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# Working towards equity for diverse learners: Drawing on values and ways of being as strengths in mathematics classrooms

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*Internationally and within Aotearoa/New Zealand, both Indigenous and migrant students are marginalised by the structural inequities they encounter in schooling. As a result, the mathematical achievement of these students is typically framed within a 'gap' story which problematises students as a group that need to be fixed. In this paper, we report on one section of a longitudinal research and development project with Pacific heritage students designed to focus on culturally sustaining mathematics pedagogy and to engage all students in high level challenging activity and mathematical practices. Data analysis of classroom observations and interview data from a range of participants examined the ways in which teachers connected to Pacific values during mathematics teaching. The findings suggest that building on values and ways of being can support diverse students to develop a positive mathematical disposition while retaining a strong cultural identity.*

*Keywords: Culturally sustaining mathematics pedagogy, primary education, values, equity.*

## Introduction

Similar to other countries around the world, for many decades in Aotearoa/New Zealand, we have heard the stories of the under-achievement and achievement 'gaps' for both Indigenous and migrant students (Faulkner, et al., 2019; Turner et al., 2015). Pacific students in New Zealand enter schooling with deep and rich backgrounds of understandings and experiences. However, they encounter structural inequities within the schooling system which cause them cultural and social dissonance and a view of mathematics as having little relevance in their lives, or as something unattainable (Hunter & Hunter, 2018). Mathematics as a subject was long considered by many to be value and culture free (Presmeg, 2007). Despite this belief, in the past few decades, researchers in ethnomathematics (e.g., Bishop, 1991; D'Ambrosio, 1985) have shown that mathematics is a cultural product. This means that the teaching and learning of mathematics cannot be decontextualised from the learner and instead is wholly cultural and closely tied to cultural identity. Consequently, equity in schooling is achieved when educators explicitly connect to and build on the cultural, social, and linguistic contexts of non-dominant students, their families, and community (Averill & Rimoni, 2019; Bishop, 1991). A key educational policy in New Zealand has been a focus on the cultural values of Pacific people to address disparities in achievement and support the development of an equitable education system (Ministry of Education (MoE), 2013; 2018). However, this policy implementation in the context of mathematics education requires both understanding of Pacific values and how these can be used as a strength during mathematics teaching and learning. There has been limited research which explicitly examines how teachers can build on cultural values as a strength within the mathematics classroom. The aim of this paper is to analyse ways in which educators connected to the cultural values of marginalised students from Pacific nations to construct classroom social and socio-mathematical norms and the resulting outcomes for students.

## **Pacific people in New Zealand**

Pacific people hold an important place in the history and shaping of New Zealand through significant political and economic contributions and with ancestral links with Māori that shape the rich social and cultural tapestry of New Zealand. As a migrant group, Pacific people comprise multiple generations, as well as being both a diverse and indigenous grouping, each with their own language and cultural and social ways of being. Nevertheless, a communal approach to society shapes all their cultural values and provides a common thread. These cultural values, shaped by a collectivist way of life, contrast sharply with the more individualistic approach, and the values which sit within these, seen within the dominant middle-class Pākehā (European) group which have traditionally shaped Western schooling practices in New Zealand. These 'assumed as normal for everyone' practices match the dominant group of Pākehā learners in mathematics classrooms but position Pacific students in ways less favorable. This negative positioning potentially causes disengagement from mathematics and a deficit view of their own cultural group as mathematicians (Hunter & Hunter, 2018). If, as Gutiérrez (2002) argues we should consider participation as important as achievement then these Pacific students are experiencing a gross disservice. In this paper, we examine what happens when teachers explicitly draw on values and use these to structure classroom interaction patterns in ways that allow Pacific students participation in accessing high level and challenging mathematical activity embedded within a range of mathematical practices (RAND, 2003).

## **Mathematical practices**

Of importance in the construction of a mathematical disposition is engagement in a set of mathematical practices (RAND, 2003). These practices emerge through the interactive discourse students participate in and extend beyond mathematical knowledge to include particular actions and ways of using and doing mathematics (Cobb et al., 2001). We describe them as practices which efficient users of mathematics use when solving problems. This includes explaining, justifying, representing or generalising mathematical reasoning. Important to the development and use of mathematical practices are particular ways of communicating reasoning including asking questions and challenging others. In this paper we explore how teachers can draw on Pacific values aligned with collectivist ways of being to scaffold Pacific students to engage in robust discursive discourse premised within a set of proficient mathematical practices.

## **Values related to mathematics and culture**

With growing recognition of the inherently cultural nature of mathematics, there has also been increasing awareness of the impact of values in mathematics education as related to cognitive and affective outcomes (Bishop, 1991; D'Ambrosio, 1985). In a collectivist society, notions of fono (family as an extended rather than nuclear group) are central to how the values are considered. In a Pacific view, fono is important to everything that Pacific people do within their lives (Hunter et al., 2016). Woven within the values of what it means to be a member of fono are concepts of reciprocity, respect, service, inclusion, relationships, spirituality, leadership, collectivism, love and belonging (MoE, 2013, 2018). It could be argued that these values are appropriately applied to most societies. But, there are many subtle, and not so subtle, differences between how they are enacted within either a collectivist or individualistic society (Averill & Rimoni, 2019). These differences in meaning are

at the basis of considerable dissonance for Pacific students as they try to navigate a school world which conflicts with many of their core beliefs founded on the values they have been raised with.

Within class streamed grouping for mathematics teaching has been a commonplace practice in Aotearoa/New Zealand for many years with many negative outcomes for Pacific learners. The placement of Pacific students in low ability groups supports teachers developing deficit views and low expectations (Rubie-Davies, 2016). In addition, the use of ability grouping conflicts with the beliefs and values of Pacific people because these grouping structures encourage competitiveness and place importance on the individual rather than group success. This emphasis contrasts sharply with notions of communalism and collectivism where the success of the individual is judged by the success of the collective as a whole. Within this perspective, the Pacific notion of service is important and the role of the individual within the context of mathematics is to ensure that mathematical understandings are constructed and understood collectively.

A clash of values during mathematics teaching and learning potentially causes dissonance and disengagement with mathematics (Kalogeropoulos et al., 2021). For Pacific students, passive listening rather than active participation and inquiry aligns with the Pacific value of respect. We have outlined in an earlier study (Hunter & Anthony, 2011) how many of the Pacific students considered that they learnt mathematics best through listening to teachers. Teachers are thought to be elders and hold the knowledge and this is always considered correct and unchallengeable. These same students also described their discomfort at needing to question and challenge peers about their mathematical reasoning because they saw it as being disrespectful. Nevertheless, learning mathematics includes learning how to talk and act as mathematicians. In this paper, we want to show how teachers positioned the students to talk in ways which respected and honored their cultural values while at the same time they learnt to work as mathematicians.

## **Methodology**

The research reported on in this paper is part of a larger on-going longitudinal project which spans more than ten years. Developing Mathematical Inquiry Communities (DMIC) is a transformative school based professional learning and research approach focused on providing more equitable outcomes for Pacific students. The leaders of this work (authors) are New Zealand born of Kuki Airani (Cook Island) heritage. They draw on the Pacific value of fono in leading this work as mother and daughter. The participants include teachers across twenty-seven New Zealand low socio-economic primary schools. The teachers come from diverse backgrounds and their length of teaching experience varies. The two teachers reported on in this paper had been in the project more than a year and were selected as exemplary multiple case studies (Hannula, 2022) to represent pedagogical practices that connected with Pacific values to engage students in mathematical practices.

Data for this paper drew on video recorded classroom observations and field notes. In the first instance, the research team read the lesson transcripts and associated interview data and identified excerpts during the lesson that related to the development of mathematical practices. Data analysis included a mixed deductive and inductive approach. Initial deductive coding focused on analysis of the lesson excerpts in which the teachers drew on values previously identified in research literature (e.g., Hill, Hunter, & Hunter, 2019; Hunter, 2021; Hunter & Miller, 2022) to develop student

engagement with mathematical practices. Further detail is provided in the findings, however, in summary, the coding drew on the following operationalisation of the codes—family as students working as a collective and taking collective responsibility for understanding—collaboration as working together and offering different contributions for a common goal—reciprocity as sharing knowledge and ideas with peers—respect as belief in capability, supporting students to think deeply in relation to mathematics questioning and challenging in a polite way and—service as serving others by ensuring their understanding. The second layer of inductive coding examined specific teacher actions and ways of students engaging with mathematical practices. Emerging themes and patterns that were identified as consistent across both participants are used in this paper to develop exemplary case studies of both teachers drawing on student values and ways of being to position students to participate in mathematical activity.

## **Findings and discussion**

Across these lessons, the teachers used open and flexible pedagogy built around teacher noticing and responding to student reasoning. The students were given high level challenging tasks. These were written within known Pacific contexts so that the students did not have to struggle with both the context and the mathematics. The classroom lessons used a structure that Smith and Stein (2011) suggest as best practice to promote productive discourse. Each lesson followed a similar format in that first a problem was launched by the teacher and then the students worked in small groups of two or four students to construct shared problem solutions. As they worked in their small groups, the teacher monitored both the emerging mathematical reasoning and the patterns of participation. Each lesson ended with a large group sharing session where the teacher sequenced student explanations and facilitated discussion, inquiry, and argumentation. The lesson concluded with the teacher connecting the different mathematical thinking to a big mathematical idea.

### **Developing a safe supportive learning environment**

As a clear issue of equity, developing a safe and supportive learning environment was seen as a key task for these teachers of Pacific students. Central to all the actions teachers took was the notion of the family as a collective within the Pacific framing of cultural values. Both teachers drew on the extended understanding of families with a Pacific perspective which moves beyond immediate family to include all other members of the village, or within the context of New Zealand, neighbors, church members, and other people in the local community. This was used to embody the ways in which construction of a mathematical explanation and justification depended on all members' contributions so that ultimately groups of students collectively owned the responsibility for it and for each other's understandings. For example, a teacher used a ratio problem within the context of making a ta'ovala (a Tongan ceremonial costume). These require considerable time and expertise on the part of different groups of people and he used this as a metaphor to connect to the value of collaboration to illustrate how he wanted the students to work together on construction of their mathematical explanation. He begins by discussing how they are made:

- Teacher A: They are made in a group, and it takes quite a long time. But if you work in a group how would that be of benefit?  
Student 1: It would be faster.

- Teacher A: The weaving would get done faster. In our mathematics today, we are going to be looking at a problem where people are weaving them together and thinking about how long it would take to do that. Think of the reasons why are we working in a group to solve our maths problems?
- Student 2: To share our ideas.
- Teacher A: To share our ideas. That's a good answer. Why else are we working in a group?
- Student 3: Different ways of doing it.
- Teacher A: We have got different ways of doing it. We are sharing it, sharing it with other people in our group. How does that help us in our maths?
- Student 4: So everyone understands.
- Teacher A: So we can share our ideas and our different ways of doing it so we can understand how different people did it. I might say "Oh I never thought that way but Hemi told me a good way to do it". If you think back to the people making the ta'ovala, I am sure when you first start making it, it is hard but the more experienced people have you learn from them as you go and in the end it is all shared knowledge.

In this discussion, the teacher reinforced the need to respect the different contributions and capabilities within the mathematics groups. At the same time, he affirmed that success is achieved through the collective working together by drawing on Pacific values of family, collaboration, and reciprocity to construct rich deep mathematical understandings.

In other examples, the teachers re-visited notions of the family and the strengths inherent in being a member. They made direct links to the student's family context and emphasised that family members take different roles which collectively make different cultural activities successful. To encourage student voice, the teachers built on the Pacific students' own sense of cultural pride by reinforcing their need to represent themselves well:

- Teacher B: Remember you are a member of our whanau (family) so you need to be loud and proud and confident, we are all ready to think and listen.

### **Developing group and individual accountability**

Within mathematics classrooms, it is important that students are responsible for their own sense-making and the sense-making of others. To emphasise individual and group accountability, the teacher actions drew on the Pacific values of respect and service. Clear expectations were placed on the students that they had an individual responsibility to understand and make sense of the mathematical reasoning, and at the same time a collective responsibility for peers and group understanding. For example, a teacher stopped the students as they worked in groups:

- Teacher B: I have just seen some really great work going on here. Tere was explaining his thinking and Marama asked him a question. That's great because Marama was making sure she knew what was going on. But then Tere did not leave it there because when he answered Marama's question, he checked in that everybody else got it. That's like what we talked about when you are in a Kapa Haka group, you can't leave anybody behind and you just keep working together until everyone is with you.

The concept of service as a Pacific value contrasts with a commonly accepted meaning in the Western world, as something someone is expected to do for you for financial compensation or another reward. In this instance, the teacher both promoted the need for accountability but also reinforced the concept of service as putting others before yourself and being accountable for them constructing shared knowledge.

In another lesson, the same teacher drew student attention to the parallels between a group of students working together and the actions of a Pacific dance group. Rather than having any individual star, in a Pacific dance group, the ethos is to induct, support, and challenge members until they achieve similar levels of expertise. In this instance, she drew attention to similarities and linked her observations to the individuals she saw taking leadership and actively supporting other group members to question and challenge the mathematical reasoning:

Teacher B: There is really interesting korero (talk) going on. This group were having problems and argument and Tevita, you weren't giving out the answers but you were pushing them to think. You had everyone talking and discussing how they were going to sort out the ideas. That is similar to in a mā'ulu'ulu when you clap to keep the rhythm and encourage the group. You began by challenging and other people were following your lead, so the arguing was ka pai (great).

As we described earlier, Pacific students can find questioning and challenging others very difficult because as it potentially conflicts with their concept of the value of respect. This teacher showed that she recognised the need to provide positive models of how students are to engage in inquiry and argumentation. Her descriptions provide a sense of normalisation towards discursive interactions which are not just premised on agreeing but also involve disagreement as part of the construction of a mathematical explanation. At the same time, she highlighted the way in which others can induct their peers into the role of questioning and challenging by connecting this to a cultural metaphor of a Tongan dance.

### **Developing ways of questioning and challenging**

If Pacific students are to have equitable opportunities to participate fully in mathematical discourse, then it is important they are able to develop an appropriate voice in the mathematics classroom. Evident in the data are many examples of the teachers carefully supporting and scaffolding the students into ways of questioning and challenging. Models of questions and challenges were displayed and role-played and the teachers regularly took opportunities to outline the types of questions or statements students could use and re-positioned this as a respectful action that showed students were interested in the ideas of others. For example, before the students started their small group activity the teacher said:

Teacher A: You have got to ask those questions because that is what good mathematicians do. It shows you are interested in their ideas. You can ask "what did that mean?" or "what did you do there in that bit?". Keep asking those questions until you really understand. That is even more important when you disagree but you need to say why. Use your maths but do it politely and ask those questions, or say "I don't agree with that idea because", friendly argue so they have to justify their thinking and you are helping them.

In this excerpt, the teacher has drawn the students' attention to their need to use the voice of a mathematician while also pressing them to be accountable to constantly collaborate and sense-make. At the same time, he has positioned the actions of agreeing and disagreeing with mathematical ideas as something which can be achieved politely and a way of helping others. Politeness is a key concept which underpins the Pacific value of respect.

## Conclusion and implications

Participating in and learning mathematics is about learning the key to how mathematics as a discipline works. Clearly, for equitable outcomes in mathematics for Pacific students we need to note the importance of participation as key to learning as Gutiérrez (2002) argues. For too long, Pacific student voices have been silenced within traditional mathematics classrooms by pedagogical practices that draw on the values of the dominant cultural groups in New Zealand. In this paper, we have used data from two exemplary case studies to build a view of mathematics teaching that draws on the values of a marginalised group of students as a strength to support engagement with mathematical practices. We have showed how the teachers made both implicit and explicit connections to values including family, respect, collaboration, service, and reciprocity in ways that drew on Pacific understandings of these values. Averill and Rimoni (2019) highlighted that non-Pacific heritage teachers have differing understanding of Pacific values than Pacific heritage teachers. In the current study, the inclusion of cultural metaphors was an important means to connect to the values in a Pacific framing.

New Zealand, similar to many other Western countries, currently has an inequitable schooling system including in relation to mathematics teaching and learning. In contrast to approaches that problematise marginalized groups of students, in this paper, we illustrated teacher actions which are representative of how different teachers have drawn on and used Pacific values to scaffold their students into mathematical practices. The findings indicate the potential of such an approach in both supporting mathematical learning and dispositions and the maintenance of a strong cultural identity. In a wider sense, the paper adds to the current research field in relation to drawing on the strengths such as values and experiences of marginalised students to develop equity.

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