Te Kākano (the seed): Growing rich mathematics in ECE settings

Sally Peters and Lesley Rameka

How can we grow rich authentic mathematics in early childhood settings? This article focuses on Te Kākano (the seed), a metaphor for growing rich mathematics. Early childhood educators are likely to be familiar with the Te Kākano framework from Book 18 of the *Kei Tua o te Pae* assessment exemplar series (Ministry of Education, 2009). This framework is now central to a new early childhood resource, *Te Aho Tukutuku: Early Mathematics* (Ministry of Education, 2010), which is to be published in 2010. The ideas presented here expand on the background material in *Te Aho Tukutuku: Early Mathematics* to give further insights into Te Kākano, with more detail than could be included in the resource itself. This article acknowledges the collective thinking that underpinned Te Kākano's conception, and explains the theoretical ideas that are key to understanding the approach.

The original inspiration

The idea of Te Kākano, which forms the basis of *Te Aho Tukutuku: Early Mathematics* (Ministry of Education, 2010), was collectively developed by an earlier working group, Te Whāriki and Mathematics in Early Childhood Education. This group, comprising people with expertise in early childhood education (ECE) and/or mathematics, was set up by the Ministry of Education in 2001 to look at the implications of the Numeracy Strategy for early childhood education.

The definition underpinning the Numeracy Strategy is: "To be numerate is to have the ability and inclination to use mathematics effectively in our lives—at home, at work, and in the community" (Ministry of Education, 2001, p. 1). The early childhood working group looked at ways in which this "ability and inclination to use mathematics effectively in our lives" might be fostered in early childhood settings, and what was necessary to support this kind of learning. In doing so they were aware that the dispositional focus of the definition was crucial. Dispositions concern "not only what people can do, but how they tend to invest their capabilities—that is what they are disposed to do" (Perkins, Tishman, Ritchhart, Donis, & Andrade, 2000, p. 270). Motivation is crucial, because "people often don't apply or practise their skills if they are not inclined to do so" (Carr et al., 2009, p. 16). These ideas were reflected in a report by the Education Review Office (2000) on literacy and numeracy that was published at the time, which acknowledged that "it is clearly not useful to learn skills if, in the process of acquiring them, the disposition to use them is lost" (p. 10).

Pedagogical approaches play a key role in ensuring that the inclination to use mathematics is fostered (see Anthony & Walshaw, 2007), and teachers' own positive dispositions towards mathematics are likely to be central in this process (Haynes, Cardno, & Craw, 2007). In 2001 there was some evidence available on the ways in which the inclination to use mathematics could be fostered, such that children made progress not just in skills but also in their purposes and contexts for using mathematics. These findings came from a major project, EMI-4s (Young-Loveridge, Carr, & Peters, 1995). EMI-4s was funded by the Ministry of Education to explore the mathematics of four-year-olds and how this could be enhanced. The early childhood centres that were most effective at enhancing children's mathematics learning utilised the many meaningful and interesting opportunities to use mathematics in everyday life, along with providing a rich environment, with open-ended resources for mathematical exploration and games in which children could vary the level of challenge. Later, a Ministry of Education resource, *Making Things Count* (Ministry of Education, 1999), was produced, drawing on the findings of EMI-4s. Peters and Jenks (2000) wrote a supporting document for *Making Things Count*, providing further insights for early childhood centres.

In 2010 the developers of *Te Aho Tukutuku: Early Mathematics* expanded on the work of the initial working group, drawing on the early resources noted above and the *Effective Pedagogy in Mathematics/Pāngarau* best evidence synthesis (Anthony & Walshaw, 2007) to create a resource

that aims to support early childhood educators to strengthen mathematics learning in their settings. This article provides important theoretical background to the resource itself, which will be useful for all those who engage with *Te Aho Tukutuku: Early Mathematics*.

Mathematics embedded in *Te Whāriki*, rather than being a separate thread

When focusing on mathematics in ECE, the first issue to consider is the place of mathematics within New Zealand's bicultural early childhood curriculum, *Te Whāriki* (Ministry of Education, 1996). The aspirations for ECE in New Zealand are for children:

> to grow up as competent and confident learners and communicators, healthy in mind, body and spirit, secure in their sense of belonging and in the knowledge that they make a valued contribution to society. (Ministry of Education, 1996, p. 9)

Te Whāriki provides a "woven mat" of principles and strands to support these aspirations. One of the curriculum's developers, Tilly Reedy, noted that the "main achievement occurs in the development of a child's mana" (Reedy, 2003, p. 68) and that children should be "empowered in every way possible, particularly in the development of their mana" (p. 74). *Mana* can be translated as prestige, power or reputation, but it also has a deeper meaning of spiritual power and authority. Children are said to be born with an increment of mana inherited from their parents and from their ancestors (Mead, 2003; Metge, 1995). The development of a child's mana is central to the five strands of *Te Whāriki*.

Learning outcomes for children in *Te Whāriki* are knowledge, skills and attitudes, which combine as learning dispositions and working theories (Ministry of Education, 1996). Carr (2001) has described learning dispositions in terms of "being ready, willing and able to participate in various ways: a combination of inclination, sensitivity to occasion, and the relevant skill and knowledge" (p. 21). Dispositions can be thought of as situated learning plus motivation (Carr, 2001). As noted earlier, in supporting children's dispositions to be competent and confident learners of mathematics, fostering motivation is likely to be crucial.

The original working group spent time highlighting and discussing both the explicit mathematics and the more implicit potential for mathematics within the detail of *Te Whāriki.* Although there is a lot of explicit mathematics within the Mana Reo—Communication and the Mana Aotūroa—Exploration strands, mathematics is implicit in all strands; for example, in negotiating fairness, understanding routines, planning and predicting (Mana Whenua—Belonging); and in self-care skills, food preparation, dressing and so on (Mana Atua—Well-being). Through this highlighting exercise, it became clear that mathematics is woven into all the strands. Rather than separating mathematics (creating a separate thread that can't be woven back into the whāriki), it was decided that it would be more beneficial to weave mathematics into the curriculum mat. This kind of incorporation is important for any individual aspect that has the potential to be treated as a separate thread (for example, mathematics, literacy, music, art).

The working group rejected approaches that appeared to be disempowering for children or that overlooked the holistic nature of their development. Instead, it developed a framework that could assist educators to think about the mathematical possibilities within *Te Whāriki* and ways in which these might be supported and developed.

A framework—Te Kākano

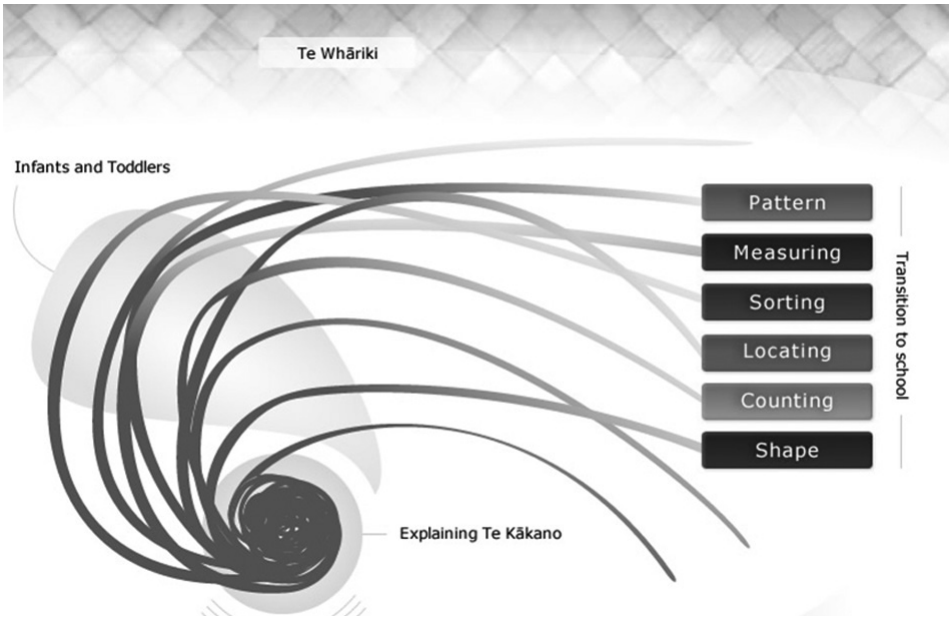
A framework, Te Kākano, was developed to help educators to notice and respond to the mathematics learning taking place in a particular context (see Figure 1). It is important to remember that this learning is situated *within* the weaving of principles and strands of *Te Whāriki*, and that these remain central when thinking about mathematics learning.

The framework, which was developed and agreed upon by the multicultural working party, was based on the metaphor of a seed (te kākano), which could grow and flourish in the right environment. The intention was to describe the mathematical learner, and acknowledge the range of purposeful activities for the development of mathematical tools and systems in a bicultural environment. This development was significant. Woodhead (1997) had concluded that many ideas about what children are believed to "need" tell us more about "the cultural location and personal values" of the developer than the nature of childhood (p. 63). It was therefore important to consider the "cultural location and personal values" of the people deciding the goals for children. In many situations Western frameworks are developed and then applied to all learners. The Te Kākano framework was developed collectively, and reflected a bicultural approach that resonated with, and was supported by, the Pasifika experts in the original Te Whāriki and Mathematics in Early Childhood Education working group.

Key points about the Te Kākano framework are that it:

- is a living framework that is constantly evolving
- captures aspects, but not necessarily everything

FIGURE 1 TE KĀKANO



 Source: *Te Aho Tukutuku: Early Mathematics* (Ministry of Education, 2010)

Children … are precious seeds from the ancient Māori homeland, the receptacle of the combined understandings, abilities and strengths of their ancestors, an important living connection to the family—past, present and future …

- is relevant in all settings, but the specifics may vary, with different aspects emphasised in different cultures.

The metaphor of a seed acknowledges that children do not arrive in ECE as empty husks; they bring knowledge and understanding with them. The range of mathematical purposes and tools that are developed are influenced by the "nutrients" that surround the seed.

E kore au e ngaro, he kākano i ruia mai i Rangiātea

Te Kākano makes reference to the traditional Māori whakataukī (proverb), "E kore au e ngaro, he kākano i ruia mai i Rangiātea": I will never be lost; the seed was sown in Rangiātea (the ancestral Māori homeland). The whakataukī refers to the source of Māori identity, of Māori distinctiveness, derived from ancestors. Ancestors live on in their descendants, and who one is is bound to and defined by ancestry and whakapapa (genealogy). The strengths, abilities and characteristics of ancestors are passed on to later generations, ensuring the descendants will not decline or fall by the wayside.

This whakataukī is often associated with small children and what they bring with them to learning contexts. It underscores the importance of, and the value placed upon, children in Māori society. Children are viewed as the personification of the worlds of yesterday. They are precious seeds from the ancient Māori homeland, the receptacle of the combined understandings, abilities and strengths of their ancestors, an important living connection to the family—past, present and future; they are a living embodiment of ancestors, and a link in descent lines stretching from the beginning of time into the future (Metge, 1995; Reedy, 1991).

The whakataukī also makes reference to rangatira (chiefs or leaders) of the past. A feature of rangatira is their innate chiefly qualities, inherited from ancestors—qualities that are inherent in all Māori children. The term *rangatira* encapsulates many Māori virtues, aspirations and human possibilities, including ideas of beauty, strength and courage, and includes a focus on individuals reaching their highest potential in order to expand and deepen their talents and skills (Macfarlane, Glynn, Grace, & Penetito, 2005; Rameka, 2007).

In this resource the whakataukī is used to represent children's potential to learn, and in particular their potential to develop mathematical understanding and knowledge. It recognises that children have innate strengths, abilities and understanding that provide the basis for the development of mathematical knowledge and understanding.

Te Kākano as a tool for early-years settings

The Te Kākano framework recognises the range of mathematical ideas (cultural tools for mathematical thinking) within a setting. The strands in Figure 1 represent these purposes. Depending on how the seed is nurtured, these strands may be numerous and strong, or, in a less fertile setting, they may be few or weak, because only some strands are supported.

Te Kākano provides a valuable framework for strengthening mathematical learning within a setting. It allows settings to consider the range of mathematics available to children, and the ways in which these are engaged with. It provides insights into opportunities to support progression through the breadth of meaningful mathematics, as well as ideas to support progression within a strand. Progression is also about increasing the range of contexts (physical and social) in which mathematics is used. The framework provides a tool for reflecting on what is supporting mathematical learning in a setting. Staff can explore the "nutrients" that surround their "seed" by considering teacher pedagogy, teacher content knowledge, family/whānau knowledge and resources. These all interact with the children's interests to foster particular mathematical learning.

Naming the strands

The strands in Te Kākano's framework are illustrated in *Kei Tua o te Pae*, Book 18 (Ministry of Education, 2009), which provides some examples of purposes, labelled in both Māori and English (referred to as "the sorts of strategies and dispositions a teacher might notice", Ministry of Education, 2009, p. 3). It is important to note that the diagram in *Kei Tua o te Pae* represents some of the possibilities proposed by the original working party: it is not a definitive list. Also, these strands are not static: they cross and interweave in different activities. For example, *Kei Tua o te Pae* acknowledges that in one exemplar, *calculating and counting*, *measuring* and *designing* might all overlap. In another, *estimating and predicting* might overlap with *pattern sniffing*.

In *Te Aho Tukutuku: Early Mathematics*, six strands have been named and illustrated through

examples. These are Pattern, Measuring, Sorting, Locating, Counting and Shape. This selection was influenced by the work of Bishop (1988), who showed that counting, measuring and locating (along with designing, playing and explaining) are important for the development of mathematical ideas in any culture. Early childhood services can develop their own personalised Te Kākano from this basic framework by choosing and naming key strands for their setting, in partnership with their community. This is consistent with the overall approach in ECE, where settings weave their own curriculum whāriki from the framework of principles and strands, and each setting can develop its own emphases and priorities (Ministry of Education, 1996).

Using Te Kākano to focus on mathematics learning

The strength of Te Kākano as a tool for ECE settings is that it recognises the key role of teacher pedagogy, teacher content knowledge, family/whānau knowledge and resources as factors that nurture the seed. The framework provides a way of focusing on each of these aspects, thus offering a way to strengthen and enrich the mathematics, which is both fostered and developed.

We can look into the diagram at any point to examine in more depth what is happening for a particular child or a particular group of children. In doing so we see the authentic context in which an activity takes place, and the specific detail of the mathematical purposes, strategies and dispositions happening there, along with the mathematical complexity that is involved. This can be illustrated with the example of Tom measuring dough (Figure 2, taken from *Kei Tua o te Pae*, Book 18, Ministry of Education, 2009, p. 14).

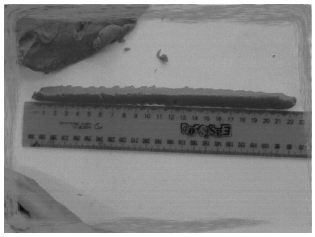
Using Te Kākano to focus on this situation highlights the mathematical purposes and mathematical complexity involved in this activity Figure 3). It retains the other information about the authentic context, the relationship between Tom and his teacher and the nature of their interaction. It also shows some of the surrounding nurturing elements, or "food", for Tom, in the form of the teacher's knowledge and the availability of resources such as a ruler. It makes no claim that Tom would respond in these ways in another context; it simply documents and draws attention to what happened here.

FIGURE 2 AN EXCERPT FROM TOM'S LEARNING STORY

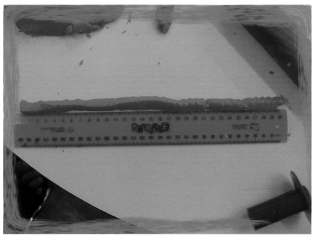
MEASURING THE PLAY DOUGH

Child: Tom Teacher: Rosie Date: February

"It's 19 long."



"This one is 22 centimetres."



"I've made it 30 centimetres now."

A learning story

Tom held up a long piece of play dough he had squeezed from the piping equipment and exclaimed, "Look, Rosie – it's sooo long!"

"Yes, you're right, Tom, it sure is! Let's get a ruler and measure it to see how long it really is," I suggested.

Tom placed his play dough strip along the tape measure.

"Can you see the numbers, Tom? They tell you how long it is," I explain.

After studying the numbers carefully, Tom cleverly announced, "19 long."

"Yes, 19 centimetres," I add.

"I'll make another one – but even longer this time. Look, this one is … 22 centimetres," he continues.

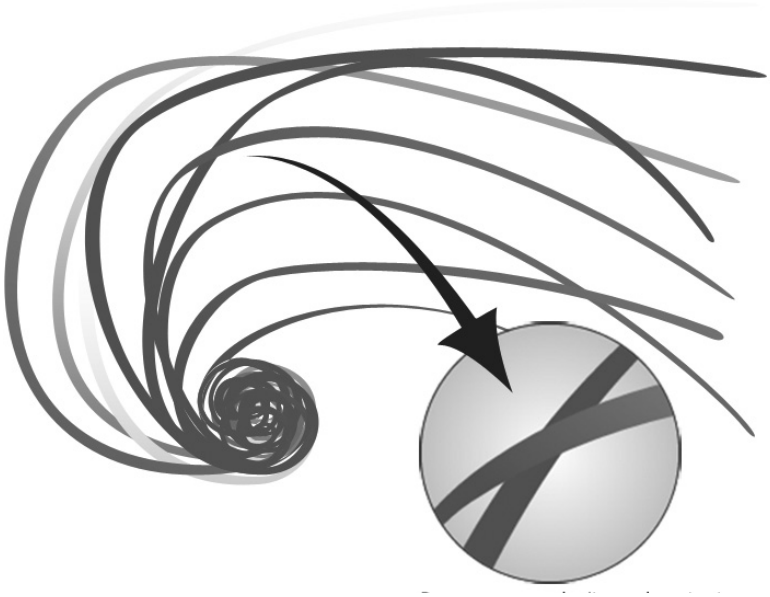
"Wow, can you make the strip as long as the ruler – 30 centimetres long, Tom?"

After much squeezing and slight adaptation, Tom successfully makes the strip reach from one end of the ruler to the other.

"Look – it's 30 centimetres long now!" he announces proudly.

Source: *Kei Tua o te Pae*, Book 18, (Ministry of Education, 2009, p. 14)

FIGURE 3 LOOKING CLOSELY AT AN EXPERIENCE USING TE KĀKANO



 Source: *Te Aho Tukutuku: Early Mathematics* (Ministry of Education, 2010)

Some knowledge and understandings ascend from potential being into the world of becoming, where they challenge and stretch thinking, and then move into the world of being and of enlightenment.

The context in this example is Tom playing with playdough and talking with his teacher. We might identify several interconnecting mathematical purposes; for example, "Measuring" and "Communicating mathematical ideas". The best evidence synthesis also looked at this example and included "Mathematical exploration" as an additional purpose (Anthony & Walshaw, 2007, p. 34), while "Setting and solving problems" is the purpose for Tom noted in *Kei Tua o te Pae*, Book 18 (Ministry of Education, 2009, p. 14). These different interpretations in different sources illustrate a strength of the framework, in that it invites different perspectives and could be used as a tool for discussion in ECE settings. If revisited with Tom, he might identify other purposes. For example, there may be something here about status as a purpose, hinted at in his "soooo long" comment, which could have been part of an ongoing interest in rolling longer pieces. This is just a snapshot; Tom, his teachers and his family would know more about the context, which would shed more light on the purposes.

Within each purpose, further detail of the mathematical complexity can be identified. For example, in this situation if we look at the specifics of measuring, Tom is investigating length, comparing, solving a problem in context and using appropriate metric units (centimetres). In this context he was also recognising the numerals 19, 22 and 30.

Ki te whai ao, ki te ao mārama

"Ki te whai ao, ki te ao mārama" (to the glimmer of light, to the world of light) describes the notion of progression in the framework. The phrase refers to the traditional Māori story of the creation of the universe. It describes the movement from "te kore, ki te pō, ki te ao mārama" (from nothingness, to the night, to the world of light), and symbolises the unfolding of the cosmos and the universe. These understandings of the universe and the evolution of the world are also used to describe the unfolding of consciousness and the gradual development of full awareness and understanding.

The creation narrative provides a three-dimensional perspective of the world, beginning with te kore, the realm of potential being and energy. This is a time of potential and possibilities, a time of openness to new ideas and growth. It is the seed-bed of learning and development. Secondly, there is te pō, the realm of becoming, which is marked with uncertainty, hesitancy, apprehension and negotiation. It does, however, also have a sense of stretching and swelling, and unfolding potential and consciousness. Finally, te ao mārama is the realm of being, of realisation, enlightenment and clarification. This is not viewed as the end point, but as part of a continuously unfolding stream (Royal, 2003).

There are two key ideas expressed in Marsden's explanation of the unfolding world (Royal, 2003). The first is that of continuity, where the world is continuously being created and recreated. This relates strongly to children's learning in that, like the universe, children's ideas and understandings are continuously being created and recreated, defined and redefined. Like the universe, there is no end point to children's learning, thinking and understanding. Rather, it is an ongoing, lifelong process. Marsden's second key point is that the universe is dynamic. He maintains that it is a stream of processes and events that is linear rather than cyclical. He does, however, point out that the linear movement is a two-way process, making reference to "the spirits of the departed descending to Hawaiki and that which is in the process of becoming ascending to the world of light" (Royal, 2003, p. 135). This idea also strongly links to the dynamic nature of knowledge acquisition and learning, and the two-way traffic of ideas, thinking and understanding. Some knowledge and understandings ascend from potential being into the world of becoming, where they challenge and stretch thinking, and then move into the world of being and of enlightenment. Other knowledge and understandings descend from the world of being, from a place of knowing and certainty, to a world of becoming or uncertainty. It is here that views and opinions that were once firmly held may be challenged and interrupted, and if unable to stand up to the critique of becoming, are relegated to the world of potential being, or nothingness. In this way, learning is not just an accumulation of ideas and understandings, but a dynamic process of continuous germination, cultivation and pruning.

In strengthening Te Kākano, progress can be envisaged as a complex array of contributing variables, rather than a stage-like progression against a developmental framework. This is a key element, because it avoids a narrow interpretation of learning against a socially constructed set of stages, which may not be

appropriate for all cultures and may limit the ways in which mathematics is noticed, recognised and responded to in early childhood settings (Ministry of Education, 2004). Instead, progression occurs both within and across the strands. The working group identified three dimensions of progress:

1. a wider range of purposes, strategies and dispositions
2. a wider range of contexts
3. increasing mathematical complexity.

We will now look at each of these in turn.

1. A wider range of purposes, strategies and dispositions

A key aspect of progress is developing an increasingly rich Te Kākano framework within a specific setting. As children find new mathematical purposes that are meaningful to them, these purposes create a broad basis for mathematical development, fostering both inclination and ability. In contrast, if only one or two strands are fostered, the possibilities for learning—both now and in the future—are likely to be constrained.

Sometimes this aspect of progress includes using a particular mathematical concept for an increasing number of purposes. In Tom's example, he may have been using similar skills (for example, comparing) for other purposes and has now applied them to measurement—an important new step. If he began recognising numerals for other purposes (for example, on a calendar or in a book), this would also be progress.

2. A wider range of contexts

The second aspect of progress is a purpose or skill being used in different contexts. For a young child, a key element of progress is widening the contexts in which ideas can be used. For example, if a child who has been engaged in a mathematical activity at home then sees that this purpose and skill can be used in the ECE setting, this is an important aspect of progress. Similarly, there is progress if a purpose (such as Tom's measuring) takes place in a different context within the setting (perhaps comparing the length of block roads or heights of block towers). Another way of thinking about context is the social context. In Tom's example, he is talking with the teacher. If he is later involved in communicating mathematical ideas to other adults and/or his friends, this is also progress.

3. Increasing mathematical complexity

A third aspect of progress is developing increasing mathematical complexity within a purpose. (This may also relate to increasingly complex purposes.) In the next steps in Tom's story, it was suggested that Tom might be interested in measuring himself. If he did decide to do this, it would increase the mathematical complexity (as well as possibly adding a new physical and social context, as it may involve measuring against a wall and someone to help). This may lead to exploring ways of comparing the heights of other children in the setting. These further explorations into measuring would strengthen and extend this strand.

Noticing, recognising and responding

Te Kākano was first developed several years ago, and we have become more aware of the complexity of learning and the importance of learning dispositions in the interim. However, it still provides a useful framework to help educators notice the mathematics that is happening within authentic everyday contexts, and strive to understand it (Drummond, 1993, cited in Ministry of Education, 2004). *Te Aho Tukutuku: Early Mathematics* (Ministry of Education, 2010) has developed the ideas in Te Kākano further, and has added vignettes for discussion. This resource will provide a tool to support discussions with families and among teams of educators to identify the rich possibilities for the strands of the framework. These can then be incorporated into the setting. For example, reading or telling stories, or singing songs to babies that include English and Māori counting words, introduces mathematical language and purposes without expecting a mathematical response from the child at this point (a six-month-old baby may respond to the rhythm and expression in a story rather than the mathematics, but is being surrounded by the mathematical language of their culture). The strands provide insights into other mathematics that might be highlighted in a setting.

The framework draws attention to the purposes that are being highlighted, and to the patterns of purposes, contexts and concepts over time. It allows progress (in all its forms) to be documented. Te Kākano also provides a way to reflect on the "food" (resources, teacher and family/community knowledge) that might strengthen these developments and perhaps foster new ones. In doing so, it can be used to consider the opportunities afforded, invited or potentiated (Claxton & Carr, 2004) within broad settings, and also within more specific, moment-to-moment experiences and interactions. It acknowledges the nature of these opportunities (or limitations) when looking at what is happening for individual children or groups of children.

Having noticed and recognised mathematical learning, these understandings can be put to good use (Drummond, 1993, cited in Ministry of Education, 2004). Sometimes, through striving to understand, it may become evident that the mathematical element in a situation is secondary to another purpose, and that it is appropriate to respond to the main purpose rather than "hijack" the situation (for example, not interrupting a child's exploration of a complex science topic with an irrelevant "how many … ?" question). At other times it may be appropriate to do no more than provide the space for a child to consolidate something they are exploring without pushing for a next step. (For example, a child in the EMI-4s project constructed a track around the kindergarten with interlocking wooden peg boards, and he worked along the track, throwing a die that had dot patterns from 1 to 3, placing the appropriate number of pegs into the board for each throw. When he ran out of pegs, he reversed the process and removed the correct number of pegs for each throw.) At other times an educator's recognition may lead to ways in which the child can be supported to explore other contexts, purposes or concepts.

Conclusion

One effect of the introduction of National Standards into primary schools in 2010 is that families and early childhood educators are likely to become particularly aware of the mathematical learning young children are engaged in. However, as with reading, there is a danger that inappropriate practice might raise the achievement of particular skills in the short term but lead to negative attitudes that are detrimental to enjoyment and progress in the long term (see Carr & Peters, 2008; Education Review Office, 2000). Ideally, pedagogy focuses on strengthening dispositions and encourages an orientation towards learning goals where children persist with difficulty and strive to understand or master something new. This contrasts with performance goals, where children strive to gain favourable judgements or

avoid negative judgements (Smiley & Dweck, 1994). If we want children to develop learning goals, then it is counterproductive to have an emphasis on performance goals when it comes to mathematics (or any other domain).

The approach offered by *Te Aho Tukutuku: Early Mathematics* is holistic and integrated. It avoids treating mathematics as a separate curriculum thread, divorced from the other key elements of *Te Whāriki*. Instead, it offers the metaphor of a seed, Te Kākano, to grow rich mathematics in ECE settings. It recognises the movement and unfolding from "te kore, ki te pō, ki te ao mārama" and the dynamic, integrated lifelong nature of mathematical learning.

Acknowledgements

This article is based on a background paper written for the Ministry of Education, prior to the development of the *Te Aho Tukutuku: Early Mathematics* resource. The Te Kākano diagrams in this article are Crown copyright 2010. They come from CD-ROM *Te Aho Tukutuku: Early Mathematics*, a Ministry of Education Early Childhood Education Maths resource, 2010. We are grateful to the Ministry of Education for allowing the diagrams to be reproduced here, and for supporting the development of the background paper into an article for *Early Childhood Folio*.

We acknowledge the contributions of the original 2001 working party and the recent *Te Aho Tukutuku: Early Mathematics* group to the ideas presented here. We are also grateful to the *Kei Tua o te Pae* team for allowing Tom's Learning Story to be reproduced in this article.

References

Anthony, G., & Walshaw, M. (2007). *Effective pedagogy in mathematics/pāngarau: Best evidence synthesis iteration [BES] edition for early childhood educators.* Wellington: Ministry of Education.

Bishop. A. J. (1988). *Mathematical enculturation: A cultural perspective on mathematics education.* Dordrecht, Netherlands: Kluwer.

Carr, M. (2001). *Assessment in early childhood settings*. London: Paul Chapman.

Carr, M., & Peters, S. (2008). *Literacy learning progressions: 2007 draft for consultation*. Submission to the Ministry of Education.

Carr, M., Smith, A. B., Duncan, J., Jones, C., Lee, W., & Marshall, K. (2009). *Learning in the making: Disposition and design in the early years*. Rotterdam: Sense.

Claxton, G., & Carr, M. (2004). A framework for teaching learning: The dynamics of disposition. *Early Years*: *Journal of International Research and Development*, *24*(1), 87–98.

Education Review Office. (2000). *Early literacy and numeracy: The use of assessment to improve programmes for four to six year olds.* (Education Evaluation Reports, No. 3). Wellington: Author.

Haynes, M., Cardno, C., & Craw, J. (2007). *Enhancing mathematics teaching and learning in early childhood settings.* Wellington: Teaching and Learning Research Initiative.

Macfarlane, A., Glynn, T., Grace, W., & Penetito, W. (2005). *He tikanga whakaaro: Mai he tirohanga Māori: A response from a Māori worldview to the proposed New Zealand Curriculum Framework key competencies*. A paper prepared for Ministry of Education Curriculum, Teaching and Learning Division.

Mead, H. (2003). *Tikanga Māori: Living by Māori values*. Wellington: Huia.

Metge, J. (1995). *New growth from old: The whānau in the modern world.* Wellington: Victoria University Press.

Ministry of Education. (1996). *Te whāriki: He whāriki mātauranga mō ngā mokopuna o Aotearoa: Early childhood curriculum.* Wellington: Author.

Ministry of Education. (1999). *Making things count.* Wellington: Learning Media.

Ministry of Education. (2001). *Curriculum update: The numeracy story*. No. 45. Wellington: Author.

Ministry of Education. (2004). Book 1: An introduction to Kei Tua o te Pae. In *Kei tua o te pae: Assessment for learning: Early childhood exemplars.* Wellington: Learning Media.

Ministry of Education. (2009). Book 18: Mathematics pāngarau. In *Kei tua o te pae: Assessment for learning: Early childhood exemplars.* Wellington: Learning Media.

Ministry of Education. (2010). *Te aho tukutuku: Early mathematics* [CD-ROM]. Wellington: Author.

Perkins, D., Tishman, S., Ritchhart, R., Donis, K., & Andrade, A. (2000). Intelligence in the wild: A dispositional view of intellectual traits. *Educational Psychology Review*, *12*(3), 269–293.

Peters, S., & Jenks, J. (2000). *Young children's mathematics: A supporting document for the "Making things count" resource* (Occasional Paper No. 8). Wellington: Institute for Early Childhood Studies.

Rameka, L. (2007). Māori approaches to assessment. *Canadian Journal of Native Education: Indigenous Approaches to Care and Education*, *30*(1), 126–144.

Reedy, T. (1991). *A tangata whenua perspective of early childhood*. Paper presented at the Fourth Australia and New Zealand First Years of School conference, Auckland College of Education, Auckland.

Reedy, T. (2003). Tōku rangatiratanga na te mana-mātauranga "Knowledge and power set me free …" In J. Nuttall (Ed.), *Weaving Te Whāriki: Aotearoa New Zealand's early childhood curriculum document in theory and practice* (pp. 51–78). Wellington: New Zealand Council for Educational Research.

Royal, T. C. (Ed.). (2003). *The woven universe: Selected writings of Rev. Māori Marsden.* Masterton: The estate of Rev. Māori Marsden.

Smiley, P. A., & Dweck, C. S. (1994). Individual differences in achievement goals among young children. *Child Development*, *65*, 1723–1743.

Woodhead, M. (1997). Psychology and the cultural construction of children's needs. In A. James & A. Prout (Eds.), *Constructing and reconstructing childhood: Contemporary issues in the sociological study of childhood* (2nd ed., pp. 63–84). London: Falmer Press.

Young-Loveridge, J. M., Carr, M., & Peters, S. A. (1995). *Enhancing the mathematics of four-year-olds: The EMI-4s study* (Vols. I & II). Hamilton: Department of Education Studies, University of Waikato.

SALLY PETERS is a senior lecturer in the Department of Human Development and Counselling at the University of Waikato.
Email: speters@waikato.ac.nz

LESLEY RAMEKA
Ko Tararua te maunga
Ko Ōhau te awa
Ko Tainui te waka
Ko Ngāti Tūkorehe te hapū
Ko Ngāti Raukawa te iwi.

Lesley Rameka is the Academic Leader, Bachelor of Teaching (ECE), for Te Tari Puna Ora, New Zealand Childcare Association. **Email**: lesley.rameka@nzca.ac.nz

Both authors were members of the original working party that developed Te Kākano and later contributed to the development of *Te Aho Tukutuku: Early Mathematics.*