The Relationship Between Language, Culture and Ethnomathematics

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Abstract

In an earlier paper, we pointed to a number of unresolved issues pertaining to the introduction of ethnomathematics into classrooms and how Indigenous cultural practices and language might be adversely affected, particularly when attempts are being made to revitalize these. In this paper, we continue this discussion by describing theoretical and practical issues related to the connection between the language of instruction, culture and ethnomathematics. We illustrate these issues and propose a three step approach, cultural symmetry, for working with these issues by drawing on the ethnomathematical concept of location and direction pertaining to Māori, the Indigenous community of Aotearoa/New Zealand.

Keywords: Ethnomathematics; Cultural Symmetry, Māori Language Revitalisation; Colonisation

Introduction

In our earlier article in the Journal of Mathematics and Culture in 2008 (Meaney, Fairhall, Trinick, 2008), we raised concerns about the use of ethnomathematical activities as a means to improve mathematical understanding, without consideration of the value, in their own right, of the culture and language that the ethnomathematical activities were embedded in. In classrooms in Western societies, mathematics is often decontextualized and teaching about it in international languages, such as English and French, is rarely problematized. However, the consequence of this is that activities are often taught without regard for the original culture and languages in which the activities arose.

In many Western classrooms, this imperialistic approach to mathematics teaching and learning (Bishop, 1990) may not be considered problematic, but for marginalised Indigenous groups who are endeavouring to simultaneously save their Indigenous language and culture,
these aspects need to be elevated. This is because as Fishman (1991) and others have argued, culture is in the language and that “take language away from the culture, and the culture loses its literature, its songs, its wisdom, ways of expressing kinships relations and so on” (Fishman, 1991, p. 72). Therefore, the potential loss of a language for discussing a cultural practice in educational situations has implications for the cultural knowledge connected to it. Therefore, we contend that revitalisation and maintenance of the language, including the teaching of mathematics, is insufficient unless cultural knowledge is also revitalised and maintained (Trinick, 2015).

In our earlier paper, we raised concerns related to the impact on the Indigenous language and culture of Aotearoa/New Zealand when te reo Māori was used as the medium instruction for the teaching of Western mathematics and/or ethnomathematics—in particular how this might affect the valuing or changing of those cultural activities. We acknowledge that all languages and cultures change over time. However, the issue is how to ensure that these changes do not result in undesirable consequences for the language and culture and, thus, the community of speakers. Our aim in this paper is to suggest an alternative, less detrimental, approach for using ethnomathematical approaches that supports both revitalisation and maintenance of an Indigenous culture and language, whilst also supporting students to gain Western mathematical understanding. To do this, we describe some of our recent theoretical and practical work around these issues, drawing on examples from the teaching and learning of location and direction.

Ethnomathematics is often cited as a potential solution to a range of different problems in mathematics education (Meaney & Lange, 2013). For example, “one of the goals of ethnomathematics is to contribute both to the understanding of culture and the understanding of mathematics, and mainly to lead to an appreciation of the connections between the two” (D’Ambrosio, 1999, p. 146). On the other hand, it has also been criticised for reinforcing
colonial and hegemonic constraints about what counts as the valuable mathematics needed to gain entry to further study or high paying jobs (see for example, Vithal & Skovsmose, 1997; Jablonka & Gellert, 2010; Pais, 2011). If ethnomathematics is to be used constructively in educational situations so that it supports the decolonising of cultural knowledge, then there is a need, amongst other things, to recognise that cultural considerations are as important as mathematical ones. From a teaching and learning perspective, this means that when students engage in ethnomathematics, they should be aware that they are learning and responding to different forms of mathematics, as well as to cultural aspects of the activity. This should result in meta-discussions about what constitutes valuable mathematical knowledge and who gets to decide this, as these can lead to understandings about how mathematics education could be a contributor to colonisation or decolonisation.

**Colonial Linguistic and Cultural Hegemony**

At the time the first missionaries and settlers arrived in the 18th century, Māori had a robust system for educating their children to ensure the survival of their communities in Aotearoa (Riini & Riini, 1993). These included mathematical aspects connected to “the design (of canoes, buildings and tools); astronomical, meteorological and oceanographic information and analysis; geometries of pattern in weaving (rāranga), painting (kowhaiwhai) and carving (whakairo); and the logic of argument in oratory” (Barton & Fairhall, 1995, p. 1). After 1840 and the establishment of a British colony, European forms of government and schooling were instigated. The hegemonic function of the early schools was to provide a formalised context to assimilate Māori communities into European beliefs, attitudes and practices with the intent to “civilise” the Māori population (Simon, 1998). This goal of assimilation was maintained by successive governments and their agencies over the next 150 years, resulting in a range of educational policies, both overt (English-language-only schooling policy) and covert.
(English-language-only workplaces), to privilege English as the sole language of education (Trinick, 2015) and Western mathematics as the only mathematics worth teaching. With the privileging of English and Western knowledge domains, such as mathematics, in both society and schooling, many Māori, came to believe that their language and knowledge was of limited use in this new environment. Apple considered (1979) that “to a large extent society as it exists ... is held together by implicit common sense rules and paradigms of thought by hegemony as well as overt power” (p. 96). The imposition of this hegemonic model; that is, where one language (English) and one form of ethnomathematics, Western mathematics, limited the use of other languages (Māori) and other forms of ethnomathematics, can be traced to ideologies and beliefs that informed the Eurocentric education of the time. English language hegemony was utilised as a means to build a nation state, and to take political power and control from Māori (May, 2012). Similarly, for Māori, “western mathematics has been one of the most powerful weapons in the imposition of western culture” (Bishop, 1990, p. 51). As in other situations of colonisation, the educational policies reflected strong assimilationist attitudes that linked proficiency in English to supposed best outcomes for Māori (de Bres, 2008). While te reo Māori was excluded from schooling, it was still nurtured throughout the 19th and 20th centuries in largely Māori rural communities (May & Hill, 2005). However, throughout the period following World War II and into the 1960s, the urban migration of Māori considerably changed the demographics of Aotearoa/New Zealand. This shift to urban areas where te reo Māori was not strong, combined with other forces, impacted negatively on Māori language development and resulted in the younger generation of Māori rapidly losing their language and culture (King, 2007). By the 1970s, te reo Māori was an endangered language (Spolsky, 2005).
We can only speculate, but if schooling in Aotearoa/New Zealand had been allowed to continue to develop in the Indigenous language, from the colonial era into modern times, then an adapted form of Western mathematics would likely be present. This is because Māori understood that the knowledge associated with technology and trade could enhance their traditional ways of life (Spolsky, 2005). Māori, like all other cultural communities, do not stagnate in the development of cultural practices but adapt to fit changing circumstances. Although it is highly probable that any change would have caused angst in the community, survival including the need to adapt to changing economic times was paramount. In reality, Māori were denied the opportunity for over 150 years to incrementally develop subjects such as mathematics in their Indigenous language and based on their cultural perspectives.

**Māori-Medium Schooling and Revitalisation Efforts**

It was against the background of rapid and significant language loss that the Māori community initiated Māori-medium education, in particular many schools, such as *kura kaupapa Māori*, were founded. Te Koutu is one such school (Meaney, Trinick, Fairhall, 2012). However, to revitalise and reinvigorate an endangered language and culture primarily via schooling, as is the case in Aotearoa/New Zealand, is fraught with many tensions and issues. Initially, *kura kaupapa Māori* were developed outside the state system, not only to revitalise *te reo Māori*, but also as a resistance movement to the assimilationist nature of New Zealand European schooling (Penetito, 2010).

By the 1990s, *kura kaupapa Māori* had become government funded, which on one hand provided their schools with financial security, but on the other hand required *kura* to implement state-mandated curricula and assessment practices developed from Eurocentric perspectives (McMurchy-Pilkington & Trinick, 2008). On this basis, the Ministry of Education insisted that the structure of the inaugural Māori-medium mathematics curriculum “mirror” the hegemonic English-medium version (McMurchy-Pilkington & Trinick, 2008).
The requirement to essentially translate the English-medium version into Māori was met with some consternation and resentment (Trinick, 2015). Nevertheless, as McMurchy-Pilkington (2004) noted, Māori curriculum developers took advantage of opportunities to co-opt its development in order to elaborate the Māori language in a systemised way—thus enabling the teaching of mathematics in the medium of Māori to senior secondary school levels. This indirectly raised the status of the language within the Māori community as well as among educators. The development of a Māori-medium curriculum also encouraged the linking of mathematics to contemporary Māori contexts—albeit somewhat tempered by the requirements of the national curriculum and standardised national high stakes assessments.

Nevertheless at that time, few attempts were made to systematically incorporate traditional Māori mathematical practices into Māori-immersion mathematics classrooms. This was partly due to uncertainty about how it could be done without devaluing the cultural practices and in a manner that did not reinforce the hegemonic valuing of Western mathematics. There was some concern that using cultural activities in the teaching of Western mathematics would be akin to inviting the Trojan horse in because it had the potential to “destroy the conceptual basis of Maori culture and language” (Barton & Fairhall, 1995, p. 1). In the 1980s, attempts were made to connect Māori culture to mathematics by identifying symmetrical patterns found in traditional artefacts (Knight, 1984). However, by the 1990s, only focusing on patterns as exemplars of Western mathematics was disparaged as insufficient to count as ethnomathematics (Barton, 1993).

By the late 2000s, the capacity to develop Māori-medium curriculum had expanded significantly because of lessons learnt from earlier developments and thus the “Ministry of Education appeared more accommodating of difference” (McMurchy-Pilkington, Trinick & Meaney, 2013, p. 357). This provided an opportunity for Māori-medium schools to be more proactive in reintroducing traditional Māori mathematical concepts and practices into the
classroom, something which had been recognised as neglected by Māori themselves (Meaney, et al., 2012).

**Cultural Symmetry**

From our investigations of how to use mathematics lessons in the revitalisation of cultural practices, we have developed a three-step approach, which we call cultural symmetry (Trinick, Meaney, Fairhall, 2016). Our work in this area indicates that a set of principles is needed to ensure that the introduction of ethnomathematics-based lessons contributes to discussions with students about the cultural practice, the mathematics as well as how knowledge comes to be valued. In describing this three-step approach, we draw on earlier work we have done in regard to the spatial concepts of location and direction (see for example, Trinick, Meaney, Fairhall, 2015). This is an area of interest for Māori because traditionally they were renowned for their navigational expertise, being able to navigate using traditional techniques across vast distances in the Pacific Ocean (Best, 1922). Additionally, one of the authors had recorded information from elders in the 1990s that they considered important about location and direction for specific areas of Aotearoa/New Zealand (Trinick, 1999)—knowledge that perhaps is no longer readily available as it once was.

In research undertaken a few years ago at Te Koutu, the school where Uenuku is principal, it was clear that many of the students across all ages had difficulties using the environment to orientate themselves (Trinick, Meaney, Fairhall, 2015). We considered that just having theoretical knowledge about how to read a map was perhaps not adequate. We were also aware that the teachers at Te Koutu who had been very much inculcated into Western spatial orientation struggled with teaching Māori spatial orientation conventions and frameworks, which included an orientation to East/West rather than North/South. There was, therefore, a practical need to work on this issue.
Another consideration was that technology such as Global Positioning System (GPS) was changing what was valued as useful skills in work situations. Global Positioning System (GPS) locates specific points based on their latitude and longitude anywhere on Earth. It is now used almost exclusively to guide ships, airplanes, rescue and salvation crews, land surveys and so on, replacing the reliance of traditional compass knowledge. However, in school mathematics the incorporation of GPS into lessons of location and direction has been slow with few experimental studies being undertaken (see for example, Mooney & Laubach, 2002). Although incorporating the use of GPS might seem contradictory to revitalising traditional practices, one of the key aims of Te Koutu is to prepare students to live as Māori in a modern technological world. We considered that including discussions about the role of GPS would provide opportunities for students to evaluate how knowledge comes to be seen as valuable in school mathematics.

**Step 1**

The first step in cultural symmetry is for the cultural knowledge to be identified and then acknowledged as valuable. In regard to the spatial orientation concepts, it was considered important to have the students understand that location and direction are not just about finding one’s way, but about how the features in the tribal landscape influenced cultural practices developed over a long period of time. In 2014, students in Year 8 were asked to create a map of their local tribal area from memory, adding significant cultural sites, place names, places of significance and a measurement scale of some sort. They were then told the story of Tuki and Ngāhuruhuru, two young men who were kidnapped from Northland, New Zealand, in 1793 and taken to Norfolk Island to teach the colony’s prisoners about how to make rope from flax. While there, and amid questions about Aotearoa/New Zealand, Tuki drew a map of his homeland for Governor Philip Gidley King from memory (Binney, 2004). Specifically, the map provides an insight into how Tuki understood the world: the places important to him, his
tribe, his enemies and included political and spiritual information (Binney, 2004). The area that Tuki knew best was disproportionate in size and area to the rest of Aotearoa/New Zealand, and it was also the most detailed (see Figure 1). However, it also shows that he had knowledge of distant places, such as Te Waipounamu (Pounammo on the map) which is about 1 240 km from northland (Tuki’s area).

![Figure 1: Tuki’s Map from: https://commons.wikimedia.org/wiki/File:New_Zealand-Map-by-Tuki-1798.jpg](https://commons.wikimedia.org/wiki/File:New_Zealand-Map-by-Tuki-1798.jpg)

The students then compared their maps with Tuki’s map. Uenuku, in reflecting on the lesson, stated:

Most of the students’ maps of Rotorua reflected Tuki’s perceptions of scale etc. For example, the area where the students were familiar with and lived was out of scale with the rest of their map. Lake Rotorua varied between 5km and 35km. They surprised me in the depth of cultural detail they were able to add to their maps. They then appreciated the idiosyncratic nature of Tuki’s map.

This lesson highlighted cultural aspects of locating and directing by connecting the local area to larger geographical spaces. It also allowed for a discussion about the knowledge which is shown in Tuki’s map and why he might have valued it so highly that he included it in his
map. The comparison with the students’ own maps enabled Tuki’s map to be seen in the context of his experiences and what was considered important, for example who his friendly relatives were, and not judged for accuracy against its closeness to Western cartographical representations of New Zealand. In this way, the students came to see that models and maps of spatial environments are sociocultural tools as is the language that describes spatial orientation (Gauvin, 1991).

**Step 2**

The second step is to introduce the traditional ways for describing location and direction in te reo Māori. Māori used a variety of spatial frameworks abstracted from geomorphic or landmark-based systems to orientate themselves to the general direction of—east, west, north and south—and intermediary directions (Trinick, 1999). These references were derived from a mixture of phenomena, including the actions of the sun and wind, and geographical landforms. Figure 2 includes, amongst other things, some of the traditional wind names used to indicate directions.

![Figure 2: Māori geomorphic system for spatial orientation (Trinick, 1999)](image)

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This stage is important because the linguistic terms are linked to cultural frameworks and to mathematics. While there was minimal acknowledgement of traditional Māori mathematical knowledge in the first Māori-medium curriculum, the standardised directional terms had been based on the traditional orientation from East to West. However, in research (Meaney, et al., 2012), we found that those teaching or learning about location in te reo Māori had not grasped the importance of the east-west orientation. In this case, the link between language and culture had become disconnected and, therefore, could not act as a viaduct for learning. The hegemony of Western mathematics ways of valuing the North/South orientation made it challenging for both teachers and learners to consider other possibilities. In this case, explicit discussion about the east-west orientation was needed if language and cultural practices were to be revived in a meaningful way. This was done by having one of the authors, Tony, discuss with the teachers the background to why the directions were labelled as they were.

**Stage 3**

The third and final stage is to discuss the origins and frameworks that underpin location and direction in Western mathematics as well as traditional Māori practices and discuss advantages and disadvantages of both. A vehicle for contextualising the various ways of knowing was to use the story of a traditional explorer; Īhenga, (an ancestor of two of the authors) who after arriving on one of the first canoes to settle Aotearoa/New Zealand set off with his uncle Kahumatamomoe to explore a large area of the North Island of New Zealand.
Quite clearly Īhenga did not have technology such as the compass, therefore it becomes essential for students to map the route by reading/listening to the traditional story. In so doing, Īhenga’s *te reo Māori* descriptions of locations and directions have to be interpreted and connected to understanding of Western maps. Students can also find the GPS coordinates of major cultural sites/landmarks along the journey, either by going to the areas themselves and/or by using Google Maps. As it may not be practicable for students to visit all of the landmarks in the story because of the long distances, Google maps can be used to find the latitude and longitude of those outside of their visiting range. Students then calculate the direction from waypoint (cultural site) to waypoint. The students’ investigations can then be presented to peers in an oral/visual presentation which would combine the Western cultural tool of the map, with the oral language representation of the journey.
Although we have not yet tried this activity out with students using the distances in the Ihenga story, we consider that it would enable understanding of how Western mathematics, as one form of ethnomathematics, could add value to understanding traditional, cultural practices, rather than detracting value from those practices by purely focusing on Western mathematics knowledge. Comparing the advantages and disadvantages of the different sets of knowledge, traditional Māori, traditional Western and modern technological allows for a meta-discussion with students about why only some of this knowledge is required to be learnt by curricula. These sorts of discussions are vital if students are also to become aware of how hegemony operates to suppress non-Western forms of knowledge as valueless.

From our perspective, keeping in mind these three steps can contribute to cultural symmetry being achieved in mathematics classrooms. It is only over time and working with the teacher and students at Te Koutu that we have become aware that simply incorporating traditional activities into mathematics classrooms was unlikely to contribute to overcoming the impact of colonisation. For students to want to participate in the revitalising and maintaining of traditional practices, then like language learning, they need to see a purpose for it.

Developing activities in order to support the resurrection or revitalization of practices that are not necessarily evident in students’ everyday lives raises the questions about who gains from this. Students may be resistant to participating in traditional practices if the goal of learning these practices are solely about maintaining knowledge and skills within the wider Indigenous community without any interest to the students themselves. Thus, finding ways to indicate the benefit of these knowledge and skills in the 21st century is essential. Otherwise the practices become exotic tokens, which do not need to be considered as valuable knowledge (Zaslavsky, 1973).
Conclusion

The acknowledged link between language and culture means that introducing Indigenous ethnomathematical practices into mathematics classrooms needs to be done with caution. The aim is not to marginalise and lower the value of the Indigenous knowledge by setting them up as “exotic tokens” and to elevate “proper Western mathematics”, that is the mathematics of national assessments. While the goal is not to “freeze” language or cultural practices at a particular juncture, thus jeopardising language and culture revitalisation efforts, the community of users need to be aware of the implications of changes.

It is, therefore, important that if the traditional imperialistic role of Western mathematics is to be overcome, then students need to be involved in critical reflections on the processes by which practices and knowledge come to be valued. This is important for both Indigenous students and non-Indigenous students who may learn in their classrooms, perhaps unconsciously, that mathematics education, although not always considered enjoyable, is politically neutral, which of course is a fallacy. Introducing ethnomathematical practices into classroom practice can support this critical awareness but only if this becomes an aim for these lessons.

References


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