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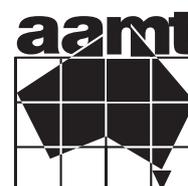
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Author(s)	NGAREWA HAWERA & MERILYN TAYLOR
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The Australian Association of Mathematics Teachers Inc.

ABN 76 515 756 909
POST GPO Box 1729, Adelaide SA 5001
PHONE 08 8363 0288
FAX 08 8362 9288
EMAIL office@aamt.edu.au
INTERNET www.aamt.edu.au



MĀORI MEDIUM CHILDREN'S VIEWS ABOUT LEARNING MATHEMATICS: POSSIBILITIES FOR FUTURE DIRECTIONS

NGĀREWA HĀWERA

University of Waikato

ngarewa@waikato.ac.nz

MERILYN TAYLOR

University of Waikato

meta@waikato.ac.nz

Pre-European traditional Māori education in New Zealand was integrated and holistic. With Western influence many Maori children struggled to achieve at school. Māori medium education based on retaining Māori values, language and culture therefore emerged to provide an alternative avenue for education. A key element in this initiative is to increase children's engagement with, and learning of, mathematics. Views from 61 Year 5-8 children in Māori medium contexts have been sought to provide insights about their mathematics education. This paper discusses some of these views and raises possibilities for future directions to support the momentum of this positive initiative.

Introduction

*E kore au e ngaro he kākano i ruia mai i Rangiātea.
(I will never be lost, the seed which was sown from Rangiātea).*

In traditional Māori society, education was oral, thematic and holistic (Barton & Fairhall, 1995; Riini & Riini, 1993). Māori children enjoyed the support of a variety of community members to fulfil their potential for learning (Hemara, 2000). A Māori world-view synthesized links between people, their activities and the environment. Shared meanings and understandings were integral to the learning process. This thinking is still prevalent in many parts of Maori society (Hemara, 2000; Pere, 1994).

Mathematics for Māori included a "very good system of numeration ... doubtless quite elaborate enough for their purposes" (Best & Hongi, 2002). They also developed systems of measurement and geometrical concepts to support their needs and innovations. A strong oral tradition meant that an emphasis on the development of mental strategies as well as physical skills was expected for solving problems in a range of contexts. This often included mathematical thinking which assisted Māori in adapting to various environments by integrating mathematics ideas and tools within everyday practices such as making waka (canoes), constructing whare (houses), gardening and rongoa (medicine) (Ohia, 2002).

When Māori children began to participate in a Western form of schooling, there came a change in the ethos of education and the learning environment for them. The values promoted in that curriculum (including mathematics) supported the dominant culture and contributed to many Māori children's general underachievement in formal

education settings (Bishop, 1988; Knight, 1994). D’Ambrosio (2001) argues that mathematics education has a responsibility to include ways to “reaffirm, and in some instances restore, the cultural dignity of children” (p.308). It is important for children from minority groups to appreciate that they possess a long and rich mathematical heritage and that they can be mathematically capable (Zaslavsky, 1998). Furthermore, Penetito (2010) suggests that successful education for Māori should begin with what it means to “be” Māori. Accordingly, alternative spaces such as Kura Kaupapa Māori (KKM) have been established as an educational option to educate Māori children through the medium of their own language and culture (Smith, 1991). This includes their mathematics education.

The official philosophical basis for guiding learning and teaching in KKM is Te Aho Matua o ngā Kura Kaupapa Māori (Ministry of Education, 2008a). A key element within this document is the notion of actively promoting a close relationship between kura (school) and the community which is considered important for supporting children’s learning in mathematics (Anthony & Walshaw, 2007). While there are special teachers employed at the school, education for children enrolled at kura is a communal responsibility (Ministry of Education, 2008c). Participation of whānau (family) is expected and valued. However, involving Māori whanau in their children’s formal education requires much consideration. Genuine engagement and discussion with them about children learning mathematics is not easy or simple as many have a background of unsuccessful achievement in mathematics education themselves (Meaney & Fairhall, 2003).

Current education literature portrays mathematics as a dynamic entity that is constructed by learners themselves (Dossey, 1992; Mason, 2008). Cotton (2004) states for example that mathematics is about supporting people to develop a range of mathematics ideas in order to make sense of their world and thereby control the complexities within it. Article 29 in the *UN Convention on the Rights of the Child* espouses that children have a right for education to be directed to the development of mental abilities to their fullest potential (Munn, 2005). To this end children should be encouraged to develop a variety of mental strategies and choose the most appropriate for the situation or problem they are engaged in (Suggate, Davis & Goulding, 2006).

National assessments have indicated progress by Māori children in recent years regarding mental computation. This research notes however, that children in these contexts need to develop greater problem solving strategies (Crooks & Flockton, 2006). To advance mathematical thinking the development of efficient multiplicative strategies is necessary (Young-Loveridge, 2008). Higgins (2005) suggests that the use of concrete materials can help promote such mathematical thinking and discussion. Using equipment (accompanied by appropriate discourse) can have a positive effect on Māori children’s experiences in mathematics learning situations (Holt, 2001). Te Poutama Tau (Numeracy Development Projects) that has been implemented in some KKM, endorses this stance (Higgins, 2005).

Twenty-first century mathematics education promotes the use of tools such as digital technologies. Neal, Barr, Barrett and Irwin (2007) suggest that e-learning (learning supported by or facilitated by ICT) can provide a vehicle to achieve Māori aspirations in education. Use of appropriate technology can influence students’ engagement with mathematical tasks and help them understand mathematics in alternative ways (Calder,

2009). The curriculum document for KKM, Te Marautanga o Aotearoa (Ministry of Education, 2008b) encourages the use of ICT to support children's learning. Recent initiatives by the Ministry of Education have endorsed this policy by providing for example, digital learning objects to support mathematics learning through te reo Māori (the Māori language).

Children are major stakeholders in their education. Their voices can alert educators to unique perspectives on mathematics learning (Averill & Clarke, 2006; Hāwera & Taylor, 2010; O'Shea, 2009). This paper seeks to acknowledge the importance of children's perspectives regarding their mathematics education. Analysis of these perspectives can only contribute to understanding their mathematics experiences and constructing possibilities for future directions.

Methodology

This paper focuses on the responses of 61 year 5-8 Māori children in four KKM. Data were gathered as part of a larger study. Most children had participated in Te Poutama Tau, the Māori medium equivalent of the Numeracy Development Projects for several years prior to the study.

Schools were asked to nominate year 5–8 children from across a range of mathematics levels. Children were interviewed individually for about 30 minutes in te reo Māori or English (their choice) in a quiet place away from the classroom. They were told that the interviewer was interested in finding out about their thoughts regarding the nature of mathematics and their learning of pāngarau/mathematics. Data regarding five questions are discussed in this paper to illuminate the thinking about a range of ideas that these children held about their mathematics learning experiences. These are:

- Ki ōu whakaaro, he aha tēnei mea te pāngarau?
(What do you think mathematics is about?)
- Kei te kainga ētehi tāngata hei āwhina i a koe ki te ako pāngarau? Pēhea to rātou āwhina?
(Are there people at home who help you to learn mathematics? How do they help?)
- I ā koe e mahi ana āu mahi pāngarau, ka whakamahia e koe ētehi taputapu pērā i te pirepire, te porotiti rānei? Ka whakamahia mo te aha?
(When you do mathematics, do you use equipment like beads and counters? What are they used for?)
- Pēhea nga rorohiko? Ka whakamahia ēnei mo te ako pāngarau?
(What about computers? Do you use these when learning mathematics?)
Of the 61 children interviewed, 44 were Year 7 and 8 (12-13year olds) who were also asked to solve a problem involving multiplication:
- E hanga motokā ana te kamupene o Hera. E 4 ngā wīra mo ia motokā. E hia katoa ngā wīra mo te 17 motokā?
(Hera has a car manufacturing company. She needs 4 wheels for each car. How many wheels does she need for 17 cars?)

Further analysis and discussion of this data and other questions children were asked can be found in Hāwera, Taylor, Young-Loveridge & Sharma (2007) and Hāwera & Taylor (2008, 2009, 2010).

Results and Discussion

Children's thoughts about the nature of mathematics

Table 1. Children think mathematics is about.

Number and operations	Don't know No reply	Learning and stimulating the mind	Links to a context	Everything	School work	Problem solving
18	17	12	8	3	2	1

When asked what they thought mathematics was about the children's responses varied with two categories dominating. Eighteen children indicated that mathematics was about number and operations while 17 did not offer a view about the nature of mathematics at all. This is of interest given that the pre-2008 national curriculum documents for English and Māori medium promoted the notion that children should learn a spectrum of mathematics ideas within a range of meaningful contexts, yet this intent has not been reflected in their responses. Only eleven of the 61 children suggested that mathematics might be connected to a situation outside the school arena.

For those children who do not have a view of the nature of mathematics, Presmeg (2002) suggests that they may find it difficult to recognize and appreciate the links between the mathematics ideas learned at school and those embedded in everyday practices in their communities. This absence of connection can compromise their ability to capitalise on the potential of the mathematics learning experiences available to them. Mathematics educators need to consider how learning for children in kura can be more closely integrated with those issues, activities, values and principles espoused and promoted within their communities. This may help these children to develop and articulate a view of mathematics and to make further connections with the mathematical ideas embedded in their lives and culture as Māori. There is an onus on education in New Zealand to support Māori children to achieve well mathematically while reaffirming the value of mathematics in their cultural milieu.

People at home whom children think help them learn mathematics

When children were asked about support at home for learning mathematics, 58 out of the 61 children responded in the affirmative. This support included mothers, fathers, grandparents, siblings, as well as uncles and aunties.

Table 2. Children's views about how people at home help them to learn mathematics.

Offer strategies	Not sure how	Ask questions	In various ways	Teach me mathematics ideas	No help
18	11	10	10	9	3

It is pleasing to note that 80% of the children reported that support for learning mathematics was available to them at home. This involved receiving advice about strategies to use, being asked questions, clarification of particular mathematics ideas and practise with number operations. However, 11 out of 58 children (almost 20%), were not sure how their families at home supported them with their mathematics

learning. The involvement of whānau, hapū and iwi in Māori education is crucial for learners' success (Penetito, 2010). If children do not have a clear view of the role their families can play in helping them to learn mathematics, their expectations of any support from family members may be overlooked. Clarifying roles and expectations between members of families as well as between kura and families could assist children to learn mathematics. Families clearly have a powerful influence on children's learning (Anthony & Walshaw, 2007; Ministry of Education, 2008c). Graham (2003) suggests that *kanohi ki te kanohi* (face to face) interactions are critical for establishing reciprocal relationships between Māori and kura to engender change to current practices. It is incumbent on mathematics educators to be more creative in facilitating situations where this can occur.

Using equipment for learning mathematics

The children's responses to use of equipment are shown in Table 3. It is reassuring to note that 60 out of 61 children thought that using equipment could help people to learn mathematics. However, more than half said that they did not use it themselves (see Table 4). The major reason that children gave for not using equipment for mathematics learning was a perception that they did not need or want it. Some thought that the use of equipment would encourage an unnecessary reliance on this practice when older, while others considered it a necessity to visualise or become an abstract thinker as soon as possible in order to advance their mathematical thinking. Other children viewed the use of equipment as time-consuming and therefore an unproductive part of their mathematical learning sessions.

Table 3. Children's responses to using equipment.

Use equipment	Use equipment sometimes	Don't know	Don't use equipment
16	9	1	35

Table 4. Reasons for not using equipment.

Didn't need any	Didn't want any	Were not offered any
19	12	4

Mathematics education in New Zealand has for some time strongly encouraged the practice of using equipment in learning sessions particularly when new ideas are being introduced (Higgins, 2005; Ministry of Education, 2008c). It seems that the purpose and potential of using equipment could be made more explicit to some children so that they can avail themselves of opportunities for scaffolding their learning. Limited use of equipment can have consequences for learners and impact on their mathematical reasoning and subsequent understanding (Anthony & Walshaw, 2007; Higgins, 2005; Young-Loveridge, 2008). Future directions could include using equipment to focus on the exploration of ideas so that children recognise its value as media for understanding and learning mathematics.

Table 5. Use of computers for mathematics learning.

Yes	No
13	48

The adoption of innovative equipment for survival is not a new idea for Māori (Ohia, 2002). However, children's responses regarding equipment indicated that there was very little use of ICT (including calculators) to support their learning in mathematics. There did not appear to be any planned, systematic use of ICT in classroom sessions. The digital tools that Māori (like others) are able to access outside the school environment seem to be absent from their cache of mathematics learning tools at school. Recent government initiatives (which include digital learning objects in te reo Māori) potentially offer Māori medium children a further avenue for exploring mathematics. Possibilities for future learning need to emphasise a greater use of ICT to facilitate the learning of mathematics ideas (Calder, 2009; Ministry of Education, 2008b). KKM may need further support to develop ways to embrace digital technologies for enhancing mathematics programmes.

Children's strategies for solving a multiplication question

Data shows that 29 out of the 44 Year 7-8 children were able to solve the multiplication question correctly using a range of strategies. These strategies included:

- (SPVP) is the Standard place value partitioning strategy e.g., $4 \times 17 = (4 \times 10) + (4 \times 7) = 40 + 28 = 68$
- (DF) is the Derived fact strategy e.g., $4 \times 17 = (4 \times 10) + (4 \times 5) + (4 \times 2) = 40 + 20 + 8 = 68$.
- (TD) is the Times doubling strategy e.g., $4 \times 17 = (2 \times 17) + (2 \times 17) = 34 + 34 = 68$
- (TT) is the Times twice strategy e.g., $4 \times 17 = (2 \times 17) \times 2 = 34 \times 2 = 68$
- (DD) is the Double double strategy e.g., $4 \times 17 = (17 + 17) + (17 + 17) = 34 + 34 = 68$
- (C4) is the Counting up in fours strategy e.g., (4, 8, 12, 16, ..., 68)
- (ALG) is a traditionally-taught written procedure.

Table 6. Strategies used for the multiplication task.

Kura	Number of year 7-8 children	SPVP	DF	TT	DD	TD	C4	ALG	No attempt made or strategy offered
1	6	0	0	0	0	1	0	1 (1W)	4
2	5	1	1	1	1	1	0	0	0
3	12	6	0	0	0	1	0	2	3
4	21	4 (1W)	4 (1W)	0	0	1	5 (1W)	6 (3W)	1
Total	44	11	5	1	1	4	5	9	8

(nW) indicates the number of incorrect solutions

Developing efficient mental strategies for solving problems has become a focus in mathematics education in New Zealand and other parts of the world in recent years. It is pleasing that some of these children demonstrated a range of strategies for solving a multiplication question. It remains a concern however that almost half were not able to begin the problem or they used what might be considered an inefficient mental strategy

(counting on in 4's or an algorithm). Multiplicative thinking is crucial for proficiency in problem solving (Young-Loveridge, 2008). Avenues must be carefully considered to ensure Māori children develop the strategies needed to support appropriate mathematical thinking. Māori have a right to be in a position of solving problems efficiently so they can fully participate in the challenges that arise in today's world.

Conclusion

Research with children educated in Māori medium settings is limited. While this study involves only 61 children, they are from four different kura. If we are serious about maximizing opportunities for children in Māori medium to learn mathematics, their views must be considered. This data indicates that many children have well established views about the nature of mathematics, the support they have at home, the value of equipment and ICT and the strategies they might use for solving multiplication problems. The insights gained from considering these children's responses suggest to us that a more focused strategy is required in Māori medium education to seek out multiple ways of:

- helping children develop a broader view about the nature of mathematics;
- ensuring that utilizing equipment including ICT, is an integral part of mathematics programmes;
- exploring and maximizing whānau involvement in children's mathematics learning;
- supporting more children to become efficient multiplicative thinkers;
- connecting children's learning experiences with the mathematics in their community; and
- enhancing education so that children in Māori medium can succeed mathematically as Māori.

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