

Using Waiata in Mathematics Teaching: Te Whakamahia o te Waiata i roto i te Pākarau

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Singing, and specifically, the singing of waiata (a song or chant related to the Māori world), is a useful and important mathematics classroom practice in any culture. Focussing on teachers in Aotearoa me Te Waipounamu New Zealand, we suggest waiata is one step teachers can take towards honouring their obligations under Te Tiriti partnership. We discuss how the singing of waiata during mathematics can support Māori students to achieve success as Māori. We outline how the use of waiata can retain focus on the mathematics while supporting the building of the classroom community, and we describe ways waiata is good for students' learning processes and how it can support the teaching of mathematical content. Lastly, we explore how the use of waiata can support the teaching of mathematics when using contexts related to the Māori world.

The catalyst for this paper came when the authors, Curtis (Kāi Tahu, Kāti Māmoe, Waitaha me Ngāti Kahungunu) and Ingram (Kōtarani, Ikarihi), discovered a shared love of waiata. Soon after, Curtis, an early childhood educator, challenged Ingram, a secondary mathematics educator, to deliver a series of workshops on the use of waiata to secondary preservice teachers. This mahi (work) resulted in shared discussion and discovery both between Curtis and Ingram and within the preservice students' curriculum classes. This paper captures that discussion and discovery and promotes the use of waiata at all levels of early childhood and school mathematics teaching and learning.

Waiata is a Māori word, directly defined as a song or chant, but this simple definition does not represent the importance of waiata in te ao Māori (the Māori world) in Aotearoa me Te Waipounamu New Zealand. *Waiata*, includes lullabies, laments, songs of love, chants, action songs and poi (Trinick & Dale, 2015). They are oral expressions embedded in every aspect of Māori society and vehicles for the intergenerational transfer of linguistic and cultural knowledge (Paringatai, 2019). Waiata are an important part of tikaka Māori (Māori practices and protocols), such as supporting a whaikōrero (speech). They are also a way to express “the complete gamut of human emotion: joy, sorrow, pain, regret, love, understanding, hate, anger” (Paringatai, 2019, p. 206).

In this paper, we focus on the use of waiata in mathematics teaching as a positive step teachers can take towards embracing a te ao Māori perspective in terms of both te reo Māori (the language) and tikaka Māori. As this whakataukī (proverb) suggests, even small steps can make a big impact.

He iti te mokoroa, nāna i kati te kahikatea

The mokoroa (grub) may be small, but it cuts through the Kahikatea (native pine)

We discuss the use of waiata in mathematics teaching generally, and then focus on what teachers in early childhood settings, primary and secondary schools can do to engage their students in te ao Māori using waiata, while also focussing on mathematics.

Te Ao Māori

Defining te ao Māori is not an easy task as it has been said that “only those with the soul of a poet can enter into the existential dimension of Māori life” (Marsden, 2003, p. 23). Te iwi Māori (the Māori people) are the indigenous people of Aotearoa me Te Waipounamu New Zealand and share whakapapa (genealogy) with whānau (families) from across the Pacific and therefore are a part of what is known as Te Moana Nui a Kiwa (the Pacific Ocean).

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Te ao Māori simply translated means the Māori world, but to get true depth of understanding you need to understand the important concepts of te reo Māori, tikaka Māori and the inextricable whakapapa links between Māori and all things, living and non-living. For centuries prior to the arrival of Europeans in the late 1700s to early 1800s, Māori had created a way of life that focussed on sustainability of environment through their understanding of the maramataka (the Māori lunar calendar used to understand the best times for planting, fishing, and harvesting), te reo Māori, tikaka Māori, whakapapa and innovation.

It was the innovation, new technologies and a window into a new world that Europeans brought with them that provided the basis of the relationship that formed between the two groups. In February 1840, two different versions of a treaty, *Te Tiriti o Waitangi* was written and signed in Waitangi, and then signed across the North Island as well as three locations in the South Island. The original version was written in te reo Māori and the second was written in English with most Māori chiefs signing the te reo version and the Crown representatives signing the English. *Te Tiriti o Waitangi* was made up of four articles (three written and one verbal) which, due to the translations, have different meanings in the different languages. These mistranslations have been the root of many historical and present-day claims from iwi Māori to the Treaty of Waitangi Tribunal in Aotearoa me Te Waipounamu New Zealand.

Te Tiriti has implications for the education system in the country, a system which emphasises principles of knowledge deeply rooted in Western values and traditions (Krakouer, 2015). There is continual underachievement of Māori students compared with non-Māori (Rajagopal, 2021), including in mathematics (National Monitoring Study of Student Achievement, 2018). As with other indigenous students, this is not because of any lack of intelligence or skill in problem-solving (Battiste, 2002). Rather it is because Māori students' identities are often not valued and honoured within classrooms. To honour *Te Tiriti*, equitable outcomes for Māori in traditional school subjects, including mathematics, need to be sought so Māori can fully engage with the wider world. These outcomes should not, however, be at the expense of students identifying as strong members of their own culture (Meaney et al., 2013). Rather than adapting to an education system in which they do not feel they have a place, Māori students need to achieve success as Māori, whatever that looks like for them and their whanau (family).

The expectation to include te ao Māori into teaching programmes is evident in the current curriculum documents and in the standards expected of teachers in English medium education settings in Aotearoa me Te Waipounamu New Zealand. *Te Whāriki* (Ministry of Education, 2017), the early childhood curriculum, draws on traditional Māori concepts and describes how, in Māori tradition, children are seen as important living reflections of their ancestors and therefore enter this world as competent, capable, and complete. The vision of the New Zealand curriculum for Years 1-13 (Ministry of Education, 2007) includes a vision for young people who will recognise the bicultural foundations of Aotearoa me Te Waipounamu New Zealand. Young people need to have the opportunity to acquire and thus nurture te reo Māori so that it “not only survives, but thrives” (Ministry of Education 2017, p. 3). Furthermore, to maintain status as registered teachers, all teachers in the country need to demonstrate a commitment to *Te Tiriti* partnership, which includes acknowledging the histories and cultures of treaty partners and practices, including developing their own use of te reo and tikaka Māori (Education Council, 2017).

The implications of these imperatives are that teachers need to be committed to understanding a Māori world view to be able to weave te reo Māori and tikaka Māori into their everyday curriculum meaningfully. To support teachers with this, there have been a range of initiatives that seek to align the education system more closely with the world of Māori. These initiatives include an expectation that achievement statistics are carefully monitored for priority learners, including Māori students (Ministry of Education, 2007) and the availability of

professional learning for teachers. For example, Tāitaiako (Ministry of Education, 2011) is a resource that supports teachers to understand and value what is important when taking a Māori world view in relation to teaching Māori learners. More recently, Te Ahu o te reo Māori is an initiative that aims for an education workforce that has the capability of implementing te reo Māori into the learning of all students (Ministry of Education, 2022).

Integrating Te Ao Māori into Mathematics Teaching

Mathematics is an important subject for students to learn and achieve success in so they can fully engage in our technologically rich, global society (Leder et al., 2002). A significant problem in mathematics education is that, despite the importance placed on it, many students do not have quality engagement in the subject, or do not participate in it when it becomes non-compulsory later in their schooling. This is often because of their perceptions of mathematics as difficult, and their negative affective relationships with the subject (Ingram, 2017). For Māori students, as well as potentially experiencing these barriers to success, they can also be impacted when their cultural capital is not considered to be a resource (Averill et al., 2009). *Cultural capital* is culturally located expertise, knowledge, interests, and experience (Barnhardt & Kwagley, 2005). When students' cultural capital is acknowledged, the learning environment within the classroom is enriched by the knowledge, behaviours and skills that have accumulated over the students' lifetimes (Paringatai, 2019)

Te ao Māori has the potential to provide solutions to addressing Māori students' academic needs, while delivering enriching mathematics education for all students (Meaney et al., 2013). Mathematical success includes achieving in mathematics, developing confidence in its use, as well as growing students in terms of their social consciousness and cultural competence (Averill et al., 2009). By integrating mathematics programmes into te ao Māori, students have the opportunity to experience a holistic and relational learning environment (Barnhardt & Kawagley, 2005).

The connections between te ao Māori and mathematics education are exemplified in the useful resource documents Tāitaiako (Education Council, 2011), and Effective Pedagogy of Mathematics (Anthony & Walshaw, 2007). Both emphasised the importance of teachers establishing an ethic of care within their classrooms, where both mathematics and culture that students bring to the classroom are acknowledged and respected. Problem solving, community and discussion are also at the heart of both documents.

There are a range of pedagogies potentially useful in mathematics teaching which enact te ao Māori while maintaining focus on the mathematics. These include using parents and students as resources in students' learning (Bishop & Glynn, 2000), using local contexts, connection to the taiao (the natural environment that connects and surrounds us), rote learning and repetition (Paringatai, 2019), and using storytelling, metaphor, and waiata (Averill et al., 2009). We focus in this paper on the use of waiata in mathematics teaching as one way of building the cultural community of the classroom and thus supporting Māori students' achievement.

Using Waiata in Mathematics Teaching

The potential use of waiata as a tool to teach mathematics is not a new idea. Music and mathematics have well-established connections (Perger et al., 2018), and music is seen as an appealing lens within which to teach the subject (Trinick & Dale, 2015) and a positive way of meeting the requirements of Te Tiriti (Joseph & Trinick, 2018, p. 2518). Averill et al., (2009) included waiata as one in a repertoire of strategies they used in their preservice primary mathematics courses to model ways that cultural perspectives can be woven into teaching. The

students identified both waiata and music as a cultural activity they could use in their teaching of measurement and number.

The use of waiata is prevalent in early childhood settings and in the early years of primary schooling (Trinick & Dale, 2018). However, as students grow into the later primary and secondary years of schooling, the mathematics becomes more formalised (Perger et al., 2018) and more content-rich and assessment-oriented. Students are usually taught mathematics separately and sometimes only participate in or observe waiata during formal school events such as the greeting of a new member of staff. Pascale (2013), in extolling the benefits of integrating singing within curriculum, suggested it must not be saved for unusual or special events and should not be avoided by teachers who do not consider themselves music specialists. Rather, it should be a common phenomenon and a usual practice for classroom teachers because of its benefits. Indeed, Trinick and Dale (2015) emphasised that teaching using waiata is more beneficial than many classroom teachers realise.

Informed by the literature and our knowledge of Te Tiriti and mathematics pedagogy, we argue that using waiata as a pedagogical tool for teaching mathematics has five benefits. Using waiata potentially enables teachers of mathematics to enact Te Tiriti partnership, waiata can support the building of the classroom community, it is potentially good for students' learning processes, it can support the teaching of content, and singing waiata can support the teaching of mathematics within Māori contexts.

Using waiata in Mathematics Teaching Enacts Te Tiriti Partnership

By meaningfully including waiata in their repertoire of teaching pedagogies, teachers can enact the partnership expectations of Te Tiriti, especially related to te reo Māori and tikaka Māori, if done correctly. Exploring the meaning of the te reo Māori within the waiata is important so the students can understand what they are singing. To introduce te reo Māori within a waiata, Trinick & Dale (2015) suggest asking students to circle any words they know or have heard before and use the knowledge of the class to build community knowledge of the words. Being able to discuss the meaning embedded in the lyrics is important (McDowell, 2017), and through practising waiata, students have an opportunity to improve their te reo Māori pronunciation as well as deepening their understanding of the words.

Choosing an appropriate waiata for the occasion and being explicit about its origins and associated tikaka is important. For example, students should stand when waiata is done within the classroom and ensure that they sing the waiata with pride as a sign of respect for the meaning and the whakapapa (reason), as well as for its composers. One opportunity for performing waiata together and observing tikaka is at the beginning of the mathematics lesson, perhaps after a karakia. *Karakia* are ritual chants invoking spiritual guidance and protection and are used to ensure a warm welcome to the class and a favourable outcome to the lesson. An appropriate waiata at this stage can complement the karakia.

Asking mana whenua (indigenous people who hold authority over their tribal land)) for locally sung waiata and tikaka is helpful. For example, the Kāi Tahu website, *Kotahi Māno Kāika* (www.kmk.maori.nz) is an excellent resource. Using local waiata is an important tool in learning about the local rohe (area) because many waiata are written to recount local legends, remember ancestors or connect with the mana whenua, flora, fauna or geography of a region. The language of waiata is therefore often strongly linked to taiao and mahika kai (food gathering practices).

Waiata Builds Community

Waiata is useful in building a community of learners. When everyone is actively participating, singing waiata together can create a bond known in te ao Māori as whanaukataka

(a shared relationship or experience that brings people together). By singing waiata, the class are building a living, feeling community and this establishes the framework of a class identity and purpose. A good example of this is the use of the song *Tūtira mai ngā iwi* (written by Canon Wiremu Te Tau Huata) as a song that brought the country together to support the All Blacks (New Zealand Rugby team) during the Lion's Rugby Tour in 2017. Singing builds creativity and compassion, enhances learning, and connects to the emotional frame of mind of the students (Pascale, 2013).

By singing waiata that has meaning for both the group and individuals, particularly for Māori students, their identities as valued members of that classroom and mathematics learners can be enhanced. Māori students have a sense of belonging and waiata supports the link they have with the past. They do not feel 'othered' as their culture is being normalised through waiata. Furthermore, by waiata reinforcing a sense of community and whanaukataka, students do not feel alone if they are struggling with mathematics and may be more inclined and confident to discuss the mathematics as peers or ask for support.

Waiata is Good for Learning Processes

Singing is an important human activity that develops students mentally, physically, and emotionally. It has the potential to influence various parts of the brain, including connections between the left and right sides (Neumann, 2018). Trinick and Dale (2015) emphasise that the learning processes involved in waiata are complex and develop students' skills in coordination, listening and creativity.

Particularly useful for the secondary classroom, waiata is an example of a tool that can be used as a brain break (Came et al., 2020). A *brain break* is a break from the current learning task that students are working on and is often needed for students with ADHD and anxiety (Smith-Nelson, 2016; Wen et al., 2021). Furthermore, students experience a range of affective responses to mathematics, including anxiety (Ingram, 2017) and students need emotional and mental release to remind them they are not alone in the classroom community.

Having a brain break can also help the problem-solving process. In mathematical problem solving, where students are encouraged to embrace confusion (Ingram, 2017), taking a brain break is useful so they can think more clearly after taking a few minutes away from the problem. Smith-Nelson (2016) suggests having a planned class-wide brain break in the middle of the most mathematically intense portion of the period. Waiata is ideal for taking a brain break, particularly waiata that is active, includes actions and is uplifting. Averill's (2017) use of singing the positions of the compass is a good waiata for this purpose. Singing the compass directions in te reo Māori as a gloriously chaotic round, while the students point in the compass direction they are singing, is a waiata that can be used with students of all ages.

*Tokerau, tokerau
Toka, toka,
Rāwhiti rāwhiti
Hauāru*

Waiata Supports the Teaching of Mathematical Content

Particularly useful at an early childhood or primary level, waiata can be used to teach concepts such as numbers or shapes (Trinick & Dale, 2015). Through the waiata that are sung within the classrooms, teachers and students can identify and connect the content of the waiata to mathematical knowledge or concepts. It is common to use waiata (using melody, chanting stamping, and clapping) to reinforce the learning of mathematical knowledge and recognise, reproduce, and create number patterns (Perger et al., 2018). Rote learning is a familiar concept

in te ao Māori because traditionally Māori was only an oral language and the constant reciting of whakapapa, waiata and pūrākau (cultural narratives) ensured the passing down of important messages and learning to the next generation. Using waiata to support counting song rhymes can help to memorise counting patterns (Perger et al., 2018). Infants and toddlers, for example, can explore their working theories about time and pattern using rhymes, song and by listening to the intonation of voice. Māori Television have produced resources to support students' learning (e.g., Numbers in te reo Māori–Waiata Mai). The popular colour song *Mā is white*, continuing with numbers is also a good waiata for this purpose.

There are a number of waiata that are useful to teach fractions. Most waiata used in Kapa Haka (action songs) have 3/4 timing. *Tahi*, a waiata by Moana and the Moa Hunters is a good example of 4/4 timing. The use of tī rākau (a traditional game of sticks) is a good source of number patterning, and this game is often accompanied by the waiata *E pāpā waiari* which has 6/8 timing. Resources available on *nzmaths* (<https://nzmaths.co.nz/resource/matariki-level-1>) describe how to be explicit about the mathematics within the waiata, which is also useful to use with early number and algebraic patterning. An example of a good waiata that directly teaches young students about position and orientation through song and action is *E rere taku poi*.

Table 1

E rere taku poi, adapted from Royal-Tangaere (1997, pp. 40–41) and Reproduced in Anthony & Walshaw (2007, p. 26).

Original dialogue	Translation	Nonverbal Actions
Toru whā	Three four	Hands on hips
E rere taku poi	Fly my poi	Swings poi in front of her and
E rere taku poi ki runga	Fly my poi above (me)	above her
Ki runga	Above (me)	
E rere taku poi	Fly my poi	Brings poi back in front of her
E rere taku poi	Fly my poi	
Ki raro	Below (me)	Swings poi down below
Ki raro	Below (me)	
E rere runga	Fly above (me)	Swings poi up
E rere raro	Fly below (me)	Swings poi down
E rere roto	Fly inside	
E rere waho	Fly outside	
E rere taku poi	Fly my poi	Swings poi in front of her and
E rere taku poi	Fly my poi	then
Ki runga	Above (me)	above her
Ki runga	Above (me)	

Waiata is Good for Connecting with Māori Contexts

A context-based approach is useful in the mathematics classroom to enhance students' engagement and learning. Contexts locate the learning of mathematics within the social practices of the classroom, which are the norms and relationships that are important to a community (Cobb et al., 2001).

Choosing authentic contexts that relate to Māori are important in infusing the mathematics curriculum with te ao Māori. From early childhood to senior secondary, there are many te ao

Māori contexts that can be used in learning mathematics. Calculating the capacity needed for digging a hole to bury the hangi baskets of particular dimensions can be linked to volume and capacity within Measurement. The long history of Māori navigation and migration and the building of waka (canoes) is filled with potential for mathematics and statistics. Tracking the traditional pounamu (greenstone) trails and recounting the pūrākau of Poutini the Taniwhā (powerful water creature), guardian of pounamu, is useful in a position and orientation unit. There are many mathematical concepts involved in the legend of Matau whose body formed the breathing Lake Whakatipu wai Māori (Lake Wakatipu), which rises and falls 10 cm every 27 minutes due to a seiche. There is also the more prevalent use of weaving harakeke (flax) and tukutuku (woven panels) to connect with linear and quadratic patterns, as well as the transformational geometry found in kōwhaiwhai and whakairo (carving) patterns.

Each of these contexts have great potential for mathematical learning and they also contain mātauraka Māori (Māori wisdom and knowledge). To honour each of these knowledge systems, each context needs to be presented to the students using a te ao Māori approach, with the storytelling, history, te reo Māori and tikaka intertwined. We suggest the meaningful incorporation of waiata is a good way to add to these contexts to honour te ao Māori. Waiata, when used to enrich a context may not include mathematics directly but adds another layer of richness to that context and supports the students' engagement. Talking to mana whenua and researching these contexts with an ear for associated waiata will add value to these contexts. For example, just as Came et al. (2020) suggested, the use of the Split Enz song, *Six Months in a Leaky Boat* to add richness to a unit on European migration, the same could be done using waiata about waka, such as *Utaina mai* to add richness when teaching a statistics or position and orientation unit in the context of the history and navigation about Māori migration.

Whakawhāiti - Conclusion

By understanding and using waiata in meaningful ways when teaching and learning mathematics, this has the potential to provide a connection and a sense of whanaukataka for Māori students amongst their peers. For Māori to succeed as Māori they need to see themselves and their culture genuinely reflected in the spaces and curriculum that is being provided to them by their teacher and for their knowledge to be seen as valuable. Education needs to strengthen, rather than weaken students' connection to their culture (Meaney et al., 2013). Teaching mathematics using a te aō Māori perspective not only meets the obligations of teachers within Aotearoa me Te Waipounamu New Zealand and enhances the education experience for Māori students, but it also enhances the quality of all students' learning (Averill et al., 2009).

Ka waiata tatou! Let us sing.

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