MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

Supporting NCEA Numeracy in Technology

This resource is aligned to the New Zealand Curriculum (2007) and provides support for the teaching and learning of literacy and numeracy in preparation for the NCEA Co-requisite. It aims to support those students who are using the NCEA qualification pathway.

Technology is a learning area that has developed swiftly in the last decade. It has a strong association with mathematical thinking.

Numeracy plays a vital role when ākonga undertake technological practice to develop and communicate design ideas and realise outcomes.

This Numeracy Pedagogy Guide (NPG) takes a selection of mathematical and statistical content ideas from Unpacking Numeracy and illustrates the small, effective steps that you can trial and weave into your teaching practice across different subjects in Technology.

Additional resources

The New Zealand Graphic and Technology Kaiako Association (NZGTTA) website is a rich source of Mātauranga Māori and Technology resources.

A glossary of statistical terms is available from TKI and contains common statistical terms.

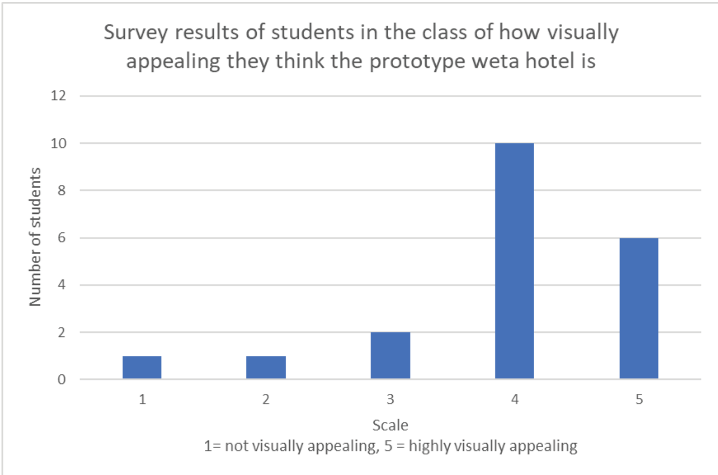
A Measured Response is a numeracy-rich example of a technology project from the NZMaths website that has ākonga identify a need, plan a response, seek feedback, design and build a 'product' applying number, measurement, and technology knowledge and skills.

Technology Numeracy Pedagogy Guide

Operations with numbers	What can this look like in Technology?	What can I do as a kaiako of Technology?
Recognise the (degree of) precision required for the context.	Recognise that measurements of materials need to be made to a certain degree of accuracy. Carry out calculations for dividing up resources *Ākonga dividing a 2 metre doweling rod into 3 equal parts, will measure out 66.7 cm for each length as it cannot be measured any more accurately.* Use appropriate methods to accurately measure materials. *Ākonga fold fabric into three then snip or mark the edge of the fabric to indicate thirds.*	Discuss with ākonga » the level of precision required in a range of different contexts in the planning, design, and measurement of an outcome. » the implications for the construction of the final outcome if measurements and the cutting/weighing of materials are carried out inaccurately. Model how to round numbers and discuss the purpose for rounding. This NZMaths resource may be useful.
Choose an appropriate approach to calculation (written, mental or digital).	Use mental strategies for estimating times, material, and resource quantities. Calculate a budget for a project and compare the cost of different materials.	Provide ākonga with term planners to help them estimate the amount of time they have to work on a project. Encourage ākonga to communicate their mathematical working in written form and to use calculators or spreadsheets where appropriate. Provide ākonga with a printed budget template to assist with comparing the costs of materials.
Work with whole numbers up to billions, fractions, decimals to 3 places, percentages, and integers.	Use decimals when making measurements and carrying out calculations. Work with proportions and ratios. *Ākonga adjust a recipe in food technology or enlarge a design to create a pattern in textiles that preserves the proportions of measurements.* Calculate percentages of amounts.	Support ākonga to understand the place value of decimals and the role zero plays as a placeholder. Create opportunities for ākonga to use ratios. *In a 3-ingredient recipe that makes 35 shortbread cookies, 340g of butter, 130g of icing sugar and 375g of flour is needed. If ākonga only make 10 shortbread cookies, the amount of butter, icing sugar and flour would be 97.14g, 37.14g and 107.14g respectively.*[1] *Calculate the range of resistance for a 5,200 ohm resistor with a 5% resistance.* There are a range of methods that can be used to calculate percentages of amounts. The calculation is interpreted as 5% of 5,200, where "of" means to multiply. 1. $5 \div 100 \times 5200 = 260$ ohms[2] 2. $\frac{5}{100} \times 5200 = 5 \times \frac{5200}{100} = 5 \times 52 = 260$ ohms[3] 3. 10% of $5200 = \frac{10}{100} \times 5200 = \frac{1}{100} \times 5200 = 5200 \div 10 = 520$ $520 \div 2 = 260$ ohms[4]

Spatial properties and representations of objects	What can this look like in Technology?	What can I do as a kaiako of Technology?
Recognise symmetry.	Identify line symmetry and rotational symmetry in products being designed and constructed to work out the repeating units that need to be produced.	Ask ākonga to define and identify line symmetry and rotation symmetry present in a variety of objects, architecture, or materials eg. Quilt design or tapa cloth.[5]
Transform objects to design for purpose (i.e. enlarge, reflect, rotate, and translate).	Use enlargement in scale drawings of products Use scale in accurate technical architectural drawings, plans and models. Investigate the symmetry and transformation of objects within a design. *Ākonga rotate and enlarge a koru or use a variety of line thicknesses in a kōwhaiwhai panel.*	The language used in mathematics when describing a transformation is exact. This may be useful for ākonga when they communicate how they have developed a product and explain how they know the transformation has been applied correctly.
Make connections between representations of objects in simple 2D and 3D.	Create technical drawings in 2D and 3D to represent 3D objects, including creating isometric drawings. Design nets for a box. Understand and use sequential drawings to show steps in a process. *Ākonga write instructions on how to make a paper plane, or construction steps in a textiles project.*	Provide three-dimensional shapes like cuboidal boxes that ākonga can open and connect with the two-dimensional shapes. Encourage ākonga to draw more than one net for a box and discuss how some nets minimise waste better than others in specific contexts. Representing 3D objects in 2D drawings can support ākonga to develop their 2D drawing.

Measurement	What can this look like in Technology?	What can I do as a kaiako of Technology?
Use and interpret results of the measurement (including timetables and time charts).	Read scales when measuring volumes and weight/mass. Select and use appropriate measuring devices. Develop a schedule in a planning tool. Estimate quantities of materials required for a project including wastage factor.	Provide ākonga with a variety of measuring tools to give them experience with reading scales that have different increments. Ask ākonga to identify potential measurement errors (eg. the scales are not zeroed) and the actions they would take to minimise these errors. Provide regular opportunities for ākonga to practise their estimation skills by asking them to estimate materials and time for projects.
Select appropriate units and convert between metric measures for the same attribute.	Use appropriate units of weight/mass and length. *Ākonga use the standard international unit of measure for the product they are making.* » *The standard international unit of measure for garment construction is cm* » *The standard unit of measure for construction is mm* » *The standard unit of measure for food ingredients varies from country to country, but ākonga can use cups, spoons, grams (g), kilograms (kg), millilitres (ml) and litres (l) to measure ingredients.* Convert between metric measures as appropriate. *Ākonga convert between seconds, minutes and hours when planning the timeline of product creation.*	Discuss with ākonga which units would be appropriate for a particular context.
Solve measurement problems in practical contexts: » **perimeter** » **volume (cuboids only)** » **area (rectangles, parallelograms, triangles)** » **mass** » **temperature**.	Calculate the perimeter of an item. *Ākonga make a brim for a hat by calculating the measurement for the inside and outside of the brim (with appropriate seam allowances). This is dependent on the circumference of the head.* Calculate the area of material, so that wastage is limited. *Ākonga calculate the area of their product. They can use this calculation to help them estimate how much paint or varnish is needed to finish their product, being mindful of aspects such as the viscosity of paint, paint bristles, humidity and paint type.* Understand temperature measures. *Ākonga know the temperature requirements for using a 3D printer or kiln when melting materials or when cooking food in the oven.* *Ākonga making food are aware of the temperature food should be stored and served at for health and safety reasons.*	Use worked examples to scaffold ākonga when they apply measurement knowledge and skills in a variety of contexts. Verbalise thinking processes using 'think-alouds' when unpacking the numeracy in technology problems. This resource shows how to calculate the area of rectangles, triangles and parallelograms. Ensure that ākonga are accessing temperatures in °C, or have the tools to convert temperatures into °C (incl. digital tools).[6] Provide ākonga with the appropriate tools to assist in ensuring products are safe to use, touch or consume.

Statistics and data	What can this look like in Technology?	What can I do as a kaiako of Technology?
Recognise and use appropriate data displays to investigate questions or claims for summary, comparison, and simple time series situations.	Create questionnaires that are appropriate to research needs. *Ākonga find out which concept is preferred to meet the needs of the community.*	Discuss with ākonga the different [types of questions]() they could use in their questionnaire. Support ākonga to reflect on the usefulness of their questionnaire, and whether it provided the information they needed.
Interpret data displays using features such as clustering, centrality, spread, unusual pieces of data, frequencies, and patterns.	Identify and interpret the features of visual displays  *What I notice: The most common response to the question "On a scale of 1-5, how visually appealing do you think the prototype wētā hotel is? (1 = not visually appealing, 5 = highly visually appealing)" was 4.* *Evidence: The score of 4 has the highest peak in the bar graph with 10 out of 20* ākonga *in my class giving this response. The second most common response was a score of 5, which 6* ākonga *gave.* *Relate to context: This means that most* ākonga *(16 out of 20 or 80%) are happy with the aesthetics (visual appeal) of the prototype weta hotel.*	Give groups of ākonga statistical question they can use in pairs or small groups to discuss and interpret their data displays, for example: » What do you notice? » What patterns can you see? » What does it make you wonder? » What conclusions can you draw from this display? » What gaps might there be in the information it provides?

Evaluate statements and representations made by others, based on data that is provided to them.	Evaluate statistical claims in the media on sustainability of products and technologies.	Provide questions that support ākonga to evaluate the credibility and reliability of statistical data, for example: » What was the purpose of the study? » Who collected it? » What information was gathered? » When was the information collected? » How was the information gathered? » Is the information consistent with other sources? Discuss with ākonga data sovereignty and in particular Māori data sovereignty, for example: » What does tikanga in data sovereignty look like? » Who holds the narrative?

Footnotes

[1] To do this calculation, ākonga need to know:

What value does 35 need to be multiplied by to get 10? This is the mathematical calculation 35 × ? = 10.

Division is the opposite of multiplying. This means ? = $\frac{10}{35}$ or $\frac{2}{7}$

$\frac{2}{7}$ can mean two-sevenths or 2 ÷ 7.

Each portion of the ratio must be multiplied by $\frac{2}{7}$ to obtain the correct ratio if only 10 shortbread biscuits are made.

[2] This method requires ākonga to understand that:

A percentage is a value out of 100. This means 5% = $\frac{5}{100}$.

The line between the numerator and denominator means “to divide.”

[3] This method requires ākonga to understand that a percentage is out of 100.

When multiplying fractions, the order we multiply the values does not change the solution (called the commutative law). This means 5/100 × 5200 (or 5/100 × 5200/1) = 5 × 5200/100 (or 5/1 × 5200/100).

The line between the numerator and the denominator means to divide. This means 5200/100= 5200 ÷100 = 52

[4] This method requires ākonga to understand the same concepts as in 2.

The solution is divided by 2 at the end, because 5% is required, not 10%

[5] Line symmetry, also called reflectional symmetry or mirror symmetry, is where one half of an object is the reflection of the other half. Rotational symmetry is the number of times an image can turn onto itself within one full turn (360°). This means that every object has at least one order of rotational symmetry.

[6] To convert from Fahrenheit (°F) to Celsius (°C), use the formula C = $\frac{5}{9}$ (F – 32).

For example, if a recipe requires the oven to be at 360°F the temperature in °C, would be C = 5 ÷ 9 (360 – 32) = 182°C.