Finding the Way: Cultural Revival through Mathematics Education

Tony Trinick, Tamsin Meaney and Uenuku Fairhall
The University of Auckland, Bergen University College, Te Kura o Te Koutu

The colonisation of many Indigenous communities, particularly in the nineteenth century, has led to a loss of cultural knowledge as the colonisers' knowledge became the valued knowledge in educational institutions. In this project we are exploring some of the challenges attached to revitalising cultural knowledge through mathematics lessons. Although school curricula for Indigenous students often highlights the need for traditional cultural knowledge to be given equivalent status, very few projects have done so successfully. We use examples of spatial orientation to illustrate some of issues that surround our efforts to revitalise cultural knowledge through mathematics education.

The Rights of Indigenous People

Although colonisation of Indigenous communities continues to be prevalent throughout the world, in 2007, the United Nations adopted the Declaration on the Rights of Indigenous Peoples. Article 31 indicates that Indigenous people should be able to protect their culture. New Zealand was one of only four countries which opposed the adoption of this declaration (May, 2011). New Zealand has had a long history of suppressing the linguistic and cultural rights of its indigenous people.

In Aotearoa/New Zealand the Indigenous Māori language and culture were excluded from schooling by a range of national policies until the 1970s whereby the Māori language was recognised as an endangered language (Fishman, 1991).

In response to the parlous state of the language, in the 1980s, various initiatives were launched that focused on revitalising Maori knowledge and language, including Maori-medium schools

(McMurchy-Pilkington, Trinick & Meaney, 2013). A key component of the development of Māori-medium schooling has been the development of Māori-medium mathematics. Although mathematics education has successfully contributed to the revival of *te reo Māori,* the Indigenous language (Meaney, Trinick & Fairhall, 2012), the same cannot be said for resurrecting Māori knowledge. Although there is interest in how this can be done, this is still very much a work in progress. In this project description, we begin the process by identifying some macro and micro issues which can affect the reintroduction of traditional cultural knowledge into the classroom.

Ethnomathematics

In the past 20 years or so, the issue of using cultural knowledge within mathematics classrooms has been frequently considered under the auspices of ethnomathematics. D'Ambrosio (1992) described a research program in ethnomathematics as "the study of the generation, organisation, transmission, dissemination and the use of jargons, codes, styles of reasoning, practices, results and methods" (p. 1183). Todate little research has investigated how these ideas can be incorporated into mathematics classrooms (Meaney, 2002). The exception would be the work done with the Yup'ik in Alaska by Lipka, Yanez, Andrew-Ihrke, and Adam (2009). Lipka et al., (2009) summarized many of the assumptions on which their ethnomathematical pedagogy was based:

> The assumptions include that students will gain increased access to the math curriculum because they can identify with the curriculum and pedagogy on multiple levels, from familiar contexts to familiar knowledge, and that they will have multiple ways of engaging with the material. … Further it is assumed that the inclusion of local knowledge, language and culture may well have a positive effect on students' identity that will be different from the typically reported process of schooling that marginalizes so many AI/AN (American Indian/Alaskan Native) students. (p. 266)

Researchers in other parts of the world acknowledge similar assumptions in regard to the benefits of ethnomathematics (Meaney 2002).

Nevertheless, ethnomathematics has been criticised. For example, the valuing of a practice only if it can be labelled as Western mathematics has been questioned (Jablonka & Gellert, 2010). Barton (2004) stated that although ethnomathematics provides opportunities to reconsider how aspects of Western mathematics are perceived, labelling cultural activities as "mathematics" was problematic. Similarly, Pais (2011) suggested that although learners may engage in a range of activities, these activities must be recognized as mathematics to become mathematics.

Macro Issues with Revival of Cultural Knowledge

For Māori-medium schools, there are a number of factors which hinder the inclusion of traditional cultural knowledge into mathematics lessons. One of these is that government-funded schools are required to implement state mandated curricula based on Western mathematics (Meaney et al., 2012).

Another challenge is that the original practice may no longer be in general use in the community. For example, in discussions with teachers in the Māori-immersion school in which Uenuku, one of the authors, a principal, it was found that many did not understand or know about traditional spatial frameworks. They did not know why the cardinal directions in *te reo Māori* were orientated to East/West rather than to North/South (Meaney et al., 2012). They were constrained by their reliance on Western mathematical concepts, which underpin resources, the curricula etc.

Without local experts who can provide necessary input about the traditional knowledge, teachers have had to turn to historical documents to ascertain what the knowledge might have been. Although documentation is more readily available over the internet (see for example, http://teaurere.org.nz/Navigation.htm), much work is left to individual teachers to build the knowledge base from which mathematics lessons can be planned. This takes time and effort that may beyond an individual teacher's possibility.

In the next section we discuss some of the issues facing Uenuku's school in attempting to incorporate traditional knowledge about spatial orientation.

Spatial Orientation

Different components of "spatial ability" have been identified, each emphasising different aspects. Bishop (1980) suggested that the major abilities of spatial thinking that are commonly addressed are spatial *orientation* and spatial visualisation. Spatial orientation is the ability to understand and operate on relationships between objects in space. Spatial *visualisation* enables a person to carry out mental manipulations of two- and three-dimensional objects (Clements & Sarama, 2009).

At te Kura Kaupapa Māori o te Koutu, we have been investigating students' understanding of spatial orientation and possibilities for introducing activities based on cultural knowledge. This is the beginning of an ongoing project and the results should be considered initial results only.

In 2013, we interviewed children from grades 2-8 (6 year olds to 12 years old). The results indicated that very few children could relate the cardinal points to specific directions (by pointing to where they thought each point was). Only the older children had a sense where places were in relationship to where they stood and none had any knowledge of the wind names as determiners of direction- the traditional way of discussing direction. Consequently, a major challenge is to have students become aware of traditional Māori spatial frameworks and ways to orientate.

In 2014, students in Year 8 were asked to create a map of their local area from memory, adding significant cultural sites, place names, places of significance and a scale. They then compared their maps with that of Tuki and Ngāhuruhuru, two young men who were kidnapped from Northland, New Zealand, in 1793 and taken to Norfolk Island. While there, Tuki drew a map of New Zealand for Governor King (Binney, 2004). Understandably, the area that Tuki knew best and thus represented in the map was disproportionate in size and area to the rest of New Zealand, and the most detailed. Their teacher, 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 surpised

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.

Although only a beginning, using historical documents that indicate the sorts of traditional knowledge known to Māori has potential to support students learning about the relationship between traditional Māori knowledge and traditional Western knowledge. In this situation, one set of knowledge is not preferred over another, rather the different kinds of problems connected to each, and the overlap between them, becomes an area of discussion and reflection for students which should support their learning.

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