

Purposeful mathematical problem solving practices in Te Kākano

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TE KURA TOI TANGATA

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Ko koe ki tēnā,
ko ahau ki tēnei kiwai o te kete

You at that handle and I at this handle of the basket



What do we mean by mathematical problem solving in the early years?

- ▶ Mathematical problem solving is:
 - ▶ “trying to achieve some outcome, when there is *no known method* (for the individual trying to achieve that outcome) to achieve it” (Schoenfeld, 2013, p. 10)
 - ▶ includes a range of problem solving strategies such as trial and error, guessing, role-modelling, and pattern-seeking
 - ▶ involves sustained, in-depth investigation, prolonged engagement, children following own ideas and reasoning, and the intentional introduction of mathematical ideas (see Bailey, 2018)
- ▶ Mathematical learning experiences centred on problem solving in early years can be informal or teacher initiated
- ▶ It is important these experiences are connected with children’s interests (Hedges & Cooper, 2016)

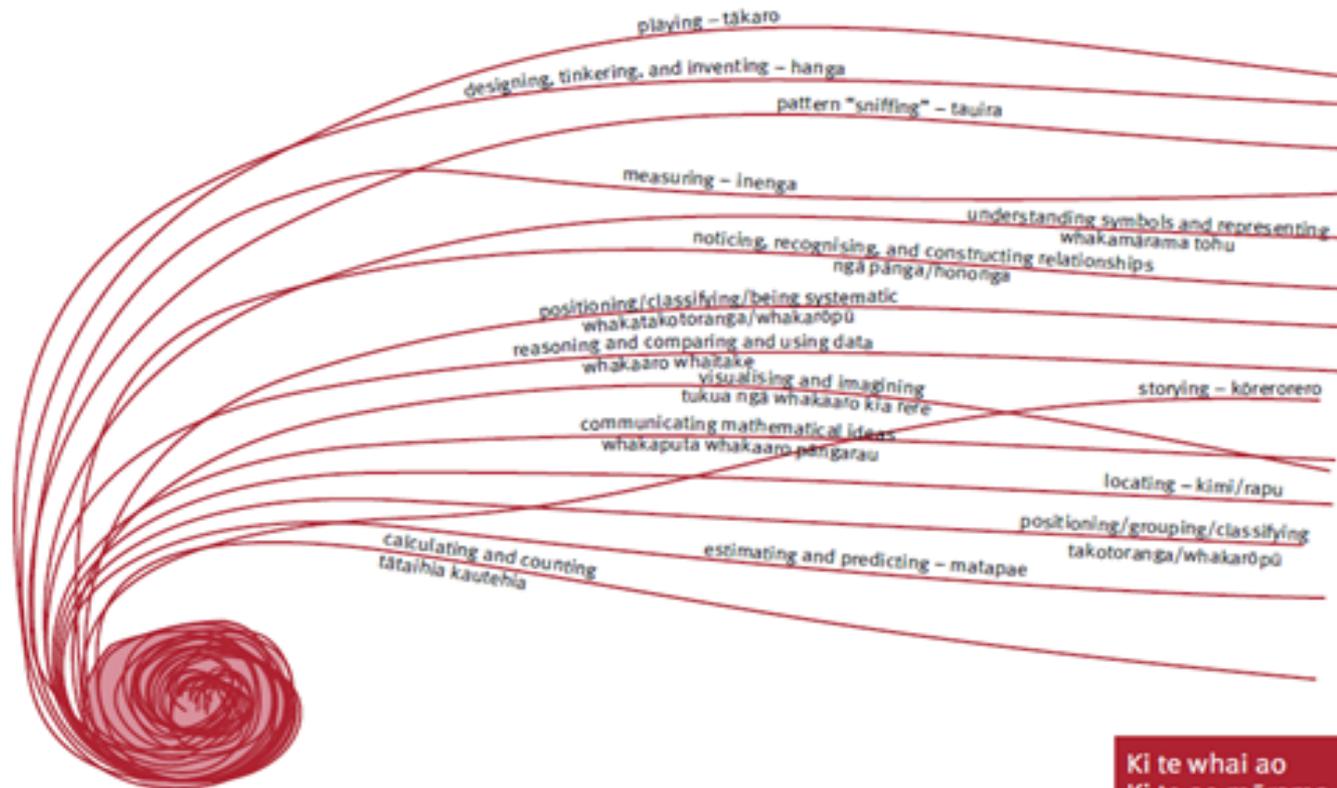
Mathematics in Te Whāriki (2017)

- ▶ Mathematics is one of the important forms of expression that children need to be powerful learners and successful communicators
- ▶ Mathematics is implicit in all five strands and explicit in two strands - Communication-Mana Reo and Exploration-Mana Aotūaroa
- ▶ Supporting curriculum resources include:
 - ▶ Te Kākano;
 - ▶ *Kei Tua o te Pae, Mathematics/Pāngarau* Book 18; and
 - ▶ Te Aho Tukutuku (CD from MoE)

Te Kākano

A living evolving framework of purposeful activities to assist teachers to notice and respond to mathematics learning

Te kākano: Purposeful activities for the development and understanding of mathematics symbol systems and technologies



He kākano
i rua mai
i Rangiatea

Increasingly: recognised as patterns over time, distributed across
enabling resources, connected to a diverse social communities, and mindful

Ki te whai ao
Ki te ao mārama
Haumi hui e taiki e

The role of mathematical problem solving in Te Kākano

More recently, a case has been made to strengthen, nourish and nurture the mathematical practices that are the threads of Te Kākano (McChesney, 2017)

In this presentation we suggest positioning mathematical problem solving more centrally within Te Kākano to keep mathematical practices at the forefront of early childhood education. This would:

- Nurture all threads and connections between the threads of Te Kākano
- Support children to be creative mathematical problem solvers

Problem solving in Te Whāriki and mathematics

- ▶ Problem solving is a generic, integral aspect of *Te Whāriki*, **and** an important mathematical practice
 - ▶ The creative, open mathematical activity integral to problem solving in the early years has parallels with the activity of mathematicians
 - ▶ Problem solving aligns with play pedagogies; and learning dispositions such as curiosity
 - ▶ Connects with a focus on problem solving in early years at school
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Research Design Information

The following example is drawn from a research study conducted by the first author that followed three beginning teachers in their first two years of teaching.

Qualitative data were collected through teacher focus group discussions, participation in problem solving workshops, observations of each beginning teacher enacting problem solving lessons, and individual interviews.

Data were analysed by identifying aspects of problem solving practice and cross-matching across teacher interviews, focus group discussions and lesson observations.

The next slide introduces one of the teachers and an example of an activity from her classroom mathematics programme.

Example of purposeful problem solving practices

Julia: a new entrant (years 0-1: 5 years old) teacher

Example of a mathematical problem: *From smallest to biggest.*

Julia set up several stations with different materials at each station: e.g., a range of different coloured blocks; different lengths of playdough and a pile of cuisenaire rods.

Julia explains:

As a class we had discussed the concepts around smallest to biggest and other vocabulary. We had worked together to line up from smallest to biggest based on how tall we are. This day I explained the different materials I had set up in the stations and that I wanted them to show me how they could arrange the materials to show smallest to biggest.

Children puzzling, persisting and problem solving

The Cuisenaire rods proved the most challenging, as they weren't very familiar with their sizes and colours. It wasn't immediately obvious how they should go about it. This proved to be a 'problem'. Some really puzzled about how to begin, which rod was smallest, and then 'what should I do?' ... (Julia).

Because cuisenaire rods are relatively close in size, Julia observed that it was more difficult for the children to make comparisons. The children were unsure about how to begin until one child organised the rods so that their bottom edges were lined up. Another child built a pyramid shape using the centre of each rod as a reference point to establish relative size.

The group of were a great example of collaboratively working together, of one student transferring his knowledge from the blocks to the rods more easily and then he was able to help the others (Julia).

The children came up with their own ways to try out and improve, and to ultimately show smallest to biggest.

Problem solving and rich mathematical learning

- ▶ *Children's problem solving processes:*
 - ▶ moving rods into different positions that made comparison visually possible;
 - ▶ breaking the problem into smaller parts by comparing different rods at different times;
 - ▶ demonstrating collaborative problem solving skills
- ▶ *Links with Te Kākano:*
 - ▶ *measuring – inenga:* strategically lining up or ordering objects so that visual comparisons are easier
 - ▶ *reasoning and comparing - whakaaro whaitake,*
 - ▶ *communicating mathematical ideas - whakaputa whakaaro pāngarau*
- ▶ *Links with New Zealand Curriculum:*
 - ▶ these measuring and comparing practices are also found within the level one measurement sub-strand (Ministry of Education, 2007).

Purposeful problem solving practices for mathematics

Implications:

- ▶ Propose that Te Kākano might be enhanced by more explicit reference to mathematical problem solving
- ▶ Mathematical problem solving and Te Kākano are useful for teachers in the first, early years of school
- ▶ The teacher's role is important for scaffolding, provocations and for noticing unexpected problems invented by the children
- ▶ Important that mathematical learning is grounded in young children's own interests, inquiries, purposes, and cultural understandings (Hedges & Cooper, 2016).

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