses the skills required by adults to participate in the workforce, in ongoing education and in active citizenship.
   (see: https://nces.ed.gov/surveys/piaac/numproficiencylevel.asp)

Unpacking the Content Ideas for Numeracy

Learners at the benchmark can…

1. Fluently and flexibly solve problems that require operations on numbers, understanding the relative size of those numbers, and making sense of the answer in context.

This means that learners can:

- recognise the (degree of) precision required for the context
- choose an appropriate approach to calculation (written, mental or digital)
- work with whole numbers up to billions, fractions, decimals to 3 places, percentages, and integers

- calculate averages (including the mean)
- work with simple interest

The problems that learners solve will include commonly encountered rates, ratios, and powers.

The following fall outside the benchmark:

- multiplying and dividing fractions
- negative and fractional exponents
- properties of exponents
- reverse percentage problems
- compound interest

2. Recognise and work with mathematical relationships.

This means that learners can:

- work with linear relationships that are represented as graphs or word rules
- recognise unknown values for a given relationship

The following falls outside the benchmark:

- non-linear and exponential functions
- step functions (e.g. parking rates)

3. Understand and use the spatial properties and representations of objects

This means that learners can:

- recognise symmetry
- transform objects to design for purpose (i.e. enlarge, reflect, rotate, and translate)
- make connections between representations of objects in simple 2D and 3D

The following falls outside the benchmark:

- working with cross-sections

4. Understand and use systems for location and navigation.

This includes how to position and orientate themselves. It means that learners can:

- have a way to navigate between points
- describe position and orientation in situations that are flexible in the system being used

The following falls outside the benchmark:

- using compass directions such as SSW, or bearings

5. Use numbers and units to measure and express attributes of objects and events as quantities, to a degree of precision appropriate to the context.

This means that learners can:

- use and interpret results of the measurement (including timetables and time charts)
- select appropriate units and convert between metric measures for the same attribute.
- solve measurement problems in practical contexts
    - perimeter
    - volume (cuboids only)
    - area (rectangles, parallelograms, triangles)
    - mass
    - temperature

The following falls outside the benchmark:

- measurements associated with circles

6. Understand and reason with statistics and data.

This means that learners can:

- recognise and use appropriate data displays to investigate questions or claims for summary, comparison, and simple time series situations
- interpret data displays using features such as clustering, centrality, spread, unusual pieces of data, frequencies, and patterns
- evaluate statements and representations made by others, based on data that is provided to them

The following fall outside the benchmark:
- sampling
- sample to population inference
- reasoning with mean as a statistical measure of central tendency
- gathering and organising data

7. Use probability to interpret situations that involve elements of chance.

This means that learners can:

- recognise and interpret everyday situations involving probability, chance, and simple risk
- use the language of probability to describe outcomes

The following falls outside the benchmark:

- doing experiments and comparing with theoretical models

Links to Key Competencies, Tātaiako, and Tapasā

The table below shows how the teaching and learning of numeracy is linked to current frameworks for best practice.

Process Ideas	Links to Key Competencies in the New Zealand Curriculum	Links to Tātaiako All cultural competencies should be apparent in the teaching and learning of numeracy	Links to Tapasā All values and all Turu should be apparent in teaching and learning of numeracy
		Learners formulate approaches that…	*Quality numeracy teaching and learning…*
1. Learners formulate mathematical and/or statistical approaches to solving problems in a range of meaningful situations.	**Thinking** Learners engage in thinking processes in order to access, use, and engage in mathematics and statistics for a range of situations. **Using language, symbols, and texts** Learners can interpret and use representations such as words, number, images, symbols, tables, graphs, and diagrams. **Managing self** Learners draw upon their knowledge and have skills and strategies for meeting challenges.	**Tangata Whenuatanga** Are place-based and make use of socio-cultural awareness and knowledge. **Ako** Authentically explore connections and similarities between learning at school and the wider world. **Wānanga** Ask for innovation, future thinking and planning as they relate to people's lives and goals. **Whanaungatanga** Support relationships with communities.	**Turu 1** Happens in contexts that are familiar and relevant to Pacific learners. Builds on the cultural and linguistical capital of Pacific learners, their parents, families and communities. **Turu 2** Involves and reflects the relationships with and between Pacific learners, parents, families, and communities. Uses Pacific resources, tools, references and conceptual models. **Turu 3** Recognises and values the prior knowledge that Pacific learners bring with them.
		Learners use mathematics/statistics to embody…	*Quality numeracy teaching and learning…*
2. Learners use mathematics and statistics to meet the numeracy demands of a range of meaningful situations.	**Thinking** Learners use creative, critical, and metacognitive processes to make sense of information and apply these processes to different purposes. **Participating and contributing** Through employing mathematics and statistics for meaningful situations, learners participate in communities, and make connections with others. Communities include family, whānau, may be school-based, or based on a common interest or purpose. They may be local, national or global.	**Manaakitanga** Ethical decision-making about how we approach mathematics/statistics to address meaningful situations. **Ako** Teaching and learning using classroom situations and beyond. **Wānanga** Collaborative problem solving and communicating.	**Turu 1** Considers the full breadth of reactions, responses, and solutions to situations that are dependent on culture **Turu 2** Understands the importance of shared knowledge and the power of collaborative relationships Uses Pacific resources, tools, references and conceptual models. **Turu 3** Encourages collaborative working and learning. Ensures Pacific learners are confident and successful in both Pacific and English-medium contexts.
		Learners interpret and evaluate by…	*Quality numeracy teaching and learning…*
3. Learners explain the reasonableness of mathematical and statistical responses to situations.	**Thinking** Learners ask questions, draw upon personal knowledge and intuition, and challenge the basis of assumptions and perceptions. Learners make connections and discern if answers are reasonable. **Using language, symbols, and text** Learners recognise how choices of language, symbols, and texts affect people's understanding and the ways in which they respond to mathematics and statistics. Learners know and use specialised vocabulary, as well as their own language, to explain ideas and findings. **Managing self** Learners are capable of self-assessment. They are resourceful, reliable, and resilient. They have strategies for meeting challenges. Learners take risks, make decisions, and persevere.	**Tangata Whenuatanga** Considering the impacts on identity, place, socio-cultural awareness and knowledge that may be in the mathematical/statistical situations. **Wānanga** Communicating the impact of mathematical/statistical responses to situations. A process of in-depth thinking and discussion followed by a sharing of ideas with others. **Manaakitanga** Including notions of ethics, integrity, and respectful evaluation/critiquing.	**Turu 1** Considers the full breadth of reactions, responses, and solutions to situations that are dependent on culture. **Turu 2** Understands the importance of shared knowledge and the power of collaborative relationships. **Turu 3** Considers the holistic and collective aspects of Pacific learners, families, and communities. Understands the dual and multiple contexts and world views Pacific learners navigate both in and out of the classroom.