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CONNECTING EXPECTATIONS OF *TE WHĀRIKI* AND *THE NEW ZEALAND CURRICULUM*: EXAMPLES OF MATHEMATICAL PRACTICES

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Abstract

The first year of primary school aims to be closely connected with early childhood education, yet this is often invisible in the curriculum of specific subjects. This paper sets out an approach that uses mathematical practices as a curriculum tool that reconceptualises school mathematics. Using the early childhood mathematics framework of Te Kākano, the strands of mathematical practices are important descriptors of mathematical activity for children. We describe examples of mathematical learning from both early childhood and the first year of school, and make a case for using mathematical practices as a conceptual tool for designing a mathematics curriculum in the first years of school.

Introduction

Strengthening continuity between early childhood education and the first years of school has been an important concern for Aotearoa New Zealand (Ministry of Education, 1996, 2007; Peters, 2010). *Te Whāriki* (Ministry of Education, 1996, 2017), and the two versions of the school curriculum document, *The New Zealand Curriculum* and *Te Matauranga o Aotearoa* (Ministry of Education, 2007, 2008), each have their own histories, and cultural and professional traditions. While there has been a great deal of attention to continuity in the transition from early childhood to school, it is mostly focused on social, cultural and wellbeing goals (Peters, 2010). In terms of identifiable subject areas, such as mathematics, any connections between each sector have therefore been less visible, often relying on teachers to make their own classroom links. So how could curriculum information be more attuned to important and enduring processes of a subject area? In what ways might teachers use a re-configuration of curriculum information as a tool for designing their localised curriculum? And how might a different way of expressing curriculum information act as a bridge between the sectors? These are timely questions for curriculum renewal in the school years due to an interest in play-based curriculum and pedagogy in the first years of school (Davis, 2015, 2018), and the current curriculum refresh of school learning areas, including mathematics and statistics.

In this paper, we set out a *mathematical practices* perspective as an alternative approach for mapping a *connected curriculum* from early childhood into the first two years of school. Mathematical practices describe mathematical ways of interacting with the world, using talk, actions and other tools within activity. We begin by highlighting background information about curriculum directions and research projects that focus on making connections between early childhood and the first years of primary school. In many national contexts, it is the school curriculum that dominates, with its structure and expectations resulting in the schoolification of the early years (Halpern, 2013; Moss et al., 2015). We have therefore identified an example of a curriculum artefact from early childhood that sets out important practices of one subject area, mathematics. We then provide examples of mathematical learning from both early childhood and the first year of school. Our aim is to illustrate how *mathematical practice*s can re-orientate how we view curriculum and also better mesh together key competencies with subject content. Using the curriculum context of mathematics enables us to describe and highlight the advantages of this approach, and to set out possible pathways that might connect the early childhood context with learning in the first two years of school.

Background curriculum context

The updated *Te Whāriki* (Ministry of Education, 2017) reiterates the importance of connecting with primary schools and claims a similar vision between *Te Whāriki*, *The New Zealand Curriculum* and *Te Matauranga o Aotearoa*. *Te Whāriki* and *The New Zealand Curriculum* have "close parallels" where "learning is seen to take place in the space between what the educational environment offers and the knowledge and experiences that children bring with them" (Ministry of Education, 2017, p. 51). Furthermore, connections between specific curriculum concepts within each curriculum are identified. "In *Te Whāriki*, learning dispositions and working theories are seen to be closely interrelated. The same is true of the key competencies and learning areas in *The New Zealand Curriculum*" (p. 51). The section entitled *Pathways to school and kura* (pp. 51–57) provides examples of goals and other curriculum information that connect early childhood and the first years of school. These five pages, one page for each of the five strands of *Te Whāriki*, set out connections between *Te Whāriki* and *The New Zealand Curriculum* with "The Weaving" named as a repeated connector between the two: "Local curriculum design involves a complex weaving of principles and strands (*Te Whāriki*), values, key competencies and learning areas (*The New Zealand Curriculum*) as children and young people engage in learning experiences" (pp. 53–57). Mathematics examples are included in the pages for the Communication and Exploration strands (pp. 56–57) where mathematics-related learning outcomes of *Te Whāriki* are placed in parallel with the key competencies of "using language, symbols and texts" and "thinking" (respectively).

The New Zealand Curriculum does not mention the early childhood curriculum until a section titled *Learning pathways* (Ministry of Education, 2007, p. 41) where the principles and structure of *Te Whāriki* are described and the transition from early childhood to school is a "new stage in children's learning (that) builds upon and makes connections with early childhood learning and experiences" (p. 41). In a diagram on page 42, each of the five strands of *Te Whāriki* is connected to a different Key Competency of *The New Zealand Curriculum* and then to competencies in the tertiary sector. This flow chart and associated text are designed to illustrate cross sector alignments where learners are "confident, connected, actively involved (and) lifelong learners" (Ministry of Education, 2007, p. 42). Examining this curriculum information shows that connections between the sectors are explicit and valued (Clarkin-Phillips, 2016). We note, however, that while the updated *Te Whāriki* contains comprehensive detail about connections and linkages, detail is confined to only one small section in *The New Zealand Curriculum*.

Over the last 20 years there have been a number of policy and research endeavours in the early years of school. A Royal Society Marsden project with a team of researchers in different parts of New Zealand followed fourteen children over a period of eighteen months (Carr et al., 2010). The children were observed on three different occasions, two in their early childhood centre and a final phase in their first year of school. The data illustrated children learning in the different contexts, using themes of learning to interpret the different contexts within and across both sectors. At the conclusion of the project, authors noted the ways in which the curriculum domains of *Te Whāriki* and *The New Zealand Curriculum* could be connected, for example, that "subject-matter ability and knowledge domains interact closely with learning-disposition ability and knowledge domains" (Carr et al., 2010, p. 18). In other research studies, a focus on educational transitions strengthened connections between early childhood and the first years of school (Peters, 2010; Peters & Paki, 2013). In addition, key competencies were signalled as important for continuity with the *New Zealand Curriculum* (Carr et al., 2013).

Another research project set in one primary school investigated how three "junior schoolteachers might improve continuity for children moving from ECE to school" (Davis, 2015, p. 2). The teaching team found that greater continuity from ECE to school could be achieved with changes to both the physical environment and teaching approaches. The teachers "established a culture of creativity, thinking and relationships" (p. 12), and by the end of the project they noticed "a broader, more balanced curriculum" where the children "were able to see themselves as successful across a range of disciplines" (p. 12). In

2015 a Ministerial Task Force was formed with a goal to establish "dialogue between the sectors as teachers grappled with understanding each other's curricula" (Clarkin-Phillips, 2016, p. 62). Furthermore, in the last few years, a policy move entitled Kahui Ako deliberately organised clusters of schools and centres working together with shared professional development interests. These connections between centres and schools are often at a more conceptual and relationship level, although some are working with more fine-grained curriculum planning. We now focus specifically on one subject area, mathematics, and present a perspective based on an early childhood resource that can be extended into the first years of primary school.

Purposeful activities as mathematical practices

The key resource, in the form of a mathematics framework, Te Kākano, is already part of the early childhood curriculum landscape. Te Kākano was first published in *Kei Tua o te Pae Book 18 Mathematics Pāngarau* (Ministry of Education, 2009) and describes "the range of purposeful activities for developing mathematical tools and symbol systems in a bicultural environment." (p. 2) As a framework for early childhood mathematics, the strands of Te Kākano extend in different directions over time and represent key aspects of mathematics (Peters & Rameka, 2010). Examples of strands are *estimating and predicting—matapae*, and *designing, tinkering, and inventing—hanga*, *measuring— inenga*, and *visualising and imagining—tukua ngā whakaaro kia rere* (Ministry of Education, 2009). These strands of Te Kākano include familiar aspects of mathematical content, such as measuring and counting, plus more general mathematics practices of estimating, exploring and designing. Representing mathematical activity in this way "is more closely aligned to the doing, talking and thinking that we observe during children's individual or collaborative activity" (McChesney, 2017, p. 5). These strands of mathematical practices are involved in children's activities, such as construction and baking as well as art, sewing and dramatic play.

In this paper we propose that the strands of Te Kākano provide a starting point for our deliberate use of the term *mathematical practices* to describe mathematical learning in the first two years of primary school. As Yvette Solomon reminded us, "mathematics is not 'all around us', waiting to be discovered by the active inquiring mind of the child" (Solomon, 1989, p. 161). Instead, learning mathematics involves social conventions related to actions, speech and using materials or tools of the discipline, established over time and set in the varied contexts of centres and schools: in other words, the multiple social practices of learning mathematics. As a specific example, "knowing number should be reconceptualized as involving *entering into the social practices of number use* [emphasis added]" (Solomon, 1989, p. 160) and "constituted by a distinct set of social rules that have to be explicitly stated and learnt in some way which involves a social existence" (Solomon, 1989, p. 162). Mathematical practices closely connect with practices of mathematicians (Burton, 1999) and include "multiple forms ranging over a spectrum of practices, such as academic, workplace, playground, street selling, home and so on" (Moschkovich, 2013, p. 264). Mathematical practices have also been studied in classrooms, involving conversations, opportunities to express different language meanings, to focus attention, and adopt mathematical thinking (Cobb et al., 2001).

Mathematicians often prioritise the overarching *processes of mathematical thinking*, such as logic and reasoning, problem solving and justifications. These are features of mathematical activity and experience that should be valued in school. Some mathematicians also claim that young children's experiences of mathematical practices involve them in aspects of 'being a mathematician' (Holton et al., 2001; Schoenfeld, 2013). We also propose that mathematical practices are readily accessible for teachers when they observe and participate in children's mathematically orientated activity, i.e., during opportunities for children to be mathematicians (Dent & McChesney, 2016; Gresalfi, 2009). The strands of Te Kākano provide a lens for recognising mathematical symbol systems (Ministry of Education, 2009), where mathematics involves language and tools such as informal and constructed models, and visual representations (McChesney, 2017). This clearly connects with two of the key competencies of *The New Zealand Curriculum*, "*thinking*" and "*using language, symbols and texts*" (Ministry of Education, 2007, p. 12).

Examples of connecting mathematical practices

We now set out three examples of mathematical practices that encompass early childhood and the first year of school: *being a measurer*, *being a pattern maker*, *and being a builder* (or constructor/designer). Each of these could be seen as roles adopted in different discipline contexts, for example, being a pattern maker within an art context, or music or dance etc. In viewing learning as participating in the practices of the discipline, then 'being a mathematician' can be represented by these three roles, where measuring, pattern making and building are oriented towards mathematical language, problem solving and representational tools; i.e., children engaged in the practices of the field, mathematics. As a consequence, children are participating as mathematicians. For each of the following, we describe contexts and opportunities for engaging with mathematics. We then set out examples from early childhood education, using examples of learning stories as descriptions of children's interests, actions and mathematical explorations. By drawing on the series *Kei Tua o te Pae* (Ministry of Education, 2004, 2009), we use the illustrative learning stories and the supporting explanatory text to bring a "lens focused on mathematics" (Ministry of Education, 2009, p. 5). We then describe the mathematical practices involved in the child's activities. The third example, *being a builder*, is commonly a shared group activity that can take place over several days. Following the early childhood examples, we provide related examples from the first year of school. These descriptions are drawn from publicly available Ministry of Education teacher resources that describe contexts and activities for mathematical learning.

Mathematical practice 1—Being a measurer

The first mathematical practice is *being a measurer*, selected because *measuring—inenga*—is one of the strands of Te Kākano (Ministry of Education, 2009, p. 3), and *Measurement* is one of the sub strands of *The New Zealand Curriculum* (Ministry of Education, 2007). When a child is 'being a measurer' in a mathematical sense, they have an interest in, and an orientation and sensitivity towards, measuring. Within their environment, measuring is purposeful for the child and measuring may contribute to answering a question or solving a practical problem. Within broader sociocultural meanings, measurement can be informal as well as the more formalised processes of measuring with a measuring tool. Furthermore, there are multiple opportunities for 'being a measurer' where children's purposes involve different measurement attributes such as height or length, area, volume or capacity, time, or weight.

Illustration from early childhood

Our illustration of *being a measurer* at kindergarten is a learning story of Tom from *Kei Tua o te Pae Book 18 Mathematics Pāngarau* (Measuring the play dough, Ministry of Education, 2009, pp. 14–15, and electronic link). Tom indicates his interest in the length of rolls of play dough by "Look—Rosie—it's sooo long!" The learning story sets out a sequence of ongoing exploration involving shared conversation with a teacher (Rosie) in a material-rich environment, including play dough and a ruler. The teacher notes highlight important aspects of this exploration; Tom experimenting with longer and longer lengths of play dough, the teacher's introduction of a 30 cm ruler, Tom reading numbers from the ruler, and increasing the length of play dough to make increasingly longer lengths, with a final goal of making a 30 cm length. A repertoire of measurement-related mathematical practices is described as follows:

> Tom is learning the use and value of a mathematical tool (a ruler) while learning about a unit of measurement (centimetres), the teacher also records that Tom has used an accurate method of measuring by his making sure that the edge of the dough strip corresponded with the beginning of the ruler. (Ministry of Education, 2009, p. 15)

This brief learning story is a clear example of Tom 'being a measurer', that is, having an orientation towards measuring in his environment (in this case length). He is the initiator of this mathematical activity by exploring and tinkering with play dough, and noticing 'longness'. Tom is interested in how

long things are; he explores how length can change and how he can make specific lengths of dough. He experiments with a ruler, as a mathematical tool, and uses the ruler to 'read' the text of the ruler scale—using the number sequence as indicators of the increasing length of the play dough. Tom also aligns the ruler with the ends of the piece of play dough (that is, aligning the scale on the ruler), and uses language to express numbers and a measurement unit (centimetres): all aspects of the social practice of measuring.

Illustration from the first year of school

There are a range of measuring experiences in the early years of primary school that focus on informal units, and a classic example is using different sized footprints to measure stable lengths of objects or spaces. Children's footprints are similar but different and clearly much shorter than a teacher's footprint. In a starter idea from *Muddy footprints*, a station in the *Worms and more* activity (nzmath, n. d., c), there are footprints of small and large animals that can be a launch pad for more measuring questions that might relate to children's lives. Another version of this kind of comparison experience is *Activity 8.3 King for a Day* (Drake, 2010), provided as a historical example of a purpose for a standard unit for length. This sets up the context and purpose for realising that informal lengths are not fair or even accurate, and so there is a need for a standard or common unit of length. The activity begins a series of tasks for children where they are actively making decisions about how to measure and what they could use to measure. They are 'being a measurer' within increasingly more complex contexts, with more children, and over a period of time. Young children continue to be fascinated by measuring distances: in particular, their own height as they grow from year to year—and for when they might be 'tall enough' for example, to reach something, or to become taller than a sibling or cousin.

Mathematical practice 2—Being a pattern-maker

Our second mathematical practice is *being a pattern-maker*; related to the Te Kākano strand of '*pattern "sniffing"—tauira*' (Ministry of Education, 2009, p. 3), and within the sub strand of *Patterns and relationships* in the Number and Algebra strand of the *New Zealand Curriculum* (Ministry of Education, 2007). As a general cultural term, 'patterns' encompass many human activities, but for our focus on mathematical patterns, we have used as an exemplar entitled 'being a pattern-maker' to convey a child's involvement as an active explorer and generator of patterns. The term 'pattern-sniffing' suggests an orientation and sensitivity towards patterns within cultural and social environments (Cuoco et al., 1996). A sensitivity to patterns involves noticing, recognising and constructing patterns, thereby incorporating other strands from Te Kākano such as *relationships—nga panga/hononga—*and *visualising and imagining—tukua nga whakaaro ka rere*.

Illustration from early childhood

'Being a pattern-maker' in an early childhood context is illustrated by the learning story of Jessica from *Kei Tua o te Pae Book 18 Mathematics Pāngarau* (Playing with repeated patterns, Ministry of Education, 2009, p. 26, and electronic link). In that story, Jessica's early childhood centre had visited the He Taonga Māori Gallery at Auckland Museum and the children observed and sketched different patterns including koru and kōwhaiwhai. When drawing and exploring geometrical shapes, children experiment with ideas related to geometrical patterns, such as how shapes can be repeated, and noticing sameness and difference in a spatial sense. A few days later, Jessica's mother showed the teacher "a fascinating drawing that Jessica had worked on at home" (p. 26). The drawing shows a figure, representing a person, and this figure is repeated many times across the width of the page. While each new figure gets smaller, the legs get longer, and illustrate a sequence and regularity of increasing length of legs for each figure. The mathematical practice of making or generating a pattern for a purpose is clear from the visual information in Jessica's drawing. She has carefully attended to the pattern in the figures as well as the difference (in leg length) from one figure to its next neighbour so that the effect across left to right of her drawing of repeated figures is a recognisable growth pattern.

Early childhood experiences include many opportunities for experimenting with patterns, where children are making their own patterns (generating a pattern, often a repeated pattern) and making patterns within patterns (repeating nested patterns). Making patterns with different colours, textures and shapes can be part of children's interests in weaving, plaiting, beading and drawing. Within this practice of pattern making is an attention to sameness and difference (e.g., red blue red blue red etc.) where children are mostly designing the repeating elements or noticing patterns that might not be immediately obvious to adults. Patterns are not limited to visual or material experiences; children experiment with patterns in rhythm, music and movement as well as patterns in daily routines.

Illustration from first year of school

Pattern Makers is a Level 1 sequence of activities from *nzmaths* (nzmaths, n.d., a), with teacher information set out for four or five sessions. In the third session, "pattern making materials are spread around the room. Students are free to move to any centre and create repeating patterns." These stations (or maker tables) might have piles of "cubes, toothpicks, nursery (ice block) sticks" or "found equipment (Lego blocks, bottle tops, leaves, etc.)". Other materials are typically assortments of buttons, the plastic animals or teddies that are often part of school mathematics equipment as well as shells, acorns, leaves, sycamore seeds and other items collected by teachers and whānau. During pattern-making activities, teachers are advised to ask questions such as "*Can you read your pattern to me? What will come next? How do you know?*", and towards the end of the session, teachers make some time for students to "share their patterns with the class. Encourage other class members to continue some of these patterns and describe the pattern" (nzmaths, n.d., a). This kind of activity clearly has learners being pattern-makers, exploring different kinds of patterns, experimenting using trial and error, and followed up with drawing or other forms of recording their patterns for later discussion.

Mathematical practice 3—Being a builder

Our final mathematical practice is *being a builder*. We have chosen a more common term 'being a builder' (or designer/constructor) to convey young children as designers, tinkerers and generators of all kinds of constructions that incorporate different materials (and with different purposes in mind). Children regularly choose to design and construct models and structures, on their own, with other children, and with assistance and challenge from adults. They also enjoy exploring the materials that might be at hand, sometimes seeking out or appropriating other materials or objects that serve a purpose in their building endeavours. Children take advantage of the mathematical properties of materials and equipment available and readily solve problems posed by limitations or constraints within their environment. They make active choices whether using specially designed equipment, such as wooden blocks, or informal, often recycled objects, as their construction materials of choice.

Illustration from early childhood

Jak builds a Wharenui (a traditional meeting house) is a learning story that illustrates some of the mathematical opportunities involved in being a builder (Ministry of Education, 2004, pp. 16–17). His teacher had noticed that

> Jak did a lot of problem solving … as he had to work out how he was going to balance the 'ribs' so they could stand up and be pointed. Jak tried all sorts of blocks and decided to build a tall pile in the middle so the ribs could lean on them. (Ministry of Education, 2004, p. 16)

Jak experimented with and exploited the spatial properties of the large wooden blocks of different sizes and shapes known as 'unit' blocks (common in ECE centres). For example, during the construction he was using the same blocks in different orientations, connecting blocks with others and placing blocks at angles so that there were sloping surfaces. He used wooden blocks of different lengths and experimented with curved blocks (quarter circle and semi-circle blocks). There are many published

learning stories, for instance Carr and Lee (2012) that illustrate the mathematical decisions of children when they are 'being a builder'. Examples from that publication include:

> *My Volcano*—Emma with Avalon and Lucy were inspired by their local mountain, O Huiarangi, to build a volcano using a range of blocks. (p. 50)

> *Ilaria, Isabella and Katherine's Learning Story*—describes a tree house they constructed from wooden unit blocks as a home for woodland animals. (p. 52)

> *O le auala laupapa a Peniamina: Peniamina's Bridge*—using coloured iceblock sticks, Peniamina built a floor model that he transformed into a bridge. (p. 79)

> *Temple Design*—Devya explored a set of new wooden blocks, designing, drawing and constructing a model temple, experimenting with different sizes and shapes. (p. 82)

> (Carr & Lee, 2012).

The mathematical practice of 'being a builder' is related to multiple Te Kākano strands that convey aspects of the creative and inventive practices of children when they construct something. The relevant Te Kākano strands are

- playing—*takaro,*
- designing, tinkering, and inventing—*hanga,*
- visualising and imagining—*tukua nga whakaaro ka rere,*
- locating—*kimi/rapu,*
- estimating and predicting—*matapae.*

These strands could possibly include, within or in addition to the following practices, measuring—*inenga*, calculating and counting—*tataihia kautehia*, or positioning/classifying/being systematic—*whakatakotoranga/whakaropu* (Ministry of Education, 2009, p. 3).

Illustration from first year of school

There are usually construction materials in New Entrant classrooms, with possibly a greater range of manufactured construction sets as well as wooden blocks and collections of different sized cardboard boxes and cylinders. Primary teachers have often included construction experiences ranging from open-ended questions "what can you make from these resources?" to making a model with a relevant purpose. Books are a useful source of ideas for mathematics teaching and one example is from a collection on *nzmaths* (Take This series). *Take This Hester Lester* is a Level 1 sequence of activities from *nzmaths* (nzmaths, n.d., b). *Hester & Lester* is a picture book (Mewburn & Bailey, 2011) and the illustrated story is a possible starting point for multiple activities. In the Geometry section of the chart, teachers are advised to

> read Hester & Lester. Have students identify the places Hester and Lester go in the story: from their house (implicit), through the mud, across the field, into the forest, across a drawbridge and moat, to a castle (built by them) etc. Have students draw their own simple pictorial map of the area in the story. (nzmaths, n.d., b)

These experiences are both engaging children in the story context and initiating spatial ideas and resources for a later 'being a builder' activity, which is set out as "use construction materials including boxes, ice block sticks, cardboard tubes, to make their own model of a castle" (nzmaths n.d., b). Although this appears to be a different, more constrained scenario, children are clearly situated as builders and constructors, where their decisions about how materials are used are based on their decisions about materials and shapes. They can experiment with and utilise properties of shapes in two and three dimensions. After making a cardboard dog (as in the story), children are asked to think about their castle from the dog's perspective, providing both external (when outside the castle) and internal perspectives (as the dog explores the castle).

Discussion: Mathematical practices as curriculum connectors

We have described three examples of mathematical practices and illustrated how this provides a means of describing children's purposeful mathematical actions, and by implication, their mathematical thinking. This illustrates an enacted curriculum in ways that bring subject matter to the foreground, while connecting other aspects of children's activity. Descriptions of practices, we propose, are more accessible for teachers, whether in early childhood settings or in schools. For example, teachers commonly notice and recognise children's persistence or 'persisting with difficulty' during activity. With a *mathematical practices* lens, however, teachers can name aspects using specific curriculum language. When being a measurer, persistence might be recognised and renamed in ways related to a practice of measuring; that is, trying out different starting points for measuring or repeating attempts to line up an object to be measured, or persisting with a particular measuring tool. When being a pattern-maker, persisting with difficulty could describe how combinations of objects are repeatedly explored until a pattern emerges, or adapted with objects to create new patterns. And lastly, when being a builder, persisting might be trying out different-shaped objects for best fit. Testing out a particular shaped-block such as rotating until it fits, or moving blocks in ways that might strengthen the structure, illustrates persistence by experimenting with and activating properties of this shape, a wooden block. A perspective on mathematical practices therefore provides more fine-grained subject-related language for describing children's learning.

Furthermore, mathematical practices provide a language and means to recognise and name these fine-grained elements of children's activity. These aspects may be more readily accessible for teachers to recognise and name during busy activity, rather than trying to link activity with wider learning outcomes, or working theories. Identifiable aspects of mathematical practices are also more connected to the contexts of children's interests in multiple and diverse activity settings. The roles of the teacher are critically important when they actively shape, prompt and provoke activity so that children's mathematical thinking and talk can be enriched and expanded. These further 'opportunities to be a mathematician' are also opportunities for children to enact and talk about their mathematical thinking and reasoning. Within such rich learning contexts, mathematical practices serve as reference points for posing further questions, for providing provocations and other challenges that deepen and expand children's activity.

Concluding comments

Our aim in this paper was to bring mathematical practices to the foreground as curriculum descriptors, with an intention that these descriptors could act as a bridge between *Te Whāriki* and the first two years of *The New Zealand Curriculum*. Based on the mathematical practices set out in the early childhood mathematics framework Te Kākano, we have shown that these can be applied to school settings. Practices are observed during children's activities and fine-grained aspects of practices describe children's active involvement in mathematical problem solving and reasoning. Young children's explorations are multifaceted; they are often problem-solvers, builders and measurers all within the same activity (Carr & Lee, 2019).

In terms of curriculum design, a mathematical practices perspective is a useful tool for teachers. We have illustrated that the language of mathematical practices can describe children's learning for different activities and acts as a connector to the more formal curriculum language of a subject area. The school curriculum for mathematics is currently set out in different ways—as Achievement Objectives and in additional information for teachers on the *nzmaths* website in sections called Curriculum Elaborations and Key Mathematical Ideas (nzmaths, n.d., d). Framing learning in terms of mathematical practices adds fine-grained detail about children's activity in contrast to the starkly described *The New Zealand Curriculum* information (Ministry of Education, 2007) and is therefore a more accessible curriculum mapping tool for teachers. It is also a flexible way of viewing curriculum with portability across different mathematical sub-strands of *The New Zealand Curriculum* as illustrated by our examples from measurement (being a measurer), number and algebra (being a pattern-maker),

and geometry (being a builder). For teachers in the first years of primary school, mathematical practices may also assist in designing and refining a curriculum that is play-based or a combination of different approaches. Existing activities could be opened up into richer and more challenging mathematics, where we can use curricular language to describe more complex learning. And mathematical practices can also better mesh together key competencies with subject content, so that there is both a description of the richness of children's activity as well as sufficient detail about valued school mathematics. Mathematical practices are therefore both a tool for describing children's learning and a resource that teachers in both sectors can adapt and extend within their own contexts.

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