

The Role of Language in Ethnomathematics

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Drawing on experiences from Māori immersion schools in New Zealand, this paper examines the impact of language when ethnomathematical practices are discussed. The inclusion of ethnomathematical perspectives into the mathematics education of indigenous students is often described as being beneficial. In New Zealand, it is also perceived as supporting the revitalisation of the Māori language, te reo Māori. This paper will argue that cultural practices including ethnomathematical ones cannot be separated from the language in which they were developed. Changing the language or the linguistic register in which the practices are discussed will have an impact on how the practices are perceived by students. This could result in a loss in the fundamental values that would normally accompany the practices. Without proper consideration of this issue many of the benefits aligned with using these practices may be nullified.

Introduction

Ethnomathematics began as ‘the study of mathematical ideas of non-literate people’ (Ascher & Ascher, 1986) but soon broadened to be the mathematical practices of a particular group of people whether they be carpenters (Masingila, 1994) or cardiovascular surgeons (Shockey, 2002). The mathematics used and developed by Western mathematicians is, therefore, one form of ethnomathematical practices (Borba, 1990). Borba (1990) suggested that ethnomathematics is ‘[m]athematical knowledge expressed in the language code of a given sociocultural group’. Other researchers in this area have also made connections to language. D’Ambrosio who is

considered by many as the ‘father of ethnomathematics’ (Stillman & Balatti, 2000) described a research programme in ethnomathematics as ‘the study of the generation, organisation, transmission, dissemination and the use of jargons, codes, styles of reasoning, practices, results and methods’ (D’Ambrosio, 1992, p. 1183).

Given that ethnomathematics is concerned with the mathematical practices of particular cultural groups, it is not surprising that descriptions of it are linked to language. Geertz (1975) suggested that when an experience is described in language, meaning is added. However, this meaning is constrained by an individual’s linguistic repertoire that developed from previous discussions with others. By describing an experience in words, aspects of it are highlighted whilst others are downplayed, often unintentionally (Meaney, 2005). For example, in te reo Māori, *runga* can mean ‘up’ but in different contexts can also mean ‘above’, ‘top’ and ‘south’ and are linked to ‘life’, ‘standing’ and ‘Sky Father’ (Salmond, 1976). These are marked by different linguistic structures but these other meanings will stay with them. These connotations are considerably different to those of the English word ‘up’ but reflect how the concepts are related in Māori culture.

Specific cultural practices such as ethnomathematical ones are embedded within the language of the culture. Wardhaugh (1998, p. 216) stated that individuals from a particular culture ‘come to use their language in ways that reflect what they value and what they do’. In a discussion of mathematics concepts found within the languages of Ojibway and Inuit hunters, Denny (1986) showed that in Inuktitut the context in which counting occurs will be signalled by the addition of a suffix. For example, ‘if events rather than things are being counted, the verb suffix *-iqtaq-*, “do so many times”, can be added to the number root’ (Denny, 1986, p. 145). Denny believed that this was consistent with people who live a hunting existent prefer ‘to include together

in a single representation a lot of information from the situation being dealt with' (p. 147). In te reo Māori, numerical prefixes are context specific and/or determined by a person's relationship with the objects that are being quantified. For instance, a mountain can be quantified using the same descriptors as those for people only when there is a relationship between the speaker and the mountain. This relationship is more important than the quantities of the item being discussed. Changing the language which is used to describe the experience, whether it is a change in natural language, such as English to te reo Māori, or a change in register within a language will have an impact on how that experience is described and therefore what is valued in this experience.

The mathematics register consists of the words and grammatical expressions that are used consistently to describe mathematical ideas (Roberts, 1998). Any group of people who regularly talk about mathematical ideas will have specific ways to succinctly convey their meanings. Halliday (1978) stated '[w]e can refer to a "mathematics register", in the sense of the meanings that belong to the language of mathematics (the mathematical use of natural language that is: not mathematics itself), and that a language must express if it is being used for mathematical purposes' (p. 195). It is only when the mathematical ideas within an ethnomathematical activity are valued by discussants that the mathematics register will be deployed. However, cultures that have not labelled a body of knowledge and skills as 'mathematics' may not have a developed mathematics register to describe their ethnomathematical practices in this way. When a new mathematics register is developed, the choice of terms and grammatical expressions will have an impact on the connotations that accompany the mathematical ideas. The development of the mathematics register in te reo Māori, as an example of this, is discussed later in this paper.

Although the relationship between cultural practices and language has been recognised for some time, the use of ethnomathematics within the classroom has rarely been discussed in relationship to the language of instruction. Instead, discussions are more likely to be centred around the potential benefits to students of using ethnomathematical practices (see Gerdes, 1996 and Stillman & Balatti, 2000). Stillman and Balatti (2000) suggested that in recognising the mathematics in real-life situations students would gain skills that would motivate them to learn about abstract concepts that could otherwise be considered as being devoid of meaning. These experiences could also support students to critique the assumptions on which these mathematical practices were based. The process of using ethnomathematics practices would also result in links being made between the students' community and the classroom. As was described by Meaney (2002), these benefits are seen as being particularly useful to indigenous students. The inclusion of ethnomathematical perspectives is believed to support indigenous students to gain better results because these students feel that their backgrounds and experiences were valued in the classroom and that mathematics can be developed by others outside of Western culture (Howard, 1995). As a consequence of the belief that using ethnomathematical practices in classrooms will benefit students, there are numerous accounts of how to integrate different activities into mathematics classrooms (see for example Powell & Temple, 2001). Yet there is very little research to show whether the potential benefits have manifested themselves as real benefits (Vithal & Skovsmose, 1997). The work by Lipka, Hogan, Webster, Yanez, Adams, Clark, and Lacy (2005) would be the exception to this. Their work has shown that the use of culturally-based mathematics teaching with Yup'ik students in Alaska resulted in significant improvement in test results. Given that the incorporation of ethnomathematical practices into classrooms

can only be done through language, any investigation of the benefits needs to include consideration of language issues.

Ethnomathematical practices in kura kaupapa Māori

This paper explores the language issues around introducing ethnomathematical practices, including those of Western mathematics, into the mathematics classrooms of a Māori immersion school (known as a kura kaupapa Māori). In kura kaupapa Māori, 'the pedagogy of these schools is based on, but not exclusively, Māori preferred teaching and learning methods' (Smith, 1990 p147-148). The document which is the guiding principle for kura kaupapa Māori, *Te Aho Matua* (Kura Kaupapa Working Group, 1989), states that the child's own home is their first school, intimating that school should be homelike with a shared culture and values. Ethnomathematical practices of the local community would, therefore, seem to be appropriate activities to incorporate into the kura's mathematics classrooms. However, there are several issues that need to be considered in relationship to the introduction of ethnomathematical practices because of the students' bilingual/bicultural position within their community.

The particular kura kaupapa Māori that is the focus of our discussion is in a provincial city of New Zealand. Students who attend this kura use only te reo Māori whilst at kura and are encouraged to use it when communicating with their friends outside of school hours. Although the parents made active decisions to place their children in a Māori immersion situation, they themselves may not be fluent in te reo Māori. As well, te reo Māori is a minority language in New Zealand and so many of the children's outside experiences would be conducted in English. These would include activities that would use their mathematical understandings such as going to fast food restaurants and playing computer games. Although the children at this kura

would also participate in some traditional Māori cultural experiences both inside and outside the kura, much of their lives would not be very different from their non-Māori (Pakeha) peers. The situation that the students at this kura are in is linguistically quite complex and so issues of language cannot be separated from considerations about how to teach mathematics.

The data for the paper is drawn from the experiences and opinions of the six staff involved in teaching mathematics in the kura. Information came from conversations with staff and also from responses to a questionnaire. The questionnaire was used as part of a larger project that was investigating language issues in the mathematics classrooms of this kura (see Fairhall, Meaney and Trinick, 2007 for further details). The researchers all had a long term relationship with the kura and its teachers. Uenuku Fairhall is the principal of the kura. Tony Trinick had been involved in the preservice mathematics education of some of the teachers, whilst Tamsin Meaney had done her PhD research at this kura in 1998 and 1999.

The following discussion first looks at teachers' opinions about using ethnomathematical experiences in the classroom and then considers the language issues in regard to this.

Many of the gains from using ethnomathematical practices in classrooms are presumed to be made in relationship to the acquisition of the standard mathematics curriculum. Learning about ethnomathematical practices becomes the entry point for gaining a better understanding of school mathematics concepts (Gerdes, 1996). As a result, ethnomathematical practices tend to be described in the mathematics register of the language of instruction. As Stillman and Balatti (2000) warned, this process potentially 'divorces the cultural practices from their context and trivializes and fragments them from their real meaning in context' (p. 325).

In an earlier paper, Meaney and Fairhall (2003) described how some of the parents had seen some of their own experiences, such as building fish traps and smoking fish, as being useful contexts for their children to learn mathematics. However, they believed that the teachers' professional experience was a more valuable guide to choosing appropriate contexts for teaching mathematics. In responses to the questionnaire, the current teachers mostly suggested counting and money experiences as outside-school mathematical experiences that learners and their parents would consider to be useful in the classroom. When asked specifically about the traditional Māori knowledge and practices which should be included in mathematics classrooms, suggestions ranged from looking at time and other measurements to looking at number patterns in traditional arts such as tukutuku (woven decorative panels), whakairo (carving), raranga harakeke (weaving flax) as well as whakaterere waka (navigation skills). Uenuku Fairhall, who is the principal of the kura, also suggested that traditional practices should be used that showed how Māori ancestors used mathematics.

One activity that he has used successfully with various groups of children and adults is that of land division. Land belongs to extended family groups and a person's share in the land will depend upon the number of generations since the original title was recognised. Generally family members are unclear of how they came to have their proportion of land. At a family night in 2004, parents came as students to attend various classes with their children acting as assistant teachers. Describing land division using the language of fractions meant that for the first time many parents understood how their land share came about and understood how fractions operated. Previously, many parents had described their own poor experiences of learning mathematics at school (Meaney & Fairhall, 2003). To find an activity that had

meaning for them and gave them an understanding of fractions was something that was very much appreciated by these parents.

This activity exhibited many of the points suggested as being valuable in using ethnomathematics practices with indigenous students. It relates to the students' backgrounds as it shows that mathematical concepts were incorporated into traditional activities and makes the concept of fractions more than just a set of abstract ideas, 'devoid of meaning'. It also seemed that in this situation, discussion of the activity using the mathematics register in te reo Māori added another dimension that had not been apparent to the parents previously.

Concerns have been raised about the use of ethnomathematical practices as tokenistic add-ons to a mathematics curriculum (Meaney, 2002). By discussing a cultural practice using the mathematics register, it is the mathematics which was focussed on. The importance of knowing about how to perform a traditional art or appreciate it aesthetically can become lost when the focus becomes mathematics (Roberts, 1996). In the land division activity, added meaning was gained by the participants when they talked about it using the mathematics register. If ethnomathematics practices are included into classrooms, then discussion of them through the mathematics register needs to add something to the meaning rather than take something away.

The mathematics register in te reo Māori

Discussion of ethnomathematical practices in te reo Māori is complicated by the newness of much of the vocabulary. Although some textbooks had been translated into Māori in the 19th century, the development of the Māori mathematics register has been a fairly recent endeavour (Barton, Fairhall & Trinick, 1995). Transliteration of expressions and terms into Māori are of limited value as they neither express the

mathematical concept or have appropriate baggage that comes with using a term which has derived from cultural experiences. In the 1980s a series of meetings (hui) were held with primary and secondary teachers who were teaching mathematics in Māori. Two of the authors, Tony Trinick and Uenuku Fairhall were at these hui. Teachers and others shared the terms that they were using to discuss mathematical ideas and a list of terms for particular mathematical concepts were compiled (see Barton & Cleave, 1989). Eventually, the Māori Language Commission became involved and a set of 600 terms and some grammatical structures was agreed upon (Barton, Fairhall & Trinick, 1995). These were then first as *Nga Kupu Tikanga Pāngarau: Mathematics Vocabulary* (Learning Media, 1991) and then an expanded version was included as a glossary at the back of the new Pāngarau (mathematics) curriculum document (Ministry of Education, 1994). A dictionary of mathematical terms was published in 2004 and made available to all schools (Christensen (Ed), 2004).

However, the lack of people who continually discuss mathematical ideas in te reo Māori has impacted on the standardisation of the mathematics register terms. The small number of teachers who teach mathematics in te reo Māori is spread over a large area of New Zealand. As a result, few terms have become solidly integrated into the lexicon with many kura and even individual teachers using local expressions. Words that are used less frequently, such as whenu (cosine), are more likely to be standardised, whereas more frequently used words such as multiplication are less likely to be. In the 1980s, whakarau was initially coined for multiplication. In recent years, there has been a shift to using whakarea but some teachers have resisted this change. Teachers need a strong understanding of mathematics and te reo Māori, if they are to explore with students how best to make use of the language for learning

mathematics. There could be problems in exploring other mathematical ideas with non-standardised language. Very few teachers learnt mathematics in te reo Māori and so many are learning the mathematical terms in Māori at the same time as they are teaching the concepts to the students. Teachers in the earlier grades are also unlikely to know the mathematical terms that their students will need to use in the following years of study. Although this situation will improve as more teachers have themselves been educated in kura, it is difficult at the present time for many teachers to utilise the resources of te reo Māori in teaching mathematical concepts.

If Western mathematics is considered to be one example of ethnomathematical practices, then its discussion in te reo Māori also needs examination. When responding to the questionnaire, almost all the teachers mentioned that new vocabulary had an effect on students' ability to learn mathematics. Some of the teachers felt that because students only came in contact with the mathematics register at school their ability to fluently discuss mathematical ideas was reduced. There was a recognition that a student's ability to acquire the mathematical register would depend on their teacher's own fluency in te reo Māori in general as well as in the mathematics register (te reo tātatai).

Uenuku Fairhall suggested that if the class and its teacher were confident in discussing mathematics and had a sophisticated understanding of the mathematics then more culturally appropriate terms would develop. He gave an example of his senior class' change of terms for the expression 'like terms' in algebra, when identifying them in expressions such as the following $-4x - 3x + 3x^2 - 5x^2$. The term used in the new dictionary of mathematical terms, *Te Reo Pāngarau* (Christensen, 2004) is *rōpū* meaning 'grouping'. Students in Uenuku's senior classes coined the term, *whakawhānau*, meaning 'making families'. It was through discussion of what

was happening when ‘like terms’ were gathered together that the students felt that *whakawhānau* was more appropriate. This is because the connotations which this term invoked more readily fitted their understanding of what was happening. Discussion of Western mathematics in te reo tātaitai (mathematics register) needs to be done in a way which makes use of the cultural connotations of the Māori words. Traditionally, *whānau* (family) was rarely used to describe inanimate objects. Therefore, the term *whakawhānau* may need to be considered as a step to helping students understand the mathematical idea that will then be replaced with the standardised term *rōpū*.

Development of te reo tātaitai needs to be done in a way which minimises damage to te reo Māori and Māori culture (Barton, Fairhall & Trinick, 1998). One teacher in responding to a question on how te reo Māori is changing as a result of using it to teach mathematics stated ‘*ma tou rourou, ma toku rourou, ka ora te iwi*’ (two heads are better than one). This suggests that the resources of both languages, English and te reo Māori, can be made use of and it may be that destructive damage can be minimalised if thought is put into how te reo tātaitai is developed (Roberts, 1998). Another teacher suggested that archaic terms should be given new mathematical meanings rather than making up new terms as one way of holding onto the traditional cultural values connected to these older terms. For example, *hangai* traditionally meant to take a shortcut or to go directly to a location, rather than going around the outside. In recent years it has gained the mathematical meaning of diagonal, thus sharing the idea of cutting across in the shortest manner.

Conclusion

The use of ethnomathematical practices in mathematics classrooms warrants thoughtful consideration. This is because every activity is embedded within the

language of the culture in which it arose. This language will highlight those features of the activity which the culture values. Changing the way an activity is discussed either by using the mathematics register or by changing the language will have implications for how the activity is perceived by the students. It may also change the actual practice itself by focussing on other ideas.

This paper used examples from a kura kaupapa Māori to illustrate the need for the mathematics register to add rather than to subtract meaning from an ethnomathematical practice. If this is not done then the value of the activity in its own right could be lost in the eyes of the learners. This paper also looked at how changing languages from English to te reo Māori to discuss mathematical ideas is not a simple procedure. The development of indigenous languages for describing Western mathematics needs to respect the cultural values of the users of the language and that means using terms which have appropriate connotations both for the mathematics but also for the culture.

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