

## The role of language in ethnomathematics: Does the language make it 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 because students would feel: that their backgrounds and experiences were valued in the classroom; that mathematics can be developed by others outside of Western culture; and that mathematics has relevance to their lives outside the classroom (see Gutstein, Lipman, Hernandez & de los Reyes, 1997; Howard, 1995; Joseph, 1993). However, little research has been done to investigate these claims in Māori medium contexts.

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. Without proper consideration of this issue many of the benefits aligned with using these practices may be nullified.

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’.

Given that ethnomathematics is concerned with the mathematical practices of particular cultural groups, it is not surprising to find that descriptions of it are linked to language. Geertz (1975) suggested that when an experience is described in language, meaning is added. In analysing an experience in order to describe it, an individual is constrained by their linguistic repertoire. By describing an experience in words, parts of it are highlighted whilst others are downplayed (Meaney, 2005). 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 te reo Māori, *runga* can mean ‘up’ but in different situations can also mean ‘above’, ‘top’ and ‘south’ and are linked to ‘life’, ‘standing’ and ‘Sky Father’ (Salmond, 1976). These connotations are considerably different to those of the English word ‘up’ but reflect how these concepts are related in Māori culture.

Specific cultural practices such as ethnomathematical ones are embedded within the language of the culture. How an activity is described will affect how it is perceived and the value which is attached to it. 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). Changing the language which is used to describe the experience, whether it is a change in natural language or a change in register within a language will have an impact on how that experience is described and therefore what is valued within this experience.

The mathematics register is the words and grammatical expressions which 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 which have not considered a conjunction of knowledge and skills as ‘mathematics’ may not have a developed mathematics register to describe their ethnomathematical practices. 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). From looking at the role of contexts in mathematics, Stillman and Balatti (2000) suggested that students would gain skills in recognising the mathematics in real-life situations which would motivate them to learn about abstract concepts that could otherwise be considered as being devoid of meaning. Students could also use these experiences in learning 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 these potential benefits have manifested themselves as real benefits (Vithal & Skovsmose, 1997). 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 classroom 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 use of ethnomathematical experiences would seem to match this aim. The document which is the guiding principle for kura kaupapa Māori, *Te Aho Matua*, 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, the students' bilingual/bicultural position within their community has meant that several issues need to be considered in relationship to the introduction of ethnomathematical practices. The kura kaupapa Māori which is the focus of this investigation 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. However, although the parents have made active decisions to remove their children from mainstream schooling and put them 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 going shopping at supermarkets and fast food places where it would be expected that they would use their mathematical understandings. Although the children at this kura would also participate in some traditional cultural experiences both inside and outside the kura, much of their lives would not be very different from their non-Māori (Pakeha) peers.

The rest of the paper draws on experiences and opinions of the six staff involved in teaching mathematics in the kura. Information came from discussions with staff and also from responses to a questionnaire. The questionnaire was used as part of a larger project which was investigating language issues in the mathematics classrooms of this kura and will be described in detail elsewhere. 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) had 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, more valuable was their belief in the teachers' teaching experience. When responding to the questionnaire, the current teachers mostly gave counting and money experiences in response to a question on the outside-school mathematical experiences that learners and their parents may think could be used 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, whakairo, raranga harakeke as well as navigation skills. Uenuku Fairhall also

suggested that traditional practices should be used which showed how Māori ancestors were users of mathematics.

One activity which 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. An intimate knowledge of fractions is needed in order for a person to understand why their share is the size that it is. At a family night in 2004, parents came as students to attend various classes and the children were 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. In previous research at this kura, it was found that many parents had poor experiences of learning mathematics in their own schooling (Meaney & Fairhall, 2003).

This activity, therefore, exhibited many of the points put forward about the value of 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 was also seen that in this situation, discussion of the activity using the mathematics register in te reo Māori added another dimension which 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 is 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. In this way, discussion of a cultural practice using the Māori mathematics register needs must be valuable to all participants.

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 19<sup>th</sup> century, the development of the Māori mathematics register has been a fairly recent event (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 of 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).

However, the lack of people who continually discuss mathematical ideas in te reo Māori would mean that the use of a mathematics register has not become

standardised. 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. For example, there are only about 6 teachers teaching mathematics in the final years of high school in kura kaupapa. Of these only two or three would be teaching solely in te reo Māori. One of these is Uenuku Fairhall. Very few teachers will have 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.

If Western mathematics is considered to be one example of ethnomathematical practices, then its discussion in te reo Māori needs examination. When responding to the questionnaire, almost all the teachers mentioned that the effect of new vocabulary had on students' ability to learn mathematics. Some of the teachers felt that the fact that students only came in contact with the mathematics register at school would affect their ability to fluently discuss mathematical ideas. 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). The teacher would also need to have a strong understanding of mathematics as well, in order to maximise the language learning experiences which would need to accompany the mathematics learning.

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, such as  $-4x - 3x + 3x^2 - 5x^2$ . 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 tātatai needs to be done in a way which makes use of the cultural connotations of the Māori words.

It also needs to be done in a way which minimises damage to te reo Māori and Māori culture (Barton, Fairhall & Trinick, 1998). Although as 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', destructive damage can be minimalised if thought is put into how the language is developed to accommodate descriptions of mathematical ideas. Another teacher suggested that old terms should be given new mathematical meanings rather than making up new terms as one way of holding onto the traditional cultural values which were linked to these older terms.

## 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.

This paper used examples from a Māori immersion school, kura kaupapa Māori to illustrate the need for discussion using the mathematics register to add rather than to subtract meaning from an ethnomathematics 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 language 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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## References

- Ascher, M. & Ascher, R. (1986). Ethnomathematics. *History of Science* 14, 125-144.
- Barton, B. & Cleave, P. (Eds) (1989) *He kupu tikanga tau ūhuatanga: Mathematics vocabulary*. Special Edition of *Ngā Mauranga* Auckland: MECA, Auckland College of Education.
- Barton, B., Fairhall, U. & Trinick, T. (1995). History of the development of Māori mathematics vocabulary. In A. Begg et al. (eds), *SAMEpapers 95*, Hamilton, NZ:CSMER, 144-160.
- Barton, B., Fairhall, U. & Trinick, T. (1998). Tikanga re tatai: Issues in the development of a Maori mathematics register. *For the learning of mathematics* 18(1), 3-9.
- Borba, M. C. (1990). Ethnomathematics and Education. *For the learning of mathematics* 10(1), 39-43.
- Christensen, I. (Ed) (2004). *Te reo Pāngarau* Wellington: Ministry of Education.
- D'Ambrosio, U. (1992). Ethnomathematics: A research program on the history and philosophy of mathematics with pedagogical implications. *Notices of the American Mathematical Society*, 39(10), 1183-1185.
- Denny, J. P. (1986). Cultural ecology of mathematics: Ojibway and Inuit hunters. In M. Closs (Ed.) *Native American Mathematics* Dallas: University of Texas.
- Eglash, R. (1997). Bamana sand divination: Recursion in ethnomathematics. *American Anthropologist*, 99(1), 112-123.
- Geertz, C. (1975). *The Interpretation of Cultures*. London: Hutchinson & Co.
- Gerdes, P. (1996). Ethnomathematics and Mathematics Education. In A. J. Bishop, M. A. Clements, C. Keitel, J. Kilpatrick and C. Laborde (Eds.) *International Handbook of Mathematics Education*, (pp. 987-1023). Dordrecht: Kluwer Academic Publishers.
- Halliday, M. A. K.: 1978, *Language as Social Semiotic*, London: Edward Arnold.
- Howard, P. (1995). Social and cultural factors in the mathematics classroom: empowering Indigenous students *The Proceedings and Papers of Bridging Mathematics Network Conference*, (pp. 31-35). Batchelor, NT: Batchelor College.
- Kura Kaupapa Maori Working Group, Katarina Mataira chair (1989). *Te Aho Matua* Wellington: Ministry of Education.
- Learning Media (1991). *Nga kupu tikanga pangarau: Mathematics vocabulary*. Wellington: Author.
- Masingila, J. O. (1994). Mathematics practice in carpet laying. *Anthropology and Education Quarterly*, 25(4), 430-462.
- Meaney, T. (2002). Symbiosis or cultural clash? Indigenous students learning mathematics. *Journal of Intercultural Studies*, 23(2), 167-187.
- Meaney, T. (2005). Mathematics as text. In A. Chronaki and I. M. Christiansen (Eds.) *Challenging Perspectives in Mathematics Classroom Communication*. (pp. 109-141). Westport, CT: Information Age.
- Meaney, T. & Fairhall, U. (2003). Tensions and possibilities: Indigenous parents doing mathematics education curriculum development". In L. Bragg, C. Campbell; G. Herbert & J. Mousley (Eds.), *Mathematics Education Research: Innovation, networking, opportunities* (pp. 507-514). Melbourne: Deakin University.
- Ministry of Education (1994). *Pāngarau, mathematics in the New Zealand Curriculum*. Wellington: Learning Media.

- Powell, A. B. & Temple, O. L. (2001). Seeding ethnomathematics with oware: Sankofa. *Teaching children mathematics*, 7(6) 369-373.
- Roberts, T. (1996). Whose mathematics do we teach? *The Australian mathematics teacher*, 52(4), 42-46.
- Roberts, T. (1998). Mathematical registers in Aboriginal languages. *For the learning of mathematics*, 18(1), 10-16.
- Salmond, A. (1976). Te ao tawhito: A semantic approach to the traditional Māori cosmos. Reprinted in 1986 in *Nga kete waananga: A selection of papers relating to Ākonga Maori* Auckland: Auckland College of Education.
- Shockey, T. L. (2002). Etnomatematica de uma Classe Profissional: Cirurgioes Cardiovasculares. *BOLEMA*, 15(17), 1 – 19.
- Smith, G. H. (1990). Ki te whai ao, ki te ao marama: Crisis and change in Maori education. In A. Jones, G. McCulloch, J. Marshall, G. H. Smith, L. Tuhiwai-Smith (eds) *Myths and Realities: Schooling in New Zealand* (pp. 123-155) Palmerston North: Dunmore Press.
- Stillman, G. & Balatti, J. (2000). Contribution of ethnomathematics to mainstream mathematics classroom practices. In B. Atweh, H. Forgasz & B. Nebres (Eds.) *Sociocultural research on mathematics education: An international perspective*, (pp. 201-216). Mahwah, NJ: Lawrence Erlbaum Associates.
- Vithal, R. & Skovsmose, O. (1997). The end of innocence: A critique of “ethnomathematics”, *Educational Studies in Mathematics*, 34, 131-157.
- Wardhaugh, R. (1998). *An introduction to sociolinguistics*. Malden, Mass: Blackwell Publishers.