

# How young children learn mathematics



by Dr Anne Meade and Deirdre Van Duyl

## Our approach to teaching and learning mathematics

“Children’s informal mathematical knowledge originates within the course of their typically occurring everyday activities. Infants, for example, learn about time and pattern through the use of rhymes and song and develop spatial skill and awareness as they move around their environment.” (Antony & Walshaw, 2007, p. 25)

Children typically learn mathematical concepts at Daises by teachers using maths language - informally but intentionally - as children play. They add maths language too when they are engaged in everyday experiences together. Tamariki absorb and process mathematics ideas and language from a very early age.

Children’s in-built drive to find patterns powers many forms of mathematics learning. Their ‘inner drive’ to repeat actions seems to be innate. When they detect a statistical pattern, say, that certain objects can contain smaller objects (a containment schema) they move onto experimentation.

Professor Alison Gopnik, a guest of Daises in 2014, shared research that babies as young as 8 months old work with statistical patterns. By 9 months they detect patterns of probability.

Experimenting provides an avenue for learning things. Toddlers experiment with what fits in a cup, small box, play oven, or handbag! Older children continue to experiment with quantities that fit in an enclosures built with Lego, wooden blocks or branches during ‘Nature Explore’ excursions.



Children also learn by watching others. They observe with interest: Whose feet fit into which shoes? How many stacked beds will fit under the loft? How much water fits in a glass?

To consolidate a child’s understanding of containment measurement, kaiako talk about what fits. This reinforces mathematics language and children think about ‘containers’ and quantities as the day unfolds.

This is the teaching approach that applies to every mathematics schema.

## A lens focused on Te Whāriki (1996)

Mathematics for young children is about discovering and learning about mathematics concepts through play: number, geometry and measurement and statistics. Early years teachers are expected to stick to maths activities that have meaning and purpose for the age group.

Experiences to strengthen mathematics learning are outlined in Te Whāriki mostly in the Communication/ Mana Reo and Exploration/ Mana Aoturoa strands. Te Whāriki does not use separate mathematics headings.

The Communication strand wants learners to become “familiar with numbers and their uses” and demonstrate “skill in using the counting system and mathematical symbols, and concepts numbers, length, weight, volume, shape, and pattern.” The Exploration strand includes learning mathematical processes “setting and solving problems, looking for patterns, classifying for a purpose, guessing, using trial and error, and making comparisons.”

Kaiako at Daisies frequently weave in experiences with numbers and mathematical language, frequently in te reo Māori:

- Equal sharing, using real things, such as toast and fruit at kai time,
- Numbers (nama) and sequences (raupapa),
- Forward and backward counting,
- Order (whakarōpū),
- Sets (tatau) and matching (whakarite).

Teachers also include concepts and processes to do with geometry and measurement:

-Measuring (ine), including distance (tahiti) - as on excursions,

-Movement / speed (kori), including action schemas,

-Size (rahi), area (rahi), and volume (rōrahi), and area (rahi),

-Space and position (atea me te wahi), e.g. form a line, and patterns linked to sorting and classifying - this is a form of early statistics.



## Counting – kaute

Counting is often the first sort of mathematics that adults think about when we talk about young children. Many children know the numbers between 1 and 10, and how to recite them in sequence.

Rhymes that include counting are one of many fun ways we help children memorise the sequence. Reciting doesn't necessarily mean that tamariki can count objects with understanding. Educators expand understanding by counting, counting, counting.

Daisies children often enjoy board games which involve counting. Understanding the concept of counting develops as children begin to match the number words to objects (called "1 to 1 correspondence"). Children's brains need to have matured and they need to have practised counting a lot before they can count accurately. This competence is linked to understanding that the quantity is the same for, say, ten objects regardless of what they are and how they are arranged: "conservation of numbers".



## More mathematics

Evidence shows that young children have many basic mathematical understandings by age 4 years. As well as counting, they do simple arithmetic, solve problems (such as puzzles), orientate themselves in space, demonstrate geometric skills and use logic.

Their mathematical thinking is also proven, including demonstrating a number sense and a sense of probability, and carrying out spatial and geometric reasoning (Anthony & Walshaw, 2007).

Our Nature Explore research has provided examples of spatial reasoning by toddlers as well as older children.





## Blocks

Studies have shown that “block play provides a foundation for learning about problem solving and basic math and science concepts” (Guyton, 2011, 51)

Blocks are powerful learning tools from infancy through the early school years. Playing with blocks fosters many mathematical concepts including length, measurement, number, fractions, balance, estimation and geometry, e.g., lines, curves (Cuffaro, 2015).

At Daisies, kaiako provide opportunities for block play for tamariki of all ages. Very young infants treat blocks as things to handle, mouth or bang. **That’s how geometry begins.** When the children become mobile, we see volumetric play,

such as filling - and emptying – containers with blocks. They love to build and knock down higher and higher stacks of blocks, and to test how many they can hold at once.

Older tamariki engage with the blocks in more complex ways. The more they play with blocks the more sophisticated they become as designers and builders.

It can be huge fun to knock over block constructions, especially if you’re a toddler fascinated with joining and separating them with a crash! At Daisies we have a rule that “You can break it if you’ve made it, or if the ‘builder’ says you can.” Older tamariki stick to this rule better than toddlers!

As intentional teachers our role is to join in as a facilitator of block play. We declutter areas to make space for tamariki to create big structures. More floor space and teacher interest invites detailed and exciting bigger constructions. We also encourage cooperative use of blocks, and add mathematics language.

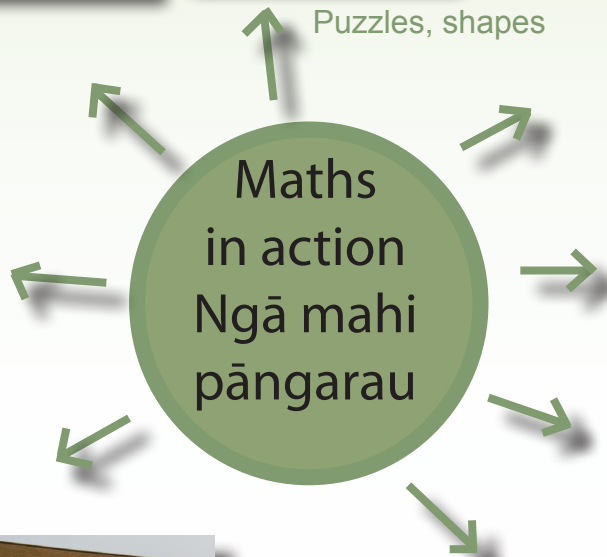
Calendar numbers,  
sequence of days



Balance, height



Puzzles, shapes



Challenge course: height; balance; spatial awareness



Measuring with  
own body

Classifying



Movement, direction



Balance, spatial  
awareness

Trajectory, volume



Number, measuring  
quantity to fit space

# Mathematics outside. Pāngarau a waho

Maths experiences outside include:

- Matching and sorting gumboots (e.g., by size, colour, patterns);
- Engaging with “challenge courses” while adults add vocabulary about positions: up, down, over, under, along, between, top, bottom, slope;
- Sorting the dry washing - by colour or similar types of garments, and also by pairs;
- Making sandcastles and talking about volume, sizes, making rows and counting;
- Loving water play - experimenting with volume and flow;
- Gardening (estimating the volume of potting mix, watching plants grow, and measuring heights; comparing the weight of buckets of soil or compost; noticing density);
- Doing carpentry including measuring, matching nails, experiencing the weight of tools;
- Experimenting with slopes - the ramp at Daisies and grass slopes in parks;
- Going shopping (matching brands, talking about quantities and money numbers);



- Nature Explore including spotting similarities and differences in trees, leaves, berries and birds; feeling hard versus soft ground; mapping; experiencing the height of trees and “spiral mountain”;
- Enjoying public playgrounds (talking about height and speed down slides);
- Exploring the Johnsonville community and beyond during excursions. Excursions involving walking build ‘muscle knowledge’ of distances;
- Going out on a ‘number or shape hunt’ and counting around neighbourhood streets.



## Maths inside. Ngā pāngarau ki roto

Examples of meaningful mathematics inside include:

- Looking in magazines for specific shapes and numbers;
- Working with puzzles entails learning maths concepts such as patterns, shapes, position and space;
- Constructing with Duplo™ and Lego™ strengthens awareness of shape, size and colour;
- Setting the table for kai involves counting and one-to-one correspondence;
- Signing in for Hui Ako uses numbers 1 to 6, and builds an understanding of a set of six;
- Cooking entails measuring weight and/or volume, using fractions, and discussing temperature
- Checking the time on the clock refers to number symbols and durations (e.g., five minutes, half an hour, an hour ...);
- Singing rhymes with puppets, before kai or during story-reading times, includes subtraction, addition and sequences (e.g., “Five Little Monkeys Swinging in a Tree”, and “Old McDonald had a Farm”);
- Dramatic play with dolls draws on one-to-one correspondence of clothes, beds or bottles to dolls, and provides occasions for measuring size;
- Dramatic play with vehicles entails movement, speed, and distance.

**During these activities, kaiako use mathematics vocabulary that connects with the actions so that children hear the words that go with or extend mathematical processes.**



# Mathematics progress in ECE

To assess how individuals or groups are progressing in their mathematics understanding, kaiako mainly watch out for tamariki using mathematics for increasingly complex purposes.

Assessment resources (Ministry of Education, 2009) for Te Whāriki, suggest teachers watch out for children's progress as follows:

- Observing and listening in on mathematical symbols, tools and practices;
- Playing with these;
- Using mathematical tools and processes for a purpose;
- Re-designing mathematics tools or practices

Our cooking experiences provide wonderful examples of children progressing mathematically.

The fact that Daisies is a mixed-age centre with no walls between babies and older children means that babies observe and hear the older children's baking sessions from a young age. And they play at cooking quantities of ingredients (sand and dough) as soon as they are toddling.



Nikau children feel pride when they start baking real food, with adult supervision. For the toddlers this entails lots of observation as they take turns to measure and mix the ingredients in one bowl. A teacher reads the recipe.

Whanake children are given more autonomy when cooking. Daisies has four sets of baking tools: one for each older child to read and follow the recipe and to prepare their own batch of biscuits with support from a teacher. Inevitably some tamariki redesign their cooking practices!

Progressions in mathematics learning are seen in most other areas of playful learning. Introducing a maths word in diverse ways broadens children's understanding of its application.



## Ideas for parents

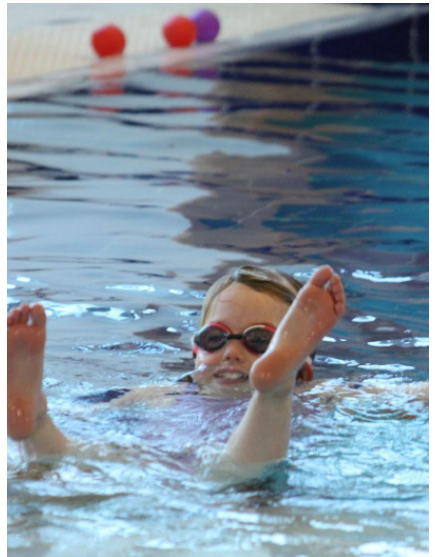
Children learn best by doing and talking at the same time, where the names of mathematical concepts are woven into informal chatting.

Use mathematical terms in everyday situations. Here are some suggestions for involving your child in mathematics learning at home and in the community.

- Baking and cooking;
- Setting the table at meal time;
- Sorting and folding washing;
- Shopping with real coins and notes;
- Looking at the clock, talking about time;
- Stowing supermarket shopping, by categories of food and household items;
- Playing board games with a dice or a similar component;
- Discussing speed and distance when travelling by car or train;
- Walking and talking about letter box numbers and car number plates;
- Walking in the bush or along a beach, talking about position (map features);
- Counting down 'sleeps' until an event.

Repeat mathematical activities many times, albeit with variety and novelty to keep the interest up.

However, note that research findings caution against using instructional approaches for children in their early years – formal instruction in the early years has been associated with demotivated learners by age 7 to 9 years, so keep it spontaneous and fresh.



## Further reading about mathematics in the early years

[www.nzmaths.co.nz/supporting-rich-mathematical-interactions-ece](http://www.nzmaths.co.nz/supporting-rich-mathematical-interactions-ece)

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Ministry of Education (2009). *Kei Tua o te Pae, Early Childhood Assessment Exemplars*, Book 16. Wellington: Ministry of Education.

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[www.tekura.school.nz/subjects-and-courses/what-you-can-study/mathematics](http://www.tekura.school.nz/subjects-and-courses/what-you-can-study/mathematics)

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Deirdre Van Duyl is a teacher at Daisies and Dr Anne Meade is co-owner of Daisies.

This booklet is one in a series about early childhood education. For more information go to

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