Communication in the mathematics classroom: A personal Maori perspective

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"The introduction of Maori medium teaching in Aotearoa has been responsible for a resurgence in the language, not only as a language of communication but also as a medium of instruction for schools teaching and learning in the Maori language. For some students and parents, Maori contexts including the language provide a learning environment more conducive to acquiring knowledge than mainstream education. Making mathematics user-friendly and an integral part of every day living will engender a feeling of acceptability and usefulness for Maori."

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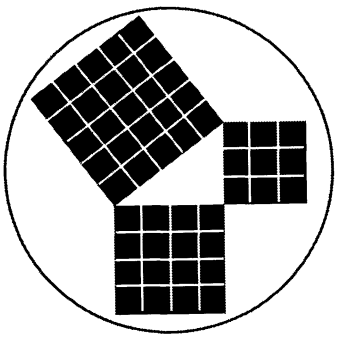
This paper talks about how communication takes place in the mathematics classroom within a Kura Kaupapa Maori school and is based on my personal experience as a teacher in Kura Kaupapa. After fifteen years teaching mathematics and science in mainstream schools I was approached to teach in the local school which had recently become a Kura Kaupapa Maori, which I accepted with enthusiasm. Not only did I have a chance to improve my spoken and written Maori, learn traditional waiata (songs) and karakia (prayers), but I also had a chance to teach mathematics in Maori, something I could never have imagined twenty years before. If you had asked me twenty years ago, "Can you imagine teaching The Theorem of Pythagoras in Maori?" I would have answered, "No way, we haven't got the words!"

I reflect on a story told by my daughter who was fortunate to be taught some mathematics in the Maori language as a fifth former. The part she remembers specifically is the Theorem of Pythagoras. She was taught how to use it as a tool for finding the lengths of sides in right angle triangles. Unfortunately she was at this school for a very short period of time and had to move. She was taught mathematics completely in Maori for 5 weeks, the time she was a student at the school. When she moved it was necessary to relearn mathematics in English. At the end of the year she sat school certificate mathematics which she answered mostly in English. Although she missed by only one mark (mathematics was never her strong point) she got full marks for the question to do with Pythagoras which she answered in Maori. She



was quite fortunate that the marker was able to understand her answer.

She made the comment that being taught Pythagoras using Maori concepts such as 'taroa' for 'hypotenuse, the side opposite the right angle' that implied something 'being longer'; 'aho' which means fishing line for 'opposite' and 'patata' which means 'the side close to or touching' for 'adjacent side' made this particular part of mathematics easier to understand. For a short time her appreciation and enjoyment of mathematics was enhanced by the use of Maori concepts and practices. She never experienced mathematics in the Maori language again once she left this school but during her time there, this 'alien and foreign' topic became less alien and less foreign.

I consider myself very fortunate to have taught at a Kura Kaupapa Maori. I started teaching in Kura Kaupapa in 1996 and the school saw me as the answer to their woes in mathematics and science education. Here was a chance to introduce new ways of doing things, to develop stimulating and exciting programs more suitable for the children. The children from this particular Kura Kaupapa Maori displayed a keenness to learn mathematics, something I had never experienced

in any of my teaching. The children saw me as the person with the knowledge who could offer something new. I would teach correct maths as opposed to the incorrect versions, and they saw maths as a part of computing, technology and science, in other words a very real part of the bigger world out there.

At the time I was only vaguely aware of the theories of learning and so I developed my own theory and my own way of teaching. At the homework centre I taught algorithms, and was a transmitter of knowledge, a practice I was familiar with. I had a big class of 30 Form 1 and Form 2 children who were keen to learn mathematics. During the mathematics lessons the students would listen to everything I had to say, and then they would go about their tasks passionately and enthusiastically. I had a big job trying to cater for the individual differences and I didn't have time to analyse methods of learning, or teaching for that matter. I taught mathematics most days and as I scoured the school for resources it became obvious that I had very few appropriate resources. I later discovered that the lack of suitable and appropriate resources was a problem in many Kura Kaupapa Maori. While there are "...plenty of resources like textbooks, charts, games, video and audio tapes to support English language subjects, very little was available for subjects taught in the Maori language" (Reedy, 1995, p.3). If I was to do justice to the programme then I needed appropriate and adequate resources.

The children spoke about 80% Maori in the classroom during their lessons. Mathematics was taught mainly in Maori and I as the teacher was facing this challenge with commitment and enthusiasm but unsure of how the lesson would go. After all I was going to teach a subject that I was very familiar with but this time I was to teach it in an entirely different language, namely Maori. I had the task of teaching children who had had teachers of mathematics unfamiliar with

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mathematics at this level and who lacked confidence to teach it. So I was it; I was the answer to their prayers. My experience at teaching mathematics was in mainstream schools namely Intermediates and Secondary schools up to Form 6. I had a basic command of the Maori language but English was the language I knew best. Like the children I did not know many of the new Maori words in mathematics so when teaching and learning mathematics we used both Maori and English words. Effective communication, of course, is one of the "components of quality teaching" (Mousley & Sullivan, 1996). The latest NCTM Principles and Standards publication states that, "Communication is an essential part of mathematics and mathematics education" (NCTM, 2000, p.60) and it was no different in the Kura Kaupapa Maori classroom.

My goal for each lesson was to teach mathematics in Maori for 90% of the time. This was according to policy, which stated that the Maori language was the medium of education and hence spoken and written as much as possible. The lessons would be conducted in Maori and develop mathematic concepts using Maori ideas, practices and stories that children were familiar with. I prepared each lesson thoroughly to ensure that the children had some understanding of what they had learnt. As I mentioned before I was only vaguely aware of the theories of learning and so I developed my own theory and my own way of teaching. I taught algorithms, and was a transmitter of knowledge, a practice I was familiar with and a system I had experienced as a student.

I would prepare each lesson thoroughly the day before and would literally translate the bulk of the lesson into Maori words and phrases that I understood and hopefully the children would understand. I even practised saying the sentences in Maori, reciting and going over the new Maori words and phrases so that when it came to giving the lesson I not only knew the whole lesson in Maori, but I was also becoming more familiar with the Maori words. I had no problem with the mathematical concepts but sometimes I had trouble remembering the Maori word, for example, 'wharite for equation'. I found, however, that they became more familiar with regular use. While there were words that took time to register, there are many Maori words in mathematics that are self-explanatory, such as 'tau-a-ira for decimal. Tau _ number, a _ by and ira _ point' which together would mean 'number by point or decimal' and other words such as'tapawha which, when broken down into tapa _ side and wha _ four, means four sided figure or quadrilateral.' Many words were well known by the children, for example: 'tahi (1), rua (2), toru (3)... tekau ma tahi (11) up to very large numbers such as rau _ 100, mano _ 1000'; also words such as 'tapiri for add,' 'weherua for separating into two parts' are words that most Maori speaking children knew. So the children had some words which we could build on, but they and I had to continually refer to dictionaries and the curriculum book to find the Maori words for many mathematical concepts.

How did the children in the Kura Kaupapa Maori classroom communicate during mathematics time? Maori was the official language of the classroom and there was no compromising this policy. When I spoke Maori to the children I expected them to reciprocate in Maori during mathematics.

However, I noticed during lessons that the children lacked the basic vocabulary of mathematics to be able to string phrases together even though we had given the children the words. Upon reflection I realise that giving words to children does not guarantee understanding. Although these children were fluent at speaking Maori and could string sentences together during conversation while playing and socialising, they found it impossible to talk mathematically in Maori. It got to the stage where English was used in some situations to talk mathematics. I decided that understanding mathematics was paramount and very important and if it meant compromising the Maori language then I did. Although we encouraged the children to talk Maori all the time, it was not a crime if they spoke English provided they had tried to learn via the Maori language first. If they were unable to foster understanding via Maori then the student would come to me for help. I would then explain in Maori and if they were still unable to understand, I would then proceed to explain in English or a mixture of English and Maori. If they hadn't constructed meaning of a concept via Maori they would construct meaning using the English language. Understanding of mathematics therefore came to some extent at the expense of the Maori language but I would then revert to Maori once they had understood the concept. In this sense I had at my disposal two languages to help the children learn mathematics.

Since finishing Kura Kaupapa and studying mathematics education at university, I have learnt aspects of maths education that can be applied to Kura Kaupapa Maori. The course has been instrumental in enlightening me about different methods of teaching, of how learning takes place, the various means of assessment and how they can be used to help students learn, and the nature of curriculum and how it is more than a collection of activities. The course has also made me aware of mathematics teaching and learning in other parts of the world, systems that I believe can be applied in the Kura Kaupapa Maori classroom.

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In this paper, I want to elaborate on some ideas about communication in the Kura Kaupapa mathematics class, given that communication is considered an integral part of mathematics and learning in mathematics today (NCTM, 2000). This view is in contrast to the traditional system where the teacher has been a transmitter of knowledge; I was that kind of teacher during my teaching career. On the other hand I had seen teachers in action, especially in science classes, where the teacher created tasks and a classroom environment that encouraged children to build on their knowledge, to ask questions and to try and answer these questions. I had not seen this way of teaching in mathematics classes. The mathematics class was more akin to traditional styles of teaching. Without realising it, I think I was unconsciously moving from the traditional style of the 'sage on the stage to guide on the side' style of teacher. I did not realise this but it was reflected in the class where discussion, exchange of ideas and inquiry took place. I expected noise levels to be high and that the children could get off task, that they could have been learning wrong mathematics or no mathematics at all. I had intuitively determined that traditional styles were no longer acceptable and I instinctively made a commitment to change gradually to an environment where "...students engage in authentic mathematical inquiry, act like mathematicians as they explore ideas and concepts and negotiate the meanings of, and the connections among, those ideas with others in the class" (D'Ambrosio, 1995, p.31), all of this through the medium of Maori language.

In making changes it is helpful to have another teacher or teachers to work with. It helps to have someone to talk to, who may be considering similar changes (Van Zoest & Enyart, 1998). I had two other teachers in our team and we met on a regular basis. However, we did not talk specifically about the mathematics teaching environment; mostly our mathematics discussions were about lack of resources, and lack of confidence to teach mathematics. Nevertheless I decided to make changes with the support of my teacher colleagues whom I could bounce ideas off and who in return could start formulating their own ideas about mathematics and maybe remedy the confidence issue. It was not enough to teach mathematics...we as a team had to teach mathematics better (Reinhart, 2000).

Having decided to make changes, I resolved to introduce problem solving into my classes. Attempts had been made before I got there to introduce problem solving especially into the Form 1 and 2 classes, but with limited success. A lot of time was spent finding suitable examples and translating these into Maori; unfortunately, like the two other members of my team the previous teacher did not have the knowledge and hence the confidence to teach mathematics. Although the children had been given problems to solve, they had not developed the problem solving skills. Initially I introduced problems both in Maori and in English to the class, which they enjoyed and found very stimulating and challenging. At that stage I had not heard of open-ended problem solving but on reflection I would like to recommend this type of problem as a daily part of the mathematics program. I realised that I had to organise the students in such a way as to create a climate that would encourage thinking, discourse and inquiry. I suggested to the students that they organise themselves into collaborative groups of three and four children. They

sorted who would be in which group with one group having six children which after a week or so decreased to five. Some groups were same gender and some mixed gender. My initial concern was the kind of talk that took place, especially the 'non-task related talk and the task related talk' (Barnes, 1999, p.49). A team of Maori researchers in 1997 had carried out research in various classes in the school where I was teaching, and one of the requirements was to gauge the ratio of non-task behaviour to on-task behaviour. To cut a long story short my class was on-task about 70% of the time, which the researchers thought was adequate but I did not think was good enough. On reflection, however, and knowing what I know now, I think it was

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adequate. As Gooding & Stacey (1993, p.53) have pointed out, "...less structured cooperative techniques are especially suitable for higher level cognitive learning" and I found that if a student was off-task it was always possible to come back on-task and thus resume the inquiries, the exchange of ideas and so forth.

I am now a great believer in the use of open-ended problem solving. I have begun to write problem solving examples in Maori at Level 1 for the Ministry of Education. These examples will be made available to Kura and total immersion units throughout the country. I have tried to make the problems I design reflect Maori situations and popular interests, namely sports, Kura Kaupapa, hui, tangi, Maori food, the sea, forests and so on. Hopefully they will encourage more exploratory talk and reflection by the children which is necessary for optimum learning (Barnes, 1999). I will be writing problems for Level 2 for the Ministry and with any luck these problems will be used alongside selected problems in the classroom. I see this as an important prerequisite for communication within the Maori medium classes.

Another technique which I find impressive but have never seen is **writing** in a mathematics classroom. "For students who had difficulty in solving a problem...writing became an opportunity to record the procedures used..." (Miller, 1993, p.51). Because of the importance of language in Maori medium education the idea of writing during mathematics classes is very attractive. "A brief, well-defined task is a good opener for writing activities" (House, 1996, p.100) Mëna he nama koe, ko tëhea te nama e hiahia ana koe? Whakamarama mai he aha ai. If you could be any number, which number would you be and why? Writing can also provide information about the student. As Burns (1995, p.85) commented, writing provided "...information about students understanding that I didn't have access to before..." This in turn can help with the way the teacher works with the students.

Communication in mathematics has become a very important part of successful mathematics teaching and learning. It is instrumental in assuring the best possible environment for optimal learning and provides a highly interactive pattern of discourse associated with effective learning. It can improve mathematics of the children and also their command of the Maori language, an essential ingredient for children taught through the medium of the Maori language. The challenge for the teacher is to create a classroom environment that is conducive to inquiry, exploratory talk, reflection, elaboration and the like. By providing challenging mathematics using open-ended problems there is a chance to stimulate and enthuse the students to higher cognitive learning.

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