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**A STRENGTH-BASED APPROACH TO DEVELOP PĀSIFIKA STUDENTS'
CULTURAL IDENTITIES AND MATHEMATICAL DISPOSITIONS**

A Thesis presented in partial fulfillment of the requirements for the degree of
Master of Educational Psychology at Massey University, Auckland, New
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ABSTRACT

This study examines cultural identity and mathematical disposition development of Pāsifika students aged 11-13 years from a strengths-based perspective. It builds on previous work that advocates for culturally responsive mathematics teaching in collaborative learning environments built around Pāsifika values. Current research also urges pedagogical actions of promoting students' use of home languages and connecting students' "lived" lives to the mathematics classroom. These teaching practices have been described to affirm student identities as well as foster stronger relationships with mathematics.

A case study approach utilizing qualitative design from a socio-cultural perspective was implemented. Data was collected through group interviews with students and individual interviews with students and teachers. The Year 8 students and their teachers within the study were from two urban Auckland schools that have participated in professional development and learning opportunities focused on culturally responsive inquiry classrooms. Coded analysis of interview transcripts was used to uncover the perspectives of students and teachers and formulated the findings of this research.

Findings revealed that home language use, connecting cultural contexts to the mathematics class, drawing on Pāsifika values to promote mathematical practices and social norms, and the role of the responsive and caring teacher validated students' cultural identities and supported the development of positive mathematical dispositions. The findings provide insights into how culturally responsive mathematics teaching can draw upon the cultural languages and values of Pāsifika students to affirm their identities and mathematical dispositions.

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CHAPTER ONE – INTRODUCTION

1.1 INTRODUCTION

This chapter provides the background to the context of the study. Current international and national perspectives call for transformative action for the mathematics teaching of diverse learners (Aguirre et al., 2017). Within the current study, equity issues are addressed with regards to mathematics teaching and learning for Pāsifika students. A predominant focus of previous research has offered a deficit theorizing approach to exploring the underachievement of Pāsifika students (Bishop, Berryman, Wearmouth, Peter, & Clapham, 2008). In contrast, this study aims to present a strength-based perspective for addressing mathematics teaching of Pāsifika students. This research aims to identify the strengths of Pāsifika students' identities, language and culture that can support mathematical dispositions.

1.2 BACKGROUND TO THE STUDY

1.2.1 Pāsifika students in New Zealand

The current study focuses on a group of Pāsifika students and their experiences with learning mathematics. In this research, the term Pāsifika peoples is used as an umbrella term to include all the terms used to describe people of *Pacific* origin and ethnicity. The term Pāsifika peoples is a collective term used in New Zealand to describe people who “identify themselves with their indigenous Pacific countries of origin because of ancestry or heritage, family and cultural connections with Samoa, Cook Islands, Tonga, Niue, Tokelau, Fiji, Solomon Islands, Tuvalu and other Pacific countries” (Schuster, 2008, p. 12). Thus, using the term Pāsifika is not descriptive of a homogenous group; instead it is used in lieu of their Island name.

Within New Zealand, Pāsifika peoples hold a significant place—historically, politically, economically, and culturally. As Hunter and Hunter (in press-b) contend “the rich and colourful elements Pāsifika peoples bring to New Zealand also enrich the cultural landscape of this country” (p. 1). Furthermore, Pāsifika

peoples constitute one of the fastest growing populations in New Zealand (Brown et al., 2007) with the percentage of Pāsifika students attending New Zealand schools expected to double, to reach 20% of all students by 2051 (Wylie, 2003).

Despite the fact that Pāsifika students enter New Zealand schools with a rich milieu of cultural knowledge and heritage, several researchers argue (e.g. Fletcher, Parkhill, & Harris, 2001; Samu, 2006; Tuafuti & McCaffrey, 2005) that New Zealand policymakers have yet to effectively represent and support Pāsifika students' values, cultures, and identities. As a consequence, Pāsifika students continue to be over-represented in the academic statistics—especially so in mathematics. Despite a 2.4% increase in achievement from 2012, a disproportionate number of Pāsifika students perform below their European and Asian equivalents (Ministry of Education, 2014). Statistics reveal that only 11% of Year 8 Pāsifika students are at or above National mathematics standards compared with 41% of all year 8 students (Education Assessment Research Unit and New Zealand Council for Educational Research, 2015).

The Pāsifika Education Plan 2013-2017 (Ministry of Education, 2013) called for a focus on lifting schools' progress, with a goal of 85% achieving National Standards and NCEA level 2 by 2017. This plan advocates for teachers to draw upon the cultural strengths of Pāsifika students—including their cultural values, languages and identities and make links to curriculum areas, in order to rectify inequitable education practices and provide students with opportunities for quality education. The next section examines issues of equity within mathematics education.

1.2.2 Mathematics for Diverse Learners

On the global stage, mathematics education has long been plagued with inequitable pedagogical practices. Children of particular racial, ethnic, language, gender, ability, and socioeconomic backgrounds experience mathematics education differently and often become disillusioned by their educational experiences (Aguirre et al., 2017). Achieving equity in education for all learners is an urgent and current challenge placed on educators within the

current political climate (Bartell, Wager, Edwards, Battey, Foote, & Spencer, 2017). Fraser (2003) defines equity as “social arrangements that permit all members of society to interact with one another as peers” (p. 78). In practical terms this means that all students that enter the education system have the right to be accepted, valued, and effectively taught by schools. When learning mathematics, Aguirre and colleagues (2017) state that equity reforms should aim for “a mathematics education that does not result in the negative experiences, fears, anxieties, and disaffected mathematical identities that we continue to encounter in schools and society” (p. 125). Highlighted in the National Research Council’s (NRC) view of mathematical proficiencies is the expressed intent that students ought to attain a “productive disposition” (Kilpatrick, Swafford, & Findell, 2001, p. 116). Transforming students’ mathematical dispositions is an important step to ensure all students embrace and develop their mathematical competencies. However, for diverse students to develop such dispositions, cultural transformation of mathematics pedagogy needs to occur.

1.2.3 Culturally Responsive Teaching

Internationally emerging research studies suggest that culturally responsive teaching holds some promising answers through its attempts to integrate students’ culture into all aspects of learning. Gay (2010) describes culturally responsive teaching as validating student identity, comprehensively addressing the needs of the whole child, encompassing the multidimensional features of education (e.g., curriculum, learning environment, student-teacher relationships, instructional strategies, and assessments), and empowering students to be effective learners and productive citizens. Indeed, research studies of culturally responsive pedagogy within mathematics classrooms shows promising results for beginning to rectify cultural imbalances and improve mathematical outcomes for diverse learners (Aguirre, 2009; Averill, Anderson, & Drake, 2015; Gay, 2010; Gutiérrez, 2009).

In New Zealand, research into culturally responsive teaching for Pāsifika students in mathematics classrooms has shown promising outcomes in relation to equitable practice. Classroom studies (Bills & Hunter, 2015; Hunter, 2010;

Hunter & Anthony, 2011) have shown that by incorporating Pāsifika values and languages into the classroom, fostering caring and meaningful teacher-student relationships, and connecting the students' home culture to the classroom, mathematical learning outcomes are improved. Though these studies offer promising directions, further research is needed to explore Pāsifika students' identities in culturally responsive mathematics classrooms. Moreover, investigation into the mathematical disposition of diverse learners is relatively limited, especially within New Zealand.

1.3 RESEARCH OBJECTIVES

The objective of this study is to further our understanding of how Pāsifika students' cultural identity and development of a mathematical disposition can be supported within classrooms that engage in culturally responsive teaching. In seeking to discover how strengths of Pāsifika students' culture can enhance students' engagement in the mathematics class the research questions are as follows:

- What aspects of a classroom learning environment do students perceive as affirming their relationship with mathematics while also maintaining a positive cultural identity?
- What classroom instructional practices do teachers utilize, and why, to enhance the mathematical disposition and cultural identities of their Pāsifika students?

1.4 OVERVIEW

Chapter two includes a review of the international and New Zealand literature that will provide a thorough background to the study. The literature explores current research and perspectives regarding cultural identity, mathematical disposition and culturally responsive mathematics teaching elements, including language, cultural context, social and socio-mathematical norms, mathematical practices, Pāsifika values and the role of the teacher.

Chapter three explores the methodology for the study. This includes justification for methodology, data collection methods, setting, sample and schedule information and quality criteria.

Chapter four, and five explores the findings of the study and the discussion of these findings in relation to the literature. Factors that promote cultural identity and mathematical disposition are discussed: The role of language, incorporating cultural context, drawing on Pāsifika values to foster social norms and mathematical practices and responsive teacher actions. Chapter five concludes with teaching implications, suggestions for further research, limitations and concluding thoughts.

CHAPTER TWO – LITERATURE REVIEW

2.1 INTRODUCTION

The previous chapter outlined the background context of the study. This chapter reviews research literature from both New Zealand and international contexts. Attending to the needs of diverse learners in the mathematics classroom is a pressing matter for current reform efforts in New Zealand. In particular, Pāsifika learners deserve educational experiences that support their cultural identities. The Pāsifika Education Plan (2013) comments that:

Pāsifika Success will be characterised by demanding, vibrant, dynamic, successful Pāsifika learners, secure and confident in their identities, languages and cultures, navigating through all curriculum areas such as the arts, sciences, technology, social sciences and mathematics. (p. 3)

Moreover, education documents within New Zealand also advocate for the need for proficient mathematical dispositions. The Effective Pedagogy in Mathematics/Pāngarau Best Evidence Synthesis sets out to uncover and explain the links between what we do in mathematics education and what the outcomes are for learners. The result is a valuable resource that can be used to enhance a wide range of outcomes for diverse learners and prioritises “the disposition to use, enjoy and build upon that knowledge throughout life” (Alton-Lee, 2007 as cited in Anthony & Walshaw, 2007). This chapter’s review of the literature investigates the cultural identity and mathematical disposition of Pāsifika students and the culturally responsive actions that may support their development.

Section 2.2 covers current theories and issues regarding the cultural identities of Pāsifika learners. Section 2.3 examines mathematical disposition and explores ways it can be supported by classroom structures. Section 2.4 highlights research concerning culturally responsive teaching and highlights culturally responsive actions that support Pāsifika students in the mathematics class. Section 2.5 covers a summary of this chapter.

2.2 CULTURAL IDENTITIES OF PĀSIFIKA LEARNERS

Cultural identity conceptualizations are widely discussed in research. The development of individual cultural identity is a process of acceptance of the cultural beliefs, norms, attitudes and values of one cultural group rather than another (Campbell, 2005). Identity theories tackle the issue of cultural identity in multi-cultural nations by proposing multiple cultural identities (Fitzgerald, 1992; Gunew, 1998). Fitzgerald (1993) contends that identity can no longer be considered a static entity but instead a multi-faceted construct. Having more than one cultural identity does not render them mutually exclusive instead cumulative layers, where the direct social context dictates which layer is drawn upon (Smith, 1992).

Research has documented the often-complex nature of the Pāsifika identity within New Zealand/Aoteroa (Macpherson, 1996; Pasikale, 1999; PISAAC, 1989; Tupuola, 2004). The use of the term 'Pāsifika' acknowledges the reality of several distinct ethnic and linguistic groups, each aligned with their own unique social structures, histories, values, perspectives, and attitudes (Samu, 2016). The current demographic profile of Pacific youth in New Zealand contributes to the changing identity formation process. With Pacific youth born in New Zealand making up over 50% of the New Zealand Pacific Island population, there is a shift from predominantly Pacific migrant community to communities born and raised in New Zealand (Samu, 2006).

Pāsifika students within New Zealand are attempting to re-establish their identities within a context that may not wholly support their Pāsifika roots. They have been described as encountering identity formation difficulty as "they are at home neither in their parents' world nor in their country of birth" (PISAAC, 1989, p. 1). Tupuola (2004) describes a movement of Pacific youth who are attempting to appropriate global cultures in order to create their own identity as Pāsifika edgewalkers. This group of youth is emulating black African American lifestyles, music and slang, and using it as a means to express their own Pāsifika culture (Macpherson, 1996). Pāsifika youth are thus adopting and borrowing from recognizable peers. Their multiple identities are evidently open

to change from the social and cultural dynamics they encounter. According to Pasikale (1999), these visible identity exchanges represent a vulnerable demographic. Importantly, Pasikale argues that:

Understanding the issues can mean the difference to our positive cultural continuity and the alienation of a generation more comfortable with other forms of sub-culture. It can also mean the difference to continued academic failure and educational success based on the realities of future Pacific Island generations. (p.5)

To ensure educational success, an inclusive sense of belonging and well-being ought to be adopted by educational practices. When teachers are able to adopt Pāsifika languages, culture, and identities within the mathematics classroom, Pāsifika students are better able to engage in proficient mathematical discourse and practices (Hunter & Hunter, in press-b). These researchers argue it is crucial students feel recognized by their educational settings instead of marginalized and misunderstood. For Pāsifika learners, teachers need to be aware of patterns of thinking and behavior typical to a Pāsifika learner especially due to their personal indigenous and generational diversity (Cahill, 2016).

Research has highlighted a variety of factors that may enable educators and school structures to understand, support, and value the cultural identities of students (Bills & Hunter, 2015; Fletcher, Parkhill, Fa’afai, 2005; Hannant, 2013; Hunter & Anthony, 2011). For example, Bills and Hunter (2015) identified that when students are free to use their own languages, have their cultures reflected in tasks and activities, and have opportunities to incorporate Pāsifika values into classroom norms, then students’ cultural identities are wholly validated. Schools also have an important part to play in ensuring Pāsifika students feel culturally valued. The school structures, systems, policies, practices and beliefs impact teacher pedagogy, direct curriculum, can engage or alienate families, and influence critical academic pathways and future opportunities for Pāsifika students (Hannant, 2013). Schools have a significant influence on the identifying process and need to ensure students’ cultural identities are

recognized, valued and supported (Nakhid, 2006). In order for cultural identity to be nurtured, students need to be able to exhibit cultural behaviors, and feel that these behaviours are valued within the school context (Fletcher et al., 2005). As Ogbu (1992) effectively highlights:

What the children bring to school – their communities’ cultural models of understanding of ‘social realities’ and the educational strategies that they, their families and their communities use or do not use in seeking education are as important as within school factors. (p. 5)

It is vital that schools and educational practices embrace, support, and nurture the unique cultural identities and languages of Pāsifika students. When these aims are achieved, equitable access to mathematical learning may take place. Though current research has explored practices that support students’ cultural identities (Bills & Hunter, 2015; Fletcher et al., 2005; Hannant, 2013; Hunter & Anthony, 2011) more research is required to explore this relationship. The next section highlights the concept of mathematical disposition and ways in which it can be supported by educational settings.

2.3 MATHEMATICAL DISPOSITION

Mathematics teaching should make a positive difference to students in order to ensure they have opportunity to actively engage in today’s information and data driven age (Watson, 2001). As Walshaw and Anthony (2008) point out, mathematics “plays a key role in shaping how individuals deal with the various spheres of private, social, and civil life” (p.133).

An important part of learning in the mathematics classroom is the development of a mathematical disposition. Thomas and Brown (2007) describe dispositions as “attitudes or comportment toward the world, generated through a set of practices which can be seen to be interconnected... Dispositions are not descriptions of events or practices, they are underlying mechanisms that engender those events or practices” (p. 8). Thus, a disposition towards a discipline such as mathematics, entails not only what mathematical content

students know, but also how they know it - not only the acquired skills but how the student uses those skills (Gresalfi & Ingram-Goble, 2008). Specifically, mathematical disposition can be described as the collection of ideas about mathematics, the utility of mathematics, and the means of participating in mathematics through classroom engagement (Gresalfi & Cobb, 2006). The importance of mathematical disposition is documented in educational policies both overseas and in New Zealand. It is reflected in the Ministry of Education's Best Evidence Synthesis for effective pedagogy for mathematics (Anthony & Walshaw, 2007). Highlighted in the National Research Council's (NRC) descriptions of mathematical proficiencies includes a "productive disposition" that is described as a "habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy" (Kilpatrick et al., 2001, p. 116). According to these policy directives, students with a positive mathematical disposition can be described as those who view mathematics as a useful entity. Assessed as having a productive disposition, students in Young-Loveridge's (2006) study, frequently described both present utility in mathematics and conceptualized mathematics as a relevant part of their future careers.

The NRC also promotes that students recognize diligence or perseverance in learning mathematics as part of a productive disposition. This connects to Heibert and Grouws's (2007) notion of struggle when learning mathematics. They describe 'struggle' to mean the effort students expend when attempting to make sense of mathematics or solving problems (2007). Research by O'Dell (2017) documented a perseverance type of mathematical disposition that related to the interplay of frustration and joy indicated by the productive struggle students experienced when solving problems. Students with positive mathematical dispositions recognize and revel in the cognitive effort required to make deeper mathematical connections.

The final part of the NRC's "positive disposition" includes students' belief in their ability to competently use and engage in mathematical practices. McClain and Cobb (2001) describe students' proficient use of mathematical practices as a necessary part of students' development of mathematical autonomy. For

example, as students' capacity to distinguish mathematical explanations from faulty explanations (Beyers, 2011), they are learning to look to the mathematical discipline for authority rather than relying on the teacher as the arbitrator of correctness. Participating in classroom learning ought to give students the space to engage in and develop a range of mathematical practices (e.g., justifying and generalizing) and consider these skills as inextricably linked to their own mathematical identities.

Classroom structures and teacher actions that promote mathematical dispositions are widely discussed in research (Boaler, 2002; Gresalfi & Cobb, 2006; Kilpatrick et al., 2001; Yackel & Cobb, 1996). In Boaler's (2002) in-depth comparison of two contrasting classroom learning environments, she found that students were less able to capitalize from mathematical learning opportunities when teachers situated themselves as the sole authority, with promotion of teacher given approaches to solving problems. In these classrooms, students behaved as passive participants who did not question the teacher's knowledge. This was contrasted with classrooms where there was a more egalitarian distribution of authority and students were more likely to produce individualized problem-solving strategies, validate their reasoning, and regulate their behavior. As a consequence, these students gained a deeper and more complex understanding of and relationship with mathematics. And ultimately, they developed positive mathematical dispositions, which led to increased motivation to engage with mathematics at deeper levels. Building on Boaler's (2002) seminal research of opportunities to learn within different classroom cultures, there is now a large body of work that affirms that limiting opportunities for students to engage in authentic mathematical problem solving may not only limit student mathematical knowledge development but also "give them passive identities as receivers, rather than users of mathematical knowledge" (p. 134).

Other researchers combine the ideas of identity and learning, as they fundamentally consider identity as a dynamic construct that is mediated by the practices of the learning community (Hand & Gresalfi, 2015). Boaler and Staples (2008) documented ways in which the structure of the mathematics classroom altered students' ideas of their mathematical ability and how they

valued the subject. Within this study, the structure of the mathematics class was transformed to facilitate high expectations and challenge as well as emphasize collaborative group work. Students drastically shifted their thinking about how they approached mathematics, how they persevered, and how they chose to engage in higher-level mathematics courses.

Research regarding mathematical disposition has documented how structuring classrooms around productive collaborative discourse enables students to develop positive identities around mathematics. However, research documenting Pāsifika students' mathematical disposition and their experiences in inquiry classrooms is relatively under-explored. The next section covers current literature regarding culturally responsive teaching with specific reference to Pāsifika students' experiences in the mathematics class.

2.3 CULTURALLY RESPONSIVE TEACHING

Culturally responsive teaching acknowledges and infuses the culture of students into the school curriculum and makes meaningful connections with community cultures (Gay, 2010; Vavrus, 2008). Culturally responsive teachers move beyond superficial ways of practicing cultural acceptance toward more comprehensive, evidence based and embedded teaching practices that validate students' culture. Gay (2010) describes culturally responsive teaching as “cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning encounters more relevant and effective for them” (p. 31). This strength-based approach contends that utilizing student voice, heritage, and knowledge is paramount for understanding and engaging culturally diverse students.

There is an emerging body of research that documents successful outcomes for previously underserved students when teachers address the cultural needs of their students (e.g. Averill, Anderson, Easton, Maro, Smith, & Hynds, 2009; Bills & Hunter, 2015; Gutiérrez, 2000; Hunter & Anthony, 2011). Gutiérrez's (2000) case study of one high school mathematics department in Maryland, USA that effectively improved enrollment in higher-level mathematics classrooms

highlighted five themes that contributed to the success of the program that emerged from the study: (1) application of a rigorous curriculum, (2) dynamic commitment to students, (3) fostering cooperative learning and (4) instructional scaffolding. In arguing for the impact of culturally responsive pedagogical actions, the fifth theme Gutiérrez noted was that the teachers of African American and Latino students often sought out resources connected with these students' pursuits. This action, she claimed, helped them to better relate to mathematical concepts. There was a specific sense that these teachers pursued connection with and learned to relate to their students' lives in order to better connect new mathematical teachings to their prior knowledge.

In the New Zealand context, studies also argue that purposefully and intensively incorporating student culture into the classroom can support students to see themselves represented and valued. For example, New Zealand studies (e.g., Alton-Lee, 2003, Bills & Hunter, 2015; Bishop et al., 2008; Fletcher, Parkhill, & Harris, 2011) demonstrated how incorporating student culture and language could strengthen students' dispositions and identities. For example, Bills and Hunter (2015) describe how through culturally responsive teaching and drawing on the cultural capital of the students ensured they related to and engaged in the mathematical problems and participated in mathematical discourse in culturally relevant ways.

Thus far, culturally responsive teaching has been described in broad-spectrum means. The next section reviews ways in which culturally responsive teaching can promote cultural identity and mathematical disposition. These include the role of language, promoting Pāsifika values, fostering social norms and mathematical practices, connecting cultural context to the mathematics class and responsive teacher actions.

2.3.1 The Role of Language

Many Pāsifika students enter New Zealand classrooms highly proficient in their home languages with rich cultural knowledge and experiences. However, traditional New Zealand classrooms position English as the dominant spoken language and the language of instruction (Meaney, 2013), and in classrooms

where Pāsifika students may be sidelined from accessing their home language, issues of equity come to the forefront.

Research with marginalized students has highlighted the significant mediating effects of language and participation in multilingual contexts with students whose first languages are not the same as the classroom languages of instruction (e.g. Bills & Hunter, 2015; Civil & Hunter, 2015; Moschkovich, 2002). Findings from these studies advocate for utilizing students' languages as a principal tool for learning mathematics, arguing that students are empowered when they are free to use their preferred language, which enhances the depth of discussion (Civil, 2014). Sharma, Young-Loveridge, Taylor, & Häwera's (2011) study documented through interviews that many Pāsifika students utilized their home languages to help their peers understand and engage with mathematical discussion. Similarly, Bills and Hunter's (2015) examination of cultural capital within mathematics classrooms, they found that by utilizing home languages, students were able to support each other and ensure that all members of the community could interact and participate.

Taking a wider perspective, it is well known that mathematical language is vital when learning mathematics (Anthony & Walshaw, 2007). Current research posits that to ensure explicit understanding of mathematical concepts, students' proficiency in their home languages should be viewed as a valuable asset. Code switching is a useful tool in ensuring proficient understanding during mathematical discussion (Moschkovich, 2007; Setati, 1998). Grosjean (1982) defines code switching as the "alternation in the use of two languages (or even more) in the same discourse" (p. 147). Students often code switch to confirm, reiterate, or understand specific mathematical concepts. Both Tongan and Samoan languages have mathematical discourses, but they have not yet been fully developed, and bilingual students can be unfamiliar with many mathematical terms and phrases both in the translation and in English (Latu, 2005). Fasi (1999) found that some words have multiple meanings in mathematical contexts, causing confusion among Tongan students. For instance, the Tonganised word "sikuea" (square) takes on various mathematical connotations – for example, an area, a number, or a numerical property. These

extra challenges further necessitate code switching to ensure full mathematical understanding.

In an analysis of code switching between two Spanish speaking students, Moschkovich (2007) highlights that students not only code switched to translate particular words but also to explain a concept, justify an answer, describe mathematical situations or elaborate, expand and provide additional information. Within the New Zealand context, Latu's (2005) study with Tongan and Samoan mathematics students found that those who utilized code-switching between their home language and mathematical language in English performed better compared with those who used their limited English as their first language. In this sense, code switching is viewed as a powerful resource for mathematical communication and understanding (Moschkovich, 2007). Studies have also shown that freedom to use students' preferred language validates their cultural identities (Bills & Hunter, 2015; Ferguson, Gorinski, Samu, & Mara, 2008; Fletcher et al., 2011).

Research studies conclude that students feel secure and empowered to learn when their language and culture is respected within the school environment (Ferguson et al., 2008; Fletcher et al., 2011; Tuafuti, 2010). Cummins (2000) argues for the idea of collaborative power relations, which describe collaborative and fair interrelationships between educators and learners. In such learning relationships, students' identities are continually reaffirmed, nurtured and respected within educational settings.

2.3.2 Social and Socio-mathematical Norms

For students to be able to engage in comprehensive conversations which involve mathematical inquiry and challenge, teachers need to negotiate the classroom learning environment with their students, and to co-create classroom social and socio-mathematical norms (Hunter, 2008; Sullivan, Zevenbergen, & Mousley, 2002; Weingrad, 1998). Social norms present participants in the learning environment with a set of appropriate ways to engage and interact with mathematical discourse (Hunter & Hunter, in press-a). Socio-mathematical norms describe "normative aspects of mathematical discussions that are

specific to students' mathematical activity" (Yackel & Cobb, 1996, p. 458). Examples of socio-mathematical norms include the determination of what constitutes an acceptable mathematical explanation and justification, and what does not (Yackel & Cobb, 1996).

In classrooms situations, it can be challenging for students to be able to successfully engage in mathematical discourse that is rich with powerful reasoning tools. However, while collaborative discourses of this nature may be challenging, it is important for enabling students – including Pāsifika and Maori students - to make deep mathematical connections (Bills & Hunter, 2015; Leach, Hunter & Hunter, 2014).

The ways Pāsifika students engage in mathematical argumentation can be influenced by their cultural ways of interacting and behaving. For example, the culture of silence within Pāsifika culture promotes traditional classroom ecology where students are expected to listen attentively to teachers and where arguing is considered disrespectful (Tuafuti, 2004). New Zealand studies of Pāsifika students have widely reported the dissonance that students experience when asked to engage in mathematical argumentation, as these practices are not widely used in their cultural homes and could have been considered disrespectful (Bills & Hunter, 2015; Civil & Hunter, 2015; Hunter & Anthony, 2011). Given these ingrained cultural beliefs about argumentation, it is unsurprising that some Pāsifika students may initially be resistant to engaging in collaborative discourse.

The notion of risk taking in the inquiry classroom is well documented (Hunter & Anthony, 2011; Bills & Hunter, 2015; Civil & Hunter, 2015). Pāsifika students in these studies felt initially uneasy and emotionally heightened when engaging in mathematical practices of challenging or questioning others. Bibby (2009) illustrates the emotional labor and risk experienced by students when participating in development of joint mathematical understanding. It is therefore vital for teachers to be able to create a safe and trusting environment that enables students to take risks and participate in powerful mathematical argumentation.

In recent times, many studies have looked at how teachers can effectively establish the social and socio-mathematical norms of the class to ensure the classroom environment is primed and safe for students to all step forward and participate in ways that enhance active mathematical participation. Studies in New Zealand (Bills & Hunter, 2015; Civil & Hunter, 2015; Hunter, 2007; Hunter & Anthony, 2011) and abroad (Lampert, 2001; White, 2003; Wood, Williams, & McNeal, 2006) demonstrate the importance of teachers establishing social discourse processes (when and how to explain, question, agree, disagree or challenge) that foster productive and inclusive mathematical discussions. Hunter's (2010) evaluation of one teacher's mathematical inquiry class stressed the importance of teaching students 'polite' ways to disagree and challenge. Many classrooms in Hunter's studies refer to the term 'friendly arguing' as a means to arrive at group agreement on a problem or to provide mathematical justification (Hunter & Anthony, 2011; Civil & Hunter, 2015; Hunter & Anthony, 2011).

Matching social norms to Pāsifika values ensures the classroom ecology is collaborative and safe. This affords students more opportunities to engage in mathematical discourse that is consistently linked to deeper mathematical understanding and strong mathematical dispositions (Boaler, 2003; Goos, 2004; Hufferd-Ackles, Fuson, & Sherin, 2004; Kazemi & Franke, 2004). In conjunction, cultivating Pāsifika culture within the classroom dynamics ensures students are able to see themselves reflected and respected in the classroom, which, in turn, supports their cultural identities.

2.3.3 Mathematical Practices

Within a mathematical inquiry community, teachers need to provide explicit attention to supporting students to develop mathematical practices. Examples of students engaging in mathematical practices include creating strategies, questioning peers, or tying abstract ideas to concrete situations (Sengupta-Irving & Enyedy, 2014). These repeated actions would include representing, inquiring, justifying and generalizing reasoning (Boaler, 2003; RAND, 2003). Cobb et al. (1999) argues that mathematical practices involve "shared ways of reasoning, arguing and symbolizing established while discussing particular

mathematical ideas” (p. 128). At the heart of the development of mathematical practices are ways of talking and reasoning, ways of asking questions, challenging others and engaging in mathematical argumentations (Hunter & Hunter, in press-a).

A large body of research contends that mathematical practices are essential in positively promoting students’ mathematical dispositions and mathematical capabilities (Boaler, 2003; Goos, 2004; Hufferd-Ackles, Fuson, & Sherin, 2004; Kazemi & Franke, 2004). Being able to proficiently use mathematical practices allows access to deeper conceptual mathematical knowledge. For example, in Goos’s (2004) study, students in one Australian urban classroom learnt communication standards over one year, and by the end were able to reason, defend, and prove their conceptions to one another. In order to develop their mathematical practices, students need space and opportunity to engage and practice them (Selling, 2016; Hunter, 2013).

The benefits of developing a rich repertoire of mathematical practices are affirmed by research studies. Sengupta-Irving & Enyedy (2014) captured how a student-driven learning environment supported students to gain more positive responses to learning and richer engagement in mathematical practices compared to a teacher-led learning environment. In New Zealand, studies have illustrated how teaching students to engage in mathematical practices promotes mathematical ability and dispositions (Hunter, & Anthony, 2011; Hunter, 2008; Bills & Hunter, 2015). For example, Hunter & Anthony (2011) reported a positive shift in disposition of Pāsifika students as they learnt about and how to engage in inquiry-based mathematical practices. Previously describing themselves as passive participants in the learning process, the students embraced classroom ecology where everyone took an active role through taking ownership of their learning across a range of mathematical practices. The researchers concluded that being able to competently engage in mathematical practices within a collaborative classroom environment affords students the ability to develop strong mathematical dispositions through well-exercised engagement in mathematical discourse.

2.3.4 Pāsifika Values

Pāsifika students come to school with a rich milieu of cultural heritage, knowledge and experience. Although Pāsifika peoples are a diverse group, a collection of core Pāsifika values are significant to all. These include reciprocity, respect, service, inclusion, family, relationships, spirituality, leadership, collectivism, love and belonging (Anae, Coxon, Mara, Samu, & Finau, 2001; Ministry of Education Pāsifika Education Plan, 2013). These values underpin both behavior and interaction in school, home, and community contexts. The ways in which these values can be woven throughout culturally responsive mathematics classrooms is illustrated by several New Zealand studies (Bills & Hunter, 2015; Chueng, 2015; Civil & Hunter, 2015; Hunter, 2007; Hunter & Anthony, 2011).

For Pāsifika peoples, love and fanau (family) are fundamental to the ways in which they live and learn. Family is a key aspect that guides Pāsifika motivation and achievement (Bills & Hunter, 2015; Fletcher et al., 2011). Other values embodied within the idea of fanau include trust, respect, reciprocity, collectivism, communalism, and service whereby these help formulate individual and group identities of Pāsifika peoples within a collectivist cultural frame (Civil & Hunter, 2015). These values are interwoven throughout interactions, experiences, perspectives and identities of Pāsifika people.

New Zealand studies have documented how the Pāsifika value of family has been embedded within the social norms that form the interactions within mathematical activities and discourse (Bills & Hunter, 2015; Civil & Hunter, 2015; Hunter & Anthony, 2011). Teachers in these studies often describe how, metaphorically, the classes were a big Pāsifika family, and this conceptualization shaped the mathematical interactions. In addition, teachers highlight that drawing on ideas of family and collectivism reinforces student responsibility for mathematical reasoning and working together (Civil & Hunter, 2015). Furthermore, the idea of working within a family is utilized to engage students in asking questions and challenging each other's ideas in an

environment that is mathematically charged but culturally safe (Bills & Hunter, 2015; Civil & Hunter, 2015; Hunter & Anthony, 2011).

The Pāsifika value of respect is threaded throughout Pāsifika practices, interactions, and perspectives. The Pāsifika tradition of showing respect for people of high status, like teachers, is prevalent and as a result students do not seek argumentative interactions and instead they listen and adhere to instructions (Singh, Dooley, & Freebody, 2001). Within Hunter and Anthony's (2011) year-long study on one Pāsifika mathematics class, students found it initially challenging to engage mathematical argumentation and reported discomfort when having to challenge others' thinking. However, New Zealand studies have shown how respect can be repositioned in culturally responsive classrooms, where challenging others' in a respectful manner is the norm. For example, the term 'friendly arguing' is sometimes used in studies and signifies the ability to consider argumentation in a positive and respectful way (Bills & Hunter, 2015; Hunter, 2008; Hunter & Anthony, 2011). Respect is also shown through the use of social banter, where students' use of jokes when challenging or questioning omits Pāsifika-ma (shame or loss of face).

Furthermore, New Zealand studies with Pāsifika students have documented how incorporating Pāsifika values within the social norms of the class promotes an effective collaborative learning environment (Bills & Hunter, 2015; Civil & Hunter, 2015; Hunter & Anthony, 2011). For example, a teacher in Hunter and Anthony's (2011) study framed the requirement that students work collaboratively within an appropriate cultural setting (preparing an umukai [village feast] and the collaborative roles all participants hold). Pāsifika concepts of reciprocity, communalism, and collectivism were developed as the teacher had them engage in mathematical explanations, representations, and justification within their groups. Respect and reciprocity were drawn upon as part of their need to actively listen, question, offer assistance, check the understanding of all members of the group, and support each other when reporting back to the whole class.

2.3.5 Connecting Cultural Context to the Mathematics Class

Incorporating relevant cultural contexts of learners is an effective and equitable action to enhance engagement. Freire (2000) advocates for situating educational practices in the lived experiences of learners. In order to transform oppressive societal structures, he advocates for utilizing marginalized peoples' cultural capital (2000). Originally theorized by Bourdieu and Passeron (1977), cultural capital was then defined by McLaren (1994) as being the general cultural background, knowledge, disposition, and skills that are transmitted from one generation to another. Cultural capital represents "ways of talking, acting, and socializing, as well as language practices, values, and types of dress and behavior" (McLaren, 1994, p. 219).

Similar to the notion of cultural capital is the idea of 'funds of knowledge' (Moll, Amanti, Neff, & Gonzalez, 1992; Hogg, 2011). Moll and Greenberg's (1992) influential work has highlighted "ways in which institutions can and should value and develop an understanding of the knowledge, skills and learning which resides or takes place in minority ethnic communities within multi-ethnic populations" (Andrews & Yee, 2006, p. 436). It has been argued that people accumulate different life experiences and have a unique knowledge base or compilation of 'forms of capital' (Gonzalez, Moll, & Amanti 2005). Households amass multiple bodies of knowledge, ideas and skills in order to preserve household and individual wellbeing (Esteban-Guitart & Moll, 2014). Studies have found that funds of knowledge used in classrooms, be they in New Zealand or international, tend to favor the dominant social class (Ferguson et al., 2008). In the New Zealand context, research on Maori and Pāsifika experiences in school suggest that their rich forms of cultural knowledge are severely overlooked in mainstream schools (Hill & Hawk, 1998).

Mathematics education researchers advocate for writing specific mathematical problems around the "lived" lives of their students (Averill & Clark, 2006; Bills & Hunter, 2015; Hunter & Anthony, 2011). Teachers to utilize problematic tasks, which are shaped around and within students' cultural and social worlds not only validate students' cultural identities but also make mathematics (and other subjects) more accessible (Averill & Clark, 2006; Bills & Hunter, 2015; Cowie,

Jones, & Otrell-Cass, 2011; Hogg, 2016). Student responses from studies where cultural context is incorporated into mathematical problems express total validation in their identities and illustrate recognition that their home lives are also rich with mathematics (Bills & Hunter, 2015; Hunter & Anthony, 2011). Instead of students concealing their cultural behaviors, students should ‘see themselves’ reflected in the curriculum, class and school culture (Ferguson et al., 2008), including the mathematics classroom.

Situating mathematical problems within relevant cultural contexts also supports the process of mathematization (Wijaya, van den Heuvel-Panhuizen, Doorman, & Robitzsch, 2015). Mathematization refers to the process of treating a subject or problem mathematically. As van den Heuvel-Panhuizen (2000) states, “just as mathematics arose from the mathematization of reality, so must learning mathematics also originate in mathematizing reality” (p. 5). Problems that are set in meaningful contexts provide rich opportunities for students to apply knowledge from their lives to learning mathematics, and in doing so will see their own identities reflected in the math (McDuffie, Roth, Wohlhuter, & Breyfogle, 2011). Researchers have called for teachers to connect mathematical activities to familiar contexts of students, in ways that they might better conceptualize the mathematical strategies and concepts (Jackson, Shahan, Gibbons, & Cobb, 2012; McDuffie et al., 2011).

2.3.6 Responsive Teacher Actions that Foster a Constructive Learning Environment

The final section concerns the role of the responsive teacher in fostering culturally safe and dynamic classrooms. Much research has documented the importance of positive teacher-student relationships within New Zealand for marginalized students (Averill et al., 2009; Fletcher et al., 2011). Relevant here is the notion of ethic of care. An ethic of care within an education paradigm describes classroom ecology and the interrelationships between teachers and students (Noddings, 2012). Teachers who practice going beyond offering professional attention and concern for their students, and also seek to develop reciprocity and interrelationships produce space for students to develop their social and mathematical identities (Walshaw & Anthony, 2008).

It is important to distinguish how an ethic of care may be enacted to ensure that Pāsifika students are not hindered by well-intentioned but ultimately counterproductive teacher actions. For example, Spiller's (2012) interviews with teachers uncovered that teachers' own beliefs and understandings actually impeded Pāsifika student learning, despite being well-intentioned. Teachers avoided singling out Pāsifika students to answer questions and would instead quietly approach students on their own. Thus, students were completing easier tasks and losing valuable opportunities to engage at higher mathematical levels due to the misguided approaches by their well-meaning teachers. Similarly, teachers in Hunter's (2008) work noted that they initially felt they should keep students safe from making mistakes with mathematical practices, rather than encouraging them to take risks and celebrate mistakes.

An ethic of care can be enacted in culturally safe and productive ways. Research studies have illustrated how culturally responsive teachers can help support students' cultural identities (Averill et al., 2009; Fletcher et al., 2011) and mathematical dispositions. In Walshaw and Anthony's (2008) literature review, they found that effective teachers develop opportunities for students to develop their mathematical and cultural identities. Samu (2006) highlights that effective teaching of Pāsifika students involves "creation of learning communities that are based on caring, inclusive and cohesive relationships" (p. 47). Watson (2002) presented the findings that low-achieving students wanted to learn in a "togetherness" environment. Present here is the important notion that marginalized and Pāsifika learners require culturally relevant and safe spaces to interact, and collaborate together.

Teachers not only play an important role in shaping safe classrooms spaces but also in supporting the development of their students' mathematical discourse. Effective teachers listen closely to their students' discourse and ideas (Franke & Kazemi, 2001). Jaworski (2004) highlighted evidence of teachers discerning and then behaving knowledgably as they interact at crucial moments in the classroom when students created a moment of choice or opportunity. Manouchehri and Enderson (1999) conducted an in-depth analysis of a 7th grade classroom, and found that the discursive interactions facilitated by the

teacher offered responsive instead of directive help, while continually monitoring student participation and understanding. Through the use of careful questioning and purposeful interventions, the teacher shifted the students' reliance away from her and toward the support of and challenge from peers. Careful monitoring of student interaction and tactful questioning are important teacher actions that help foster mathematical discourse.

2.4 SUMMARY

In order to meet the needs of diverse learners, education reforms advocate for transformation of teaching and learning practices to include ways that support students' language, culture, and identities. Pāsifika students require educational experiences that validate and support their unique cultural identities. In order to support students' mathematical dispositions, research calls for classroom structure that enables students to become a part of a collaborative learning community and proficiently engage in meaningful mathematical discourse.

Culturally responsive teaching practices that enable diverse students to engage and contribute in mathematics classrooms are important factors to consider. The role of Pāsifika language has been shown to facilitate deeper mathematical understanding, enabling students to become experts in their own culture where they can support their peers' understanding. Connecting students' cultural context to the mathematics class not only validates their identities but allows students to connect their home and school lives as well as support mathematization processes. Fostering social and socio-mathematical norms within mathematics classroom supports proficient use of mathematical practices, which allows students to engage in valuable discourse and attain deeper levels of mathematical understanding. Incorporation of Pāsifika values within the mathematics class has been shown to support this process and enables and empowers students to participate in safe and competent mathematical discourse. Finally, teachers enacting an ethic of care and taking actions to promote safe and collaborative learning spaces has been shown to support students within mathematics classrooms.

While the literature provides significant evidence of the benefits of culturally responsive teaching, it also affirms that too few classrooms in New Zealand currently incorporate culturally responsive teaching practices. The literature has pointed to the many challenges involved in changing practice. By tapping into classrooms that are attempting to enact these practices, this study will explore teachers and students within these learning communities to add to our knowledge base.

The next section details an overview of the research design.

CHAPTER 3 – METHODOLOGY

3.1 INTRODUCTION

The previous chapter discussed the literature related to the current study. This chapter outlines an overview of the research design. Section 3.2 presents justification for the qualitative research design of the current study and describes the socio-cultural perspective in which this study is set. Section 3.3 outlines the data collection methods used in this study and the role of the researcher. Section 3.4 describes descriptions of the setting, participants and research schedule. Section 3.5 describes the quality criteria including, reliability, validity, ethical and cultural considerations. Section 3.6 provides a summary of the methods used.

3.2 JUSTIFICATION FOR METHODOLOGY

This study aims to investigate the key research questions:

- What aspects of a classroom learning environment do students perceive as affirming their relationship with mathematics while also maintaining a positive cultural identity?
- What classroom instructional practices do teachers utilize, and why, to enhance the mathematical disposition and cultural identities of their Pāsifika students?

The current study utilized a qualitative interpretivist research paradigm. It sought to explain human experiences, perceptions and understandings of their social world (May, 2011). Merriam and Tisdell (2016) describe four key aspects of qualitative research as focused on the process, understanding and meaning; the researcher is the primary instrument of data collection; the process is inductive and the product is richly descriptive. These elements align with the aims of the current study to understand how Pāsifika students' cultural identity and mathematical disposition development can be fostered.

Within this study, the researcher drove the data collection through directly gathering first-hand accounts of students' experience and personal perspectives (Merriam & Tisdell, 2016). Qualitative research has been described as a set of interpretive activities and privileges no single methodological practice over another (Denzin & Lincoln, 2003). Thus, qualitative research can weave together a wide variety of data collection methods in order to explain social phenomena. Within the current study, several forms of semi-structured interviews were implemented to capture student and teacher experiences and perceptions.

In qualitative research, the process aims to derive meaning and understanding from the data collected (Merriam & Tisdell, 2016). Accounts given by students and teachers provided novel data to develop rich theoretical interpretation of student cultural identity and mathematical disposition development.

Finally, this study aimed to comprehensively describe student accounts and the multifaceted meanings behind them. In order to derive meanings from participants' accounts, the researcher coded responses into themes and comprehensively described and supported them with current research. Through the process of analysing data, meaning can be derived (Merriam & Tisdell, 2016). Data analysis commenced with the categorization of codes that highlighted emerging patterns from transcriptions of students and teacher interviews (Newby, 2014). This coding of participant responses was then comprehensively discussed and supported with current literature.

3.2.3 Sociocultural Perspective

Within social research, there is the objective to understand the “dynamics, content, context and structure of social relations” (May, 2011). The current study is situated within a sociocultural perspective. Originating from the work of Vygotsky, sociocultural theory was grounded on the notion that learning is a social activity. Children develop their higher order processes through interaction with others and their environment. Thus, learning is conceptualized as being heavily influenced by social and cultural processes, where an individual's interaction with their environment is of central importance (Nasir & Hand, 2006).

Traditionally, learning was thought to be a receiving of socially sanctioned knowledge where students were considered as the passive receivers. Freire (1970) defined this as a “banking education” where the simple depositing of knowledge into students who were considered as empty receptacles (Neito, 2010). However, among today’s educators, there is an ever-increasing understanding that learning is a sociocultural transmission where social, affective, environmental and cultural factors interact with more fixed cognitive factors (Barab & Plucker, 2002). More so than ever a sociocultural approach has been undertaken to delve into students’ learning and development where one’s culture is at the heart of the matter (Cole, 1996). The current research seeks to answer its research question through a socio-cultural lens whereby both data gathering interviews themselves and participant reports of experiences and perspectives are established on social and cultural influences. The next section covers the data collection methods utilised in the study.

3.3 DATA COLLECTION METHODS

This section details the data collection methods undertaken within the current study. These include group interviews and individual student and teacher interviews.

3.3.1 Interviews

“Interviewing is one of the most common and powerful ways in which we try to understand our fellow human beings” (Fontana & Frey, 2003, p. 61). In essence an interview is an interaction between researcher and participant, where carefully considered questions are employed to extract responses about the research subject. Interviews have the ability to reveal rich insights into people’s biographies, experiences, opinions, values, aspirations, attitudes and feelings (May, 2011).

There are three types of individual interview commonly utilized in qualitative research: structured, unstructured and semi-structured. While the structured interview operates with a prescriptive set of questions with limited flexibility possible, unstructured interviewing functions more like a conversation between

interviewer and respondent with a simple topic plan as a guide. Structured interviewing gathers unbiased data but without the range or richness, while unstructured interviewing has the ability to gather a wealth of information but has greater potential for bias.

The compromise for both these interviewing strategies is the semi-structured interview format, of which the current study utilized. The interviews adopted a predetermined set of questions with the opportunity to explore and clarify responses where needed. It ensured all angles of the topic were covered in depth and allowed exploration of unexpected but relevant question avenues.

Initial Group Interviews

Group interviews rely on systematic questioning of several individuals simultaneously. As such, they offer a useful means for researchers to explore group norms and dynamics around a specific topic (May, 2011). Though the interviewer is specifically guiding the interview by asking questions to each individual, the group context allows participants to continually reflect on their own thoughts in regards to others' responses. Thus, participants have the opportunity to comment and discuss their own opinions without waiting for guidance from the interviewer (May, 2011).

Group interviews offer some specific advantages that were relevant for this study. They present the opportunity to gather rich data which is cumulative and elaborative, they can be motivating for participants, foster recall and the format is flexible (Fontana & Frey, 2003). However, this format can also encounter problems. The results cannot be generalised, emerging group culture may inhibit individual expression, one person may dominate the discussion and 'groupthink' is a possible occurrence (Fontana & Frey, 2003). To combat these potential issues, the researcher must be vigilant and sensitive to the group dynamics. Techniques utilized by the current study's researcher included sensitively encouraging the quieter participants and ensuring as many responses were obtained from the group as possible, which ensured the fullest picture of perspectives were captured.

Semi-structured interviews were used with these groups because they allowed room for probing, clarification and discussion where possible. Often new questions would materialize and new discussion topics would follow. The purpose was to explore experiences of students within the classroom, and their beliefs and attitudes towards mathematics. The group setting allowed participants to discuss topics with one another as well as expressing their own individual experiences. These group interviews paved the way for core themes to emerge, which in turned guided the more in-depth subsequent interviews with individuals.

Individual Student and Teacher Interviews

Strengths of the individual interview process lie in its intent to combine structure with flexibility. This ensures that responses can be fully probed and explored as well as allowing the researcher to be responsive to pertinent issues spontaneously raised by the interviewee (Legard, Keegan, & Ward, 2003). It is useful when the sample size is small but the data elicited is rich and plentiful.

Despite their strengths regarding the elicitation of rich data, interviewing has notable drawbacks. They can be expensive, time-consuming, and may encounter scheduling difficulties. In relation to this study, the researcher was particularly aware of the need to be immensely flexible when working with students and teachers who are giving up precious schooling time in order to participate. In the current study, it was ensured that the organised time worked for both student and teachers. Furthermore, the interaction between interviewer and participant is prone to bias, meaning that the researcher can unintentionally steer respondents toward preferred responses through leading and closed questions. All efforts were made to ensure interview questions were objective and open, and that the researcher did not ask leading questions in an attempt to minimise the potential for bias.

As previously mentioned, the current study utilised a semi-structured interview format. This allowed the researcher to seek clarification from participants, and elicit in-depth information. This allowed student thoughts, beliefs and perceptions to be triangulated and confirmed, and ensured teachers were able

to speak freely about their experiences and beliefs. The nine students selected for the follow up interviews were chosen due to in depth and frequent participation in the group interviews or having made comments that required further exploration. The individual student interviews followed a different interview schedule but covered the same topics. The individual interviews also allowed the researcher to follow up on specific things students had said in group interviews that needed more clarification or exploration.

3.3.2 The Role of the Researcher

“There is no way we can escape the social world in order to study it” (Hammersley & Atkinson, 1983). In the social world, the relationship between the researcher and social phenomenon being investigated is interactive (Snape & Spencer, 2003). This means that in any study, the researchers bring to the table a certain set of values, judgements and assumptions. Unlike quantitative research, the research cannot be wholly objective and impartial about the study’s findings. After all, it is their unique design and interpretations of the data that produce the final results. Hammersley and Atkinson (1983) highlight the importance of reflexivity throughout qualitative research to ensure the researcher is open and honest about potential bias and judgements. Similarly, empathetic neutrality proposes that research cannot be value free but advocates for researchers to make their assumptions transparent (Snape & Spencer, 2003). As such, detailed below are assumptions that the researcher in this study holds:

Assumptions

- The researcher holds a socio-cultural perspective with regards to student learning;
- Each student brings a rich set of cultural values to the table;
- The student teacher relationship is a dynamic and important consideration;
- Mathematics is a core life skill that ought to be taught in an enriching and empowering way;

- That Year 8 is a significant year to address the core mathematical abilities of students as progression to high school requires specific mathematical skills to be in place; and
- The Developing Mathematical Communities of Inquiry program offers an effective platform for considering culturally responsive teaching for Pāsifika students.

3.4 THE PROJECT: SETTING SAMPLE AND SCHEDULE

This section covers information pertaining to the study sample and setting. Pertinent information about the students and teachers involved who participated are then included. Finally, an outline of the research timeline is included.

3.4.1 Developing Mathematical Inquiry Communities (DMIC)

The research participants of this study are involved in Developing Mathematical Inquiry Communities (DMIC) program of whole-school professional development. Within a DMIC classroom, culturally responsive teaching practices are woven through *communities of mathematical inquiry*. Inquiry can be thought of as students learning to communicate and act mathematically through participation in mathematical discussion and solving unique and unfamiliar problems (Richards, 1991). The DMIC program incorporates participation and communication patterns that promote students' use of reasoned mathematical practices (Hunter, 2008). Pertinent to DMIC is a Communication and Participation Framework (Hunter, 2008). This framework is used to scaffold teachers to involve students in mathematical practices within communities of mathematical inquiry. The students and teachers interviewed in the current study have been involved in three years of DMIC. The assumption can therefore be made that the participants within this study have been consistently involved in a classroom structure that is culturally responsive and well exercised in social norms embedded in the Pāsifika values and socio-mathematical norms embedded in a set of mathematical practices.

The study was conducted in two South Auckland decile 1 combined primary and intermediate schools from similar socioeconomic areas. The schools were

purposively chosen as they had been successfully running DMIC for three years. Both schools' populations are predominantly Pāsifika and one of the schools ran a Samoan bilingual unit. The student participants were identified with Pāsifika nations in school records and were enrolled as Year 8 students and aged between 11 and 13. The group interviews had 17 students from the first school and 20 from the second school. The individual interviews were made up of 4 students from the first school and 5 students from the second school. Students were randomly assigned to the group interview groups by the researcher. The participants recruited were achieving at or above the national standard for mathematics as identified from the most recent assessment data. The two experienced teachers involved in the study were teachers of some of the student participants, each had taught in DMIC classrooms for three years and represented the views of the other DMIC trained teachers within the schools.

3.4.2 Research Timeline.

Table 1: Summary timeline of research schedule

Phase	Time of Year	Actions undertaken
Phase 1	March-May	<ul style="list-style-type: none"> Literature Review and consultation with supervisor. Research question identified.
Phase 2	May-June	<ul style="list-style-type: none"> Meeting with representative of each school and consent obtained from Principals. Information sheets and consent forms distributed to students and parents.
Phase 3	June-July	<ul style="list-style-type: none"> Two pilot focus groups completed. Focus groups transcribed and consultation with supervisor arranged final interview questions.
Phase 4	July-August	<ul style="list-style-type: none"> 13 Focus Groups completed across the 2 schools. Transcription and analysis of focus groups.
Phase 5	August-September	<ul style="list-style-type: none"> Individual students identified and follow up interviews conducted.

		<ul style="list-style-type: none"> • Teacher interviews conducted.
Phase 6	September- November	<ul style="list-style-type: none"> • Final write up of Findings and Discussion.

The first phase of the project involved a preliminary literature review and consultation with the researcher's supervisors. Consultation with the researcher's supervisors included discussion of research plan, identification of research question, timeframes for data collection and ethics approval matters.

The second phase involved meeting with a representative of each school and discussing what their participation would look like. After obtaining consent, interview questions were piloted to two groups.

Subsequent interpretation and supervisory discussion led to the formulations of the group interview questions.

The third phase involved carrying out 13 group (n=37) interviews across both schools. Each group interview comprised of two to three students and took place in a private room with the students seated across from the researcher. The interviews were voice and video recorded. The researcher began by thanking them for their participation and explained that they were to be asked questions about their experiences in their mathematics class. The researcher then reminded the students of their rights to terminate the interview at any time and their right to refuse to answer any question.

The fourth phase began with the researcher transcribing the focus groups and coding initial themes from the data. Alongside the researcher's supervisor potential individual interview participants were identified on the basis of their responses in the group interviews. Teacher interview questions were also generated to ensure thorough triangulation of results.

The fifth phase involved conducting the follow up individual interviews. These student (n=9) and teacher (n=2) interviews took place in the same setting and circumstances as detailed above except the interviews were not video recorded.

The teachers (who had not been interviewed yet) were provided with information sheets and consent forms, which were read and completed on the interview day.

The final phase involved full transcribing and analysis of the individual interviews. Findings and discussion write ups followed this.

3.5 QUALITY CRITERIA

As with any research it is important to be critical and responsive of data gathering and interpreting methods. “Methodological awareness is a valuable mental resource in research studies” (Seale, 1999, p. 465). Continual effort has been expended by methodologists to give sound guidance to qualitative researchers in advancing or judging the quality of qualitative research (Seale, 1999). Outlined below are explanations pertaining to the reliability, validity, ethical and cultural considerations.

3.5.1 Reliability

Reliability is the extent to which the research could produce similar results under constant conditions across all settings. When it comes to qualitative research, achieving reliability is near impossible. Qualitative research cannot be generalized on a statistical basis and is instead a map of the variety of views, experiences, outcomes and the factors or circumstances that shape them, that can be transferable to the study sample’s wider population group (Lewis & Richie, 2003). In qualitative research, samples are drawn from essential and typical units where generalisations from the research can be based upon typical cases (Tolich & Davidson, 1999). Instead of viewing findings as replicable, reliability considers whether results are consistent with the data collected. Reliability can be enhanced by carrying out robust internal checks of the quality of the data and interpretation and through discussion of the research process within the report (Lewis & Richie, 2003). In the current study the sample of participants represent a group of Year 8 Pāsifika students achieving at national standards for mathematics within the context of a school participating in the DMIC programme.

3.5.2 Validity

Traditionally, validity of findings refers to the correctness or soundness of the reported research. It suggests whether an item accurately measures what is designed to measure. Several factors of validity are henceforth discussed: internal validity, triangulation and external validity.

Internal validity concerns whether the research data is accurately measuring what it is supposed to. Instead of generalizing to the whole population, this research represents an accurate description of individual accounts in a specific location (Tolich & Davidson, 1999). The current study ensured its internal validity through accurately transcribing participant voices, the researcher maintaining critical and reflective practice and being thorough in its descriptions of the data collection and interpretation process.

Fieldwork's validity is strengthened by triangulation, which can be described as the use of multiple sources of information, methods, theories, and techniques to generate a variety of data, which measures the targeted social phenomena (Denzin, 1978). If several sources reveal the same information, the researcher can be more confident in the validity of the findings. The current study utilized responses from separate sources (student and teachers) and through different means (group and individual interviews).

Traditionally, external validity refers to the generalizability of results across populations. This is at odds with qualitative research, which aims to capture unique points of view from specific populations. The best case, as Hammersley (1992) argues, is that validity must be judged on the sufficiency of the evidence offered in support of the social phenomena under investigation, however certainty of true accounts can never be ensured. Thus, with detailed information, sound judgments can be made about whether conclusions drawn from one study appropriately relate to another.

3.5.3 Ethical Considerations

It is vital for researchers to ensure their studies are conducted with robust ethical deliberation (Fontana & Frey, 2003). Research must adhere to ethical principles, rules and conventions and within qualitative research these ethical quandaries often arise in data collection and interpretation stages. It is important for researchers to be thoroughly transparent and honest with participants when it comes to informing them precisely about what their participation will involve, how long it will take, and where and how the information collected will be used.

Conducting interviews and focus groups with participants ensured their personal experiences were captured. However, this process puts the participants at risk of exploitation or misinterpretation. The researcher's attention to transparency imperatives and the interviewing style are intended to mitigate this potential.

It is important that participants fully understand their participation requirements before they give consent to be involved. Information sheets were therefore prepared for students, their parents, teachers, and principals detailing what their participation would comprise of, and how their information would be used. Participants were also informed that they would be offered access to the final report.

3.5.4 Cultural Considerations

Traditionally, research into Pāsifika peoples has been conducted by non-Pāsifika people for a non-Pāsifika audience (Nakhid, 2002). This poses the potential for information gained from participants to be misinterpreted or inaccurate conclusions drawn. As Vaioleti (2006) highlights:

For Pacific peoples, the historical pattern of data collection, knowledge creation and theorizing has been established by outside researchers gathering Pacific peoples' stories. They then try to make sense of the stories, and retell them, from their own sense-making stances. (p. 22).

Thinking in terms of other cultural groups, posits that anyone is capable of studying other groups, as long as it is explicit that their research is simply one view, not *the* view (Davidson & Tolich, 1999). Qualitative research of this kind presents the opportunity to have Pāsifika voices heard first hand. However, in order to truly understand and interpret, it is important for researchers to listen and take in another culture's views. Ethnocentric assumptions can be carefully considered and reduced so long as there is an awareness of how bias can creep into research, an open and honest awareness of the assumptions made, and ensuring ongoing consultation with members of the included cultural group (Davidson & Tolich, 1999).

Throughout the current study the following steps were taken to support the application of ethical principles and cultural considerations:

- i. The study obtained a low risk Ethics approval in consultation with supervisors, Massey University;
- ii. Approval to conduct the research in specific school sites was obtained from the participating school principals;
- iii. Written informed consent was obtained following the distribution of information sheets. The information sheet informed potential participants of the researcher's credentials and why the research was being conducted. The participants were given the option of participation in both focus groups and or interviewed individually and, whether they consented to be videoed and or audio recorded. Prior to interviews and focus groups, participants were informed of their rights, which included their ability to terminate their participation at any time, turn off the recorded device(s) at any time, what the information was being used for and what the content of the interviews and focus groups would cover. Explanations were given in a manner as to maximise student understanding. Consent was also sought from students' parents or caregivers after the same detailed information was distributed;

- iv. Confidentiality was ensured by handling information in a safe and careful manner. Focus Group and Interview data were stored securely on the researcher's password protected computer;
- v. Assurance was given to participants that identification of any individual or school from the research report would be protected through utilizing generalised school descriptors and the use of personal aliases in any written material; and
- vi. The cultural gap between the participants and the researcher was considered by the researcher seeking Pāsifika cultural advice from her Cook Islander supervisor. Interview and focus group questions were approved by the supervisor and students' teachers.

3.6 SUMMARY

This chapter has outlined justification for the qualitative research design of the current study and the socio-cultural perspective in which this study is set. It has also covered the data collection methods and the role of the researcher. In addition, descriptions of the setting, participants and research schedule have been provided. Finally, it has discussed the quality criteria including, reliability, validity, ethical and cultural considerations.

CHAPTER FOUR – FINDINGS

4.1 INTRODUCTION

The literature review discussed the research concerning culturally responsive actions that foster cultural identity and mathematical disposition of Pāsifika students. Evidence from research advocates for culturally responsive actions to be supportive of student engagement in mathematical discourse, argumentation and understanding, as well as supporting and nurturing students' cultural identities. Findings from student and teacher interviews discussed in this section provide evidence of culturally responsive actions taking place.

Section 4.2 examines the role of Pāsifika languages in supporting students to engage in mathematical discourse. Section 4.3 highlights how incorporating students' cultural contexts supports students to connect mathematics to their lives. Section 4.4 describes ways in which Pāsifika values were used to support students' use of mathematical practices. Section 4.5 highlights ways in which teachers took responsive actions and enacted an ethic of care to support student participation and understanding. Section 4.6 describes student accounts of their mathematical dispositions. Students explanations of their cultural identities are described in section 4.7. A final summary section concludes this chapter.

4.2 THE ROLE OF PĀSIFIKA LANGUAGES

Across all interviews, whether students or teachers, there was a strong perception that students' use of Pāsifika languages was a valuable and important tool. This was important because the use of Pāsifika languages in the mathematics classroom was perceived to support students' development of mathematical understanding alongside supporting students' cultural identities. This endorsement was matched by reports of actual use of Pāsifika languages in the classroom, with twelve (n=12/13) group interviews noting that Pāsifika languages were utilized by either themselves or others in their mathematics

classroom. Many reports (n=7/13 group interviews) noted that the use of Pāsifika languages promoted inclusion of their fellow peers, some of whom were still grappling with English:

Some kids are from or just came back from Samoa like they not really that good to use English so we can just communicate with them with their language. (Group Interview [GI]#3)

Like if you grew up in Tonga and then they say something that they don't understand like there's lots of Tongans just to translate. (GI#6)

In a follow-up interview one student revealed the comfort and acceptance as a Samoan learner; she felt that she was able to express herself in her first language.

I felt really embarrassed because when you're out in the city and then people ask you something in English but you didn't understand, like trying to say something and then they start laughing at you and stuff, yeah... I'm comfortable because I have a lot of friends that are the same as my culture, I can just tell them anything I want in my language. (Student Interview [SI]#4)

In addition to the more general sense of belonging and participating, students also provided examples of how Pāsifika languages were utilized for deepening mathematical understanding. Code-switching between Pāsifika languages and English was most notable in reference to discourse, help-seeking and giving within small group activities. For example:

If we has group discussion some of us will talk Samoan and then English... some of us in our class understand better in different languages like Samoan they wanna talk Samoan to them. (GI# 4)

When you are stuck with it you will ask for help in your own language. (GI#9)

Both teachers also described how code-switching enabled students to gain a stronger understanding of the mathematical discussions, stating that the freedom to switch between their preferred language and English enabled them to access deeper levels of understanding:

It helps their understanding. (T-Steve)

Because a lot of them come from Samoa, and it's their first language, it's pretty much their first language, but even for the New Zealand born ones. Something in English that they don't really understand, they can actually get the understanding from the Samoan word, and they're like, ah. (T-Sita)

Another role of code switching (discussed in four group interviews) involved Pāsifika languages as a means of social banter. More specifically, these students described using their language in a secretive manner, so teachers and other students would not know what they were discussing:

Student 1: Sometimes we talk to each other like the teacher doesn't know what we are talking about.

Student 2: Sometimes the Maori Teachers they talk in Maori and we kinda don't understand, that's why we talk in our own language. (GI#4)

These explanations represented freedom for students to express themselves in their own unique language. Marking themselves as different from their Maori teachers by speaking their home language suggests they wished to express their cultural identities as relevant too:

I like how our teacher won't stop us [laughs]. Sometimes she might let us but then there are times when she won't. Yeah, I like it. (GI#5)

These students valued being able to express their own cultural language, and the sense of autonomy appeared to enhance their cultural identity during both planned learning time and social interactions.

4.3 CONNECTING STUDENTS' CULTURAL LIVES TO THE MATHEMATICS CLASSROOM

The perception for these students that their culture is represented and validated within their mathematics class allowed them to explicitly connect mathematics to their cultural identities.

In addition to the use of language, this connection was visible through the utilization of mathematical activities that were situated in their cultural contexts. Students in five group interviews explicitly noted that they liked word problems that reflected their own cultural heritage. They expressed a sense of ownership and pride in seeing cultural heritage echoed within mathematical word problems:

Like sometimes the problems like word problems that you realize that relates to your home. (G1#11)

It's pretty cool cause our teacher is Samoan and she tells us Samoan maths problems like we are learning about volume and the problem was how many 'ie toga [Samoan mat] can fit in our cantina. (G1#9)

Teachers also were aware of the importance of connecting mathematics to their students' cultural lives. As T-Steve explained:

It can be context of the problem. Also yeah, that's very important for people. I like to think we do that quite well, and talking about it outside of the maths lesson.

For T-Sita, this awareness was deliberate and represented a shift from her previous practice. Moreover, she noted that this shift was for the benefit of all students' learning:

I've learned to, instead of giving them clues constant clues and pretty much solving it for them, is to look at the context, get them to reread the problem, and just try to put that problem into a clearer perspective for

them. They click... They have the context but it's knowing where those numbers go within that context and what to do with those numbers.

Students' ability to mathematize the problems is increased when the context is relatable and meaningful (McDuffie et al., 2011). By offering a familiar context that students recognize, it supported them to match mathematical knowledge and strategies to the problem.

4.4 DRAWING ON PĀSIFIKA VALUES TO SUPPORT MATHEMATICAL PRACTICES AND SOCIAL NORMS

In order for students to develop deep mathematical understandings, mathematical inquiry classrooms need to cultivate socio-mathematical norms that promote proficient use of mathematical practices. This section describes how the participants perceived the role of the Pāsifika values of collectivism, respect, family, and communalism and how these values promoted socio-mathematical norms and mathematical practices within the mathematical collaborative learning environment.

4.4.1 Collectivism supporting Group Participation

Creating an environment where students feel safe and are able to engage in mathematical discussion, argumentation, and debate can be challenging in other contexts. However, participants within this study were all from schools that had extended involvement with *Developing Mathematical Inquiry Classrooms* (see page 40) where, group participation and collaborative inquiry was part of the classroom culture.

The sense of community that is advocated within DMIC was evident in participants' discussions. For example, when discussing the process of small group work, student discussions reflected the Pāsifika value of communalism and collectivism—in that they noted that all group members were expected to participate: “Everyone is in a discussion; it’s not just based around one person” (GI#4). Importantly, some students were able to further articulate this sense of

community to explain that participation involved both responsibility for one's own learning and the learning of others. As GI#5 noted:

Student 1: We work together

Student 2: It's like we have to work together, someone can't be doing everything

Student 1: Make sure everyone understands

Students were aware that the collective contribution of ideas enhanced all members' learning, that is, the mathematical thinking and reasoning of the collective was more powerful than the sum of the individuals.

However, group work is not without its challenges. For example, a few group interviews (n=3/13) discussed times when class members were uninvolved in group discussions, and this was highlighted as a barrier to the group's learning:

Some of them don't do anything... they're like passengers... drivers are just doing it, so when people are in the group they try to pull them in and ask them questions. (GI#8)

However, the sense of collectivism appeared strongly embedded, with this group member noting the responsibility for inclusivity in their approach.

To enhance the collectivism approach for working within a group, students also described a number of norms they utilized as a means to support their peers. For example, explaining things in different ways was a common strategy to engage their fellow classmates (n=7/13).

Student 1: Like keep explaining, and show them this thing and that strategy

Student 2: To try and drag them into what we are doing (GI#3)

The expectation that students shared and embraced multiple strategies when solving problems provided strong support for developing capacity in

mathematical reasoning. In the group interview discussions, frequent opportunities to engage in mathematical practices which involved explanations and argumentation skills was linked to the students' sense of being a mathematical learner. Specifically, group interviews members readily discussed these practices in relation to the goal of developing understanding as follows:

Add some more details... Tell them to repeat to make sure they understand. (GI#13)

If you know something and they don't understand... give the pen and paper to them and let them have a try. (GI#9)

Overall, these examples reflect students' understanding that learning must come from participating in a social dialogic learning environment rather than an individualist one.

Teachers also described the importance of shaping the classroom learning environment to support communication and participation. T-Steve noted that the norms associated with teamwork were designed to enable students to support each other to participate: "It enables children to see what they did; it engages them more, because they're part of it". T-Sita also confirmed the advantages for collective group work: "Just the whole collaborative learning environment has been really beneficial for our kids".

These reports captured the idea that when group participation is grounded in the cultural values of students, they are able to appreciate and participate in the collaborative learning environment that supported their use of proficient mathematical practices.

4.4.2 Respect Shaping Students' use of Mathematical Practices

The use of mathematical practices, especially those associated with mathematical argumentation, is central to developing rich mathematical understanding (Goos, 2004). However, communicative patterns that include argumentation and debate require high levels of active listening and respect for others' thinking (Hunter & Hunter, 2017). Students in this study described

participating in such interactions. When asked what they did to support one another's learning, the group interview discussion (n= 12/13) included descriptions of utilizing mathematical practices like explaining, justifying, agreeing, and disagreeing. Students were well versed in mathematical argumentation techniques and recognized how to establish fair debate interactions. For example:

Student 1: We have to justify our answers. It's like how we got the answer, your strategy, the explanation.

Facilitator: What would you do if you didn't agree with someone's answer?

Student 1: Then you have to justify why you don't agree 'cause you can't say no because you have to change it. (GI#4)

The Pāsifika value of respect was reflected in the mathematical practice of offering justifications when challenging another student's idea. Specifically, several groups referenced the term 'friendly arguing'. As one student described it:

So when that person says 'oh no it's like this way' but then the other person says 'oh no it's like this way' then they should discuss what they have to do. (GI#1)

The term 'friendly arguing' appeared to offer a way to ensure that these students could engage in powerful and respectful interactions without undertones of threat or challenge or the loss of face. When asked how the argument remained friendly, students described social norms of interaction:

Student 1: Don't like shout and that.

Student 2: Don't go like your answers wrong I disagree I think my idea is right.

Student 3: Justify. (GI#7)

Don't bring negative words into it. (GI#12)

These excerpts capture the social norms of politeness as well as the importance of offering a justification in response to disagreeing with someone's explanation.

Respect for peers was also shown through explanations of others' capabilities. Many students highlighted the idea that everybody had something to offer the group suggesting that all students had strengths and capabilities. Sharing and utilizing these capabilities was seen as a positive in the mathematics classrooms. For example, one student noted that she liked that "everybody is able to contribute in speaking and everyone is not too shy, everyone is helping each other and how the boys and girls are able to interact with each other".

Both teachers also highlighted respect for all students' capability and the importance of ensuring their students' valued each other's contributions. As T-Sita noted, she was "trying to raise awareness that everybody is good at maths, and everybody's got their own way of doing it". Reflecting on the success of this, T-Sita noted that the consequence was that "they've come to really value each other and see themselves as equals".

These reports suggest that the Pāsifika value of respect had permeated collaborative interactions and the classroom ecology. Students realized their peers possessed unique capabilities and provided valuable contributions. When the rhetoric of respect is reinforced, students take steps to challenge each other's thinking in a way that does not undermine and devalue their abilities. Challenging others' thinking requires students to take risks, which emphasizes the importance of creating safe and inclusive spaces.

4.4.3 Pāsifika Value of Communalism and Family in Supporting Students to Engage in Risk Taking.

While respect is an important part of fostering effective use of mathematical practices, so too, is developing safe spaces for students to engage in collaborative learning. In particular, mathematical argumentation can be associated with risk and emotional labour (Bibby, 2009). Participants' responses suggested that shaping the classroom dynamics through the Pāsifika value of family and communalism was an effective way to support the risk associated

with mathematical argumentation within a community of inquiry. For example, students in five of the group interviews described the importance of coming together as one collective group to share ideas:

We all come together working as one group. (GI#6)

Student 1: Sometimes they will bring us together if we're stuck on that one question.

Student 2: Then we'll work on it together. (GI#3)

These examples suggest that potential risk is mitigated through the use of Pāsifika value of family and communalism, where everyone is involved and working together. During these collaboration occasions, students are required to contribute by sharing their ideas and hearing alternative ways of completing the same problem.

During one group interview, some students described how sometimes group members refrained from participating in their own group's discussion. When it was time to share their problem with the class they asked that person to speak for that group and take a risk with their learning. Other group members supported this student, by whispering answers to him and by showing him the working out. In this example, students are pushing the reluctant student to engage in practicing mathematical explanations while being safely supported by his group - exemplifying the Pāsifika values of communalism and family that support and reinforce risk-taking actions.

Both teachers also spoke about a fostering safe and communal space for their students to communicate mathematically. T-Sita for example, stated that "communication is everything, and being in a safe environment where they feel supported is everything to these kids".

Emphasizing polite and respectful interaction is important for students to engage in powerful mathematical argumentation and take risks in front of their peers. Being part of a respectful and communal family affords students the possibility of proficiently interacting as mathematicians. In conjunction with this,

being a part of a classroom environment that fosters all students' cultural ways of being and interacting likely reinforces their cultural identities.

4.5 ENACTING AN ETHIC OF CARE AND RESPONSIVE TEACHER ACTIONS

Teachers who enact an ethic of care, challenge and have high expectations of their students (Noddings, 2012). In addition, culturally responsive teachers take steps to know and interpret their students' needs and capabilities (Gay, 2010). This section discusses teacher actions that promoted students' participation in mathematical discourse and understanding, and the high expectations they had of their students.

4.5.1 Teacher Actions that Promote Student Participation

Across all group interviews students readily highlighted their teacher's role as an important factor in ensuring participation in group discussions and making strong mathematical connections. They noted that teachers took steps to ensure all students were participating in and understanding the mathematical problem or strategy. These approaches included consistent questioning, asking students to repeat their reasoning and being responsive to class participation patterns.

Making understanding explicit through questioning and repeating

When students were asked about what things their teachers did to help them learn, the most common response was questioning and getting students to repeat their reasoning (n=10/13 group interviews).

Student 1: Helps us to go to a deeper.

Student 2: Asks us deeper questions. (GI#13)

In addition, students were able to describe some of the questions their teachers utilized when making sure they understood problems:

Student 1: What did she say? Or can you repeat after her?

Student 2: How did you get that answer?

Student 1: How did she get that answer?

(GI#4)

Questions like these prompt students to explore mathematical problems and strengthen their mathematical reasoning. Students also noted that teachers were more likely ask questions and get students to repeat group discussion, when they were not participating or listening to the group.

And if we are in groups and no one is talking she makes that person talk.

(GI#8)

She asks us questions about what we did to see if we were listening.

(GI#6)

Likewise, T-Sita also spoke about promoting 'explicitness' in student reasoning by asking students to repeat and describe their mathematical processes. She highlights: "just really getting students who understand to make it explicit in their reasoning when they are working in small groups." As such, ensuring explicit reasoning assists other group members to listen to explanations that may assist with their understanding.

Collectively, these responses describe teachers who are continually ensuring that all members of the class are following and engaging in discussions. These teacher actions foster participation expectations that enable students to consistently engage in a collaborative learning environment.

Responsive to Participation Patterns

The importance of teachers being perceptive and ensuring a heightened awareness of class discussions was an important factor in ensuring all student voices were heard. One teacher described celebrating student thinking with the whole class and ensuring success was noticed:

Probably when they do something, just make a really big deal out of it, and just really get the whole class on board... also making sure that they're being heard in the groups, because sometimes that will put them off. (T-Sita)

While it is important that teachers valued student thinking and provided opportunities for all students to share their thinking publically, some students noted that sometimes dominating students had the tendency to overshadow others:

Kids coming out more and talking, because how they're passengers and drivers, there are a lot of passengers and the drivers are sometimes taking over. (Sl#4)

Though social interaction affords a space to explore mathematical ideas, being collaborative and providing equal opportunities is not always straightforward. As many studies have noted group work can result in less confident students retreating from powerful learning interactions and affirming their risk adverse nature (Hunter & Anthony, 2011). This places importance on teachers knowing their students and monitoring class participation. For teachers in this study, they referred to the need to continually reiterate the talk norms as a solution to reengaging disinterested students. As T-Steve noted:

If it's a consistent pattern, then it might be resetting the norms, going back to that and talking about that... going over with the children on what they're supposed to be doing in the lesson, what we expect from the lesson, how we behave in the lesson, that sort of thing. Then praising those behaviours you want.

As previously discussed, fostering respectful mathematical practices is an important means of generating a collaborative mathematical inquiry class. The teacher above described the importance of re-establishing the social norms to ensure the group space was safe and conducive to mathematical discussion.

4.5.2 High Expectations of Students

It is vital for teachers to have high expectations of their students and utilize challenging contextualised tasks to help develop rich conceptualised understandings (Hunter & Hunter, in press-b). For some students, they expressed a positive response to being challenged by their teachers. Believing that challenging students could make deeper understandings and connections

showed them that their teachers had high expectations of them and believed in their capabilities. Students in the follow-up interviews highlighted ways in which their teachers challenged them including:

I like how she changes it up sometimes. She can do something hard this day, something easy for me to do the next day, then she could just go up above way too high for me. (SI#5)

She just throws hard questions at any time. When we're on the mat, she just tells us - we do our questions we're supposed to do, and then the next minute, she tells us to do something quickly in our heads. (SI#3)

Similarly, both teachers highlighted the importance of preparing questions that would challenge all students:

Setting the problems at a challenging level. Yeah, so that's in the preparation. (T-Steve)

I'll have problems ranging from easy, hard and then something harder and then I'll have that will even challenge the top student. (T-Sita)

These responses described how teachers set challenging tasks for students and suggests and they had high expectations of them—expectations that are not always apparent to Pāsifika students in other classrooms (Spiller, 2012). It is through this corresponding supportive approach and questioning that students in this study were afforded opportunities to engage in higher levels of learning.

Associated with the development of high expectations, both teachers described the importance of knowing their students and their learning needs. In this way, challenging students did not always come in the form of questions and guidance, but in learning to step back and allow their students to explore problems by themselves:

During the lessons as well, we - when they get to stages like that, different students have different motivation and engagement levels.

Some students will naturally look - want someone to help them all the way through it. So, to challenge them, it's more like no - you put it on them to work through it. Yeah. (T-Steve)

In this response, T-Steve is clearly responsive to the needs of his students. He is aware of how his students are engaging in problems and the levels of support they are seeking. He recognizes the need to support student agency, and in doing so is learning when to step back to allow them to conduct mathematical discussion.

4.6 MATHEMATICAL DISPOSITION

Discussion thus far has delved into the culturally responsive actions that support mathematical discussion and argumentation. This section evaluates how students described their feelings towards mathematics. Having a positive mathematical disposition entails “a habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one’s own efficacy” (Kilpatrick, et al., p.116). Almost all of the responses from within the group interviews revealed positive opinions of mathematics (n=12/13). Questions within the group interviews specifically explored why they enjoyed learning mathematics. Responses fell into three key themes: learning and using mathematics, being challenged by mathematics and future orientations and seeing the value in mathematics.

4.6.1 Learning and Using Mathematical Strategies

When asked why they enjoyed mathematics, many group interviews talked about the process of learning and using mathematical strategies (n=11/13). Specifically, the students expressed that they enjoyed learning about different ways to complete mathematical problems:

I like maths cause I get to learn new strategies and different ways to find the answer. (GI#1)

The different strategies, how many patterns there are in maths... I can deal with maths every single day, it's fine. (GI#2)

Students often named specific mathematical topics that they enjoyed (n=9/13 group interviews) including: the distributive law, area, geometry and algebra. While many primary students regard mathematics as ‘number’ based (Leder, Pehkonen, & Törner, 2006) it was interesting that students provided a more balanced and integrated view of mathematics. One student highlighted her reasoning for a variety of different mathematical topics as follows:

Student: Fractions, sometimes. I like fractions, like using equivalent fractions. My most favourite thing is algebra.

Researcher: What do you like about algebra?

Student: There’s lots of different ways to work it out. (SI#3)

Another consistent response regarding their preference for learning mathematics was being able to share strategies and learn off one another (n=7/13 group interviews). In many responses there was a sense that mathematics was not viewed as an individual endeavour, rather learning involved a communal activity where learning from one another is central:

I like solving the problems and sharing ideas with each other. (GI#5)

I like the idea of us sharing our ideas and... having others share their ideas too. (GI#11)

These examples not only describe students enacting Pāsifika values but also denote students discussing mathematical problems and strategies, and consistently using and practising them with one another. In doing mathematics they are interacting as mathematicians, through learning new methods, terms and understanding from one another.

4.6.2 Being Challenged by Mathematics

Students’ diligence and perseverance was noted in their discussion of the challenging nature of their mathematical experiences (n=5/13 group interviews). They denoted that being challenged by mathematics was beneficial to their learning— “it’s sometimes challenging and it helps”.

In addition, clue or hint giving was described as a useful means for supporting students to make mathematical connections (n=4/13 group interviews). Students realized that being presented with the working and the answer would not afford them valuable learning opportunities. They described how the teacher would give them clues and hints towards generating understanding. For example, one student described how their teacher would support them by: “giving us ideas and clues... Its more challenging” (GI#1). Understanding their teachers’ intentions behind clue giving suggest that these students recognized that they needed to problem solve themselves in order to make mathematical connections.

Students also reported that successful mathematical learning required tenacity and persistence, and were simultaneously motivated to succeed. One student remarked that maths was “like an adventure sitting down... like with pen and paper”. When asked to expand on this idea in an individual interview they revealed:

See, when I used to do maths I used to do my maths, and then the fact you're going outside the book and there's so many things you've never seen before, there's like new things you've learnt. Sometimes you just don't want to do them, but then you end up doing them because they end up fun. It's challenging sometimes but I manage to get through it. (SI#4)

This example expresses a journey a student has undergone. Instead of “doing maths” for the sake of it, he appreciated being challenged by learning new things. Though the process was not always straightforward, he found the hard work rewarding and relished in his achievements.

4.6.3 Future Orientations and Seeing the Value in Mathematics

Having a positive mathematical disposition frequently involves conceptualizing the value and usefulness of mathematics. During group interviews, students all expressed that they believed mathematics was important —sensing its value in several aspects of their current and future lives. In discussing the utilitarian views of mathematics many students described future job preferences (n=8/13

group interviews). For example, jobs like accounting, architecture, police officer, and construction often arose in group interview discussion:

In the future, whatever you wanna be, it has to be maths. (GI#6)

Student 1: Pilot.

Student 2: A lawyer.

Student 3: A policeman.

Student 1: Many kinds of jobs. (GI#12)

Some students (n=3/13) within the group interviews discussed a possible career in relation to the relevant mathematical topic:

Maths is important because, for the future, these jobs they need like building, need to learn the maths like how long the wood will be to do the houses. (GI#1)

During individual student interviews students were able to see the value and efficacy of mathematics in terms of situating mathematical knowledge and know-how as a valuable asset for future careers.

The usefulness of mathematics in students' current lives was also frequently described; particularly in relation to monetary, cooking, and games organization. Utilizing mathematics for shopping and money related purposes were consistently recalled in most group interviews (n=10/13).

If you go to the shops, you like need to know the amount of money you give to the shopkeeper and the amount of change you get back. (GI#3)

You will need it in the long run... sometimes if you need it to pay bills and stuff. (GI# 3)

Cooking was recalled as a useful application (n=4/13 group interviews), and playing games (n=5/13 group interviews):

We use it in cooking... for measuring. (GI#4)

When we play league we count how much tackles have been made.
(GI#8)

Overall, students were readily able to relate useful applications for mathematics to their lives. As one student noted “mathematics is in everything and everything we do”. These students had developed strong relationships with mathematics that contributed to their development of a positive mathematical disposition. In addition, they also linked the mathematics to their cultural and social worlds.

4.7 CULTURAL IDENTITIES

Previous discussion highlighted how using Pāsifika languages, incorporating students’ culture into word problems, and shaping mathematical practices through Pāsifika values supported access to powerful mathematical discourse patterns and also served to affirm students’ cultural identities.

Rather than perceiving mathematics as separate from their culture, these students were able to experience strong cultural alignment within their mathematics class—an alignment which served to affirm their cultural identities. When asked how it felt to be Pāsifika within the classroom, all students (n=13/13 group interviews) revealed how it was simply “normal” or “good”. The idea that each student held a unique cultural identity and that the mathematics they did at school as part of that world was normalized:

Student 1: It feels normal. [to be Pāsifika]

Student 2: Normal.

(GI#6)

Responses from this question again reiterated the value and enjoyment of sharing ideas with people (n=5/13 group interviews). One student described that “it feels cool cause you get to share ideas with your friends and they get to share ideas with you”. This student is echoing many Pāsifika values around family, reciprocity and collectivism.

The teachers also were aware of the importance of supporting strong cultural identity in the mathematics classroom. As T-Steve discussed, students who

have strong cultural identities are able to better appreciate and execute sharing ideas and supporting each other in class:

So, I've found children - the children that I would say have been the best students at doing this, have extremely strong cultural identities. Speak their own languages, have very strong Pāsifika values at home, are also very focused on why it's relevant for their lives, what their future's going to look like, and then totally why we talk to each other in a group. Why is that valuable, to share? Why is it valuable to you, to help someone else, or be helped by someone else?

As noted, the sense of family and collectivism associated with Pāsifika values resulted in positive help-seeking behaviours. In individual interviews, students spoke about the importance of helping their fellow students, expressing not only joy in receiving help but also in being able to help their classmates make connections:

I think it's learning new strategies and also getting to help others that are struggling in maths... That I want to help others, I see the smile on their face and it just makes me really happy. (I#3)

Student 1: Well, she puts us with other groups... some are intelligent, and then some are not really at the level... the rest were under-standard, national standard. So, it was my job to take the role and to be responsible for all of them, and tell them how I think so that they could get up to national standard.

Researcher: Okay. What do you like about that role?

Student 1: To communicate with them, to help them to get better. (S1#2)

Providing students with opportunities to act as leaders and use their own mathematical knowledge to support peers was particularly important for developing student agency. Though their motivations may differ, both these students appreciated the importance of participation in mathematical conversation and wanted to support their classmates.

4.8 SUMMARY

This chapter has discussed the perceptions and experiences of students and their teachers participating in culturally responsive mathematics classrooms. The role of language was shown to support students to help each other understand the mathematical content with the additional use of code-switching to gain deeper understanding of mathematical ideas. Students appreciated seeing culturally relevant elements in their word problems. In addition, teachers reported the value of familiar context, allowing students to better connect mathematical ideas to word problems. Pāsifika values of collectivism, respect, and family were shown to develop students' proficient use of mathematical practices. These values ensured that students took responsibility for their own learning and the learning of others, engaged in respectful interactions and felt safe to take risks and share ideas publically in front of the class. Teachers took actions to support student participation in mathematical discourse by making students explanations explicit and listening carefully to student discussion. Teachers and students also reported on the ways in which teachers expected their students to engage in challenging mathematical activities and thinking. In a dynamic way, evidence of students' high-level mathematical thinking served to reaffirm teachers high expectations for their students. Culturally responsive actions were corroborated by student reports of their mathematical disposition and cultural identity. Students reported frequently learning and using mathematical strategies, being challenged by mathematics and reported utilitarian views regarding future career options and seeing present value in mathematics. Student cultural identities were wholly confirmed through commenting how normal it felt to be Pāsifika in the class. Cultural identities were further affirmed through student reflection of the importance of helping one another and sharing ideas.

The significance of the findings are discussed and explored in the next chapter.

CHAPTER 5 – DISCUSSION AND CONCLUSION

5.1 INTRODUCTION

The previous section covered the findings of the current study. Interviews with students and teachers revealed the use of home languages, incorporation of student culture into the mathematics class, drawing on Pāsifika values to develop respectful social norms and enhance the use of mathematical practices and teachers' high expectations and responsive actions that supported participation patterns developed students' cultural identity and mathematical disposition. Students described positive affirmations for the learning and using of mathematics as well as positioning mathematics as vital for the future. They also revealed strong cultural identities through positive assertions of their culture and strongly affirmed supporting and working with their classmates. In this chapter findings are discussed and supported with relevant literature.

Section 5.2 outlines the role of Pāsifika languages in supporting students' cultural identities and mathematical dispositions. Section 5.3 examines how connecting students' cultural context to mathematical problems supported cultural identity and mathematical disposition development. Section 5.4 describes how Pāsifika values shaped students' use of mathematical practices and social norms. Section 5.5 describes the responsive actions teachers took to support participation in mathematical discourse and how they enacted an ethic of care. Section 5.6 discusses elements of students' mathematical dispositions. Section 5.7 discusses the cultural identities of the students. Teaching implications for the study are described in section 5.8 and limitations for the study are discussed in section 5.9. Section 5.10 puts forth possible directions for future research. Section 5.11 ends this chapter with the study's concluding thoughts.

5.2 THE ROLE OF PĀSIFIKA LANGUAGES

Pāsifika languages offer students a powerful resource that they can draw upon to engage in the mathematics classroom. Findings from this study indicated that

students utilized their home languages for a range of reasons. They indicated that they used their home language to support their peers whose English was limited. They also perceived that the use of their home language supported others' mathematical understanding. Similar findings have been documented in previous research (e.g. Bills & Hunter, 2015; Hunter & Anthony, 2011; Sharma et al., 2011). Sharma et al.'s (2011) study highlighted through interviews with Pāsifika students that they utilized their home languages to help their peers understand and engage with mathematical discussion. Similarly, Bills and Hunter (2015) found that by utilizing home languages students were able to support and ensure that all members of the community could interact and participate. Hunter and Hunter (in press-b) argue that allowing the students to select a language they are most proficient in and as necessary code switch between that language and English provides Pāsifika students with access to richer and deeper mathematical understandings and it also positions them as experts within their culture. This was a similar finding in this study, where the allocation of preferred language use within the class afforded students the ability to support their peers' mathematical understanding but also to practice their home languages and affirm their cultural identity, while also enhancing their mathematical disposition.

Pāsifika languages can be used as a means of gaining deeper mathematical understandings for Pāsifika students, through being able to code-switch from their home languages and English. Students in the current study described switching to their home languages when they were explaining to their group, or didn't understand something. Similarly, in Chueng's (2015) case study, Pāsifika students code switched between English and Samoan, and English and Tongan to discuss and elaborate their ideas. In addition, Bills and Hunter's (2015) study described how Pāsifika students code-switched between languages in order to verbalize and articulate meanings of words or phrases. Civil (2014) contends that students are empowered when they are free to use their preferred language and this enhances the depth of discussion. Moschovich (2007) highlights that code switching can enable students to engage in a range of mathematical practices like justifying and explaining mathematical reasoning. Similar findings within the current study suggest that proficient use of code

switching afforded students the capability of reaching deeper levels of mathematical understanding. This supported them to develop their mathematical dispositions while simultaneously maintaining their cultural identities.

Code switching allows for articulation of mathematical concepts or meanings that may not have been fully established in Pāsifika languages. During interviews students described how they spoke their home languages when they needed to clarify something. Fasi (1999) identifies that some Pāsifika languages have mathematical discourses that have not been fully developed yet, and this can cause confusion among Pāsifika students. For instance, the Tonganised word “sikuea” (square) takes on several mathematical meanings including an area, a number, or a numerical property (Fasi, 1999). One study identified that Tongan and Samoan students who utilized code switching between their home language and mathematical language in English, performed better compared with those who used their limited English as their first language (Latu, 2005). Being able to aptly confirm or articulate mathematical meanings allows students to fully understand mathematical content and develop their mathematical dispositions.

When students are free to express their cultural languages, this supports and validates their unique identities. Students within the current study reported freely conversing in Pāsifika languages within the mathematics class both for mathematical activities and in social interactions. They identified chatting with their friends to prevent others from understanding what they were saying. Speaking their home languages in the school setting afforded students validation of their own unique cultural identities. Research studies have found that students feel secure and empowered to learn when their language and culture is respected within the school environment (Ferguson, et al., 2008; Fletcher et al., 2011; Tuafuti, 2010). Pāsifika people wholly value their language and cultural identities (Tuafuti, 2010) and it is therefore important to validate within education settings. Cummins (2000) highlights the idea of collaborative power relations:

Students who have experienced collaborative power relations with educators are confident because they know that their sense of identity is reaffirmed and extended in their interactions with educators. (p. 44)

Having collaborative power relations ensures that students feel accepted, valued and empowered within their school settings. The students within this study expressed total freedom and security when using their home languages, their ideas were readily articulated and cultural identities wholly validated.

5.3 CONNECTING CULTURAL CONTEXT TO THE MATHEMATICS CLASS

Situating students' culture into the mathematics class is effective approach, which connects students' home and school lives. Students within this study regularly reported that they valued seeing Pāsifika culture reflected in the mathematics class. These findings are supported by researchers (e.g. Freire, 2000; Hill & Hawk, 1998; Moll & Greenberg, 1992) who advocate for situating educational practices in the lived experiences of diverse learners in order to transform oppressive structures that marginalize them by drawing on their cultural capital. Bills and Hunter's (2015) study documented that when the cultural capital of Pāsifika students is utilized in mathematical problems and discussion, it connects mathematics to their "lived" lives and students are better able to conceptualize mathematics as part of their worlds and have their cultural identities confirmed (2015). Equivalent findings were highlighted in the current study, where students were able to see their cultural lives reflected in the mathematical problems and activities, which validated their cultural identities. In addition, connecting student culture to the discipline of mathematics, they reported shifting their conceptualization of mathematics into a relevant and meaningful entity.

Utilizing students' cultural contexts supports aptitudes for mathematization of problems. Teachers within the current study emphasized that cultural contexts supported student understanding of mathematical problems. Research (e.g., Jackson et al., 2012; McDuffie et al., 2011; Wijaya, van den Heuval-Panhuizen et al., 2005) contends that a crucial characteristic of a context for learning

mathematics is that there are possibilities for mathematization. Problems that are set in meaningful contexts provide rich opportunities for students to apply knowledge from their lives to learning mathematics and in doing so will see their own identities reflected in the math (McDuffie et al., 2011). This was a similar finding within this study, as relevant cultural contexts supported students to connect with mathematical ideas allowing both their cultural identities to be validated and mathematical dispositions developed.

5.4 DRAWING ON PĀSIFIKA VALUES TO SUPPORT MATHEMATICAL PRACTICES AND SOCIAL NORMS

Drawing on the Pāsifika value of collectivism is important in shaping the collaborative social norms of mathematics classrooms. Evident in the findings of this study is the importance of the teachers drawing on and using the Pāsifika value of collectivism. This shaped the classroom interactions as the students described how they were committed to a sense of responsibility for their own understanding, as well as the understanding of others. The way in which collectivism can shape student interactions and support students to take responsibility for their own learning and the learning of others has been captured by other New Zealand studies (e.g., Bills & Hunter, 2015; Hunter & Anthony, 2011; Hunter & Anthony, 2015). Hunter & Hunter (in press-b) explain how integration of students' lived home values and social norms that shape their interactions in mathematical activity, embed a classroom collectivist culture where students continually support one another. Similar findings were demonstrated within this study where students' cultural identities were continually supported through the teachers fostering an environment that directly matched the value the students placed on being communal rather than individualistic.

Fostering a sense of collective responsibility allowed a format for students to proficiently engage in mathematical practices. Students were able to recall and elaborate on common methods in which they supported their fellow students, like explaining things in different ways, justifying claims, and sharing strategies. Building from respectful home listening practices, mathematical activity was

shaped to include collective participation around constructing, questioning and extending mathematical explanations within the collaborative classroom environment (Hunter & Hunter, in press-a). Hunter and Anthony's (2011) study illustrated how one teacher framed the obligations for students to work together within an appropriate cultural setting (preparing an umukai [village feast] and the collaborative roles all participants hold). Pāsifika concepts of collectivism were developed as he had them participate in mathematical explanations, representations, and justification within their groups (2011). Developing proficient mathematical practices are essential in positively promoting students' mathematical capabilities and mathematical dispositions (Boaler, 2003; Kazemi & Franke, 2004; Goos, 2004; Hufferd-Ackles, Fuson, & Sherin, 2004). Within this study, students described using mathematical practices to ensure their whole group understood and suggests a robust and confident mathematical disposition.

The Pāsifika value of respect can assist students in developing safe mathematical argumentation opportunities. Students within the study frequently described the notion of 'friendly arguing' as debate that was laced with appropriate ways of interacting and ensuring students justified their mathematical disagreements. Bibby (2009) illustrates the emotional labor and risk experienced by students when participating in development of joint mathematical understanding. In addition, the Pāsifika culture of silence promotes traditional classroom ecology where students are expected to listen attentively to teachers and where arguing is considered disrespectful (Tuafuti, 2004). Hunter & Hunter (in press-a) advocate for fostering social norms of friendly communication and argumentation and that it is vital to ensure that productive mathematical discourse can occur. The Pāsifika value of respect within inquiry classrooms has been documented by several research studies (Bills & Hunter, 2015; Civil & Hunter, 2015; Hunter & Anthony, 2011; Hunter, 2008). More specifically, these studies highlight how respect can be used to shape student engagement in mathematical argumentation. Similar findings are presented in this study, as by fostering respectful social norms, reportedly enabled students to engage in valuable mathematical interactions and develop their mathematical dispositions.

When the Pāsifika value of respect is emphasized within the social norms of classroom interactions, students can readily appreciate their peers' capabilities. Findings from within this study highlighted that students truly valued the contributions of their classmates and recognized that everyone had valuable ideas to provide. Boaler (2006) advocated for developing respect within classrooms. Her study found that through encouraging students to value each other's contributions, they not only developed a more respectful culture but also made substantial gains in mathematics. Similarly, Weingrad (1998) and White (2003) have shown that for diverse students to participate in supportive mathematical discourse requires continual emphasis on acting respectfully, where all student contributions are continually valued. Hunter (2012) illustrated that engagement in collaborative group work fostered different contributions of group members that extended beyond their usual capabilities. Similar findings were demonstrated in the current study. The students' utilization of respectful social norms allowed them to appreciate the mathematical capabilities of their peers and the importance of contributing to the mathematical community. Thus, students' cultural ways of interacting and contributing supported their cultural identities, meanwhile appreciating their peers' mathematical dispositions.

Risk-taking is a valuable part of the inquiry classroom as students build confidence to share their ideas. The Pāsifika value of family can help support students to share their thinking with the whole group. Within this study, students reported on how coming together was modelled around the Pāsifika value of family and described working collaboratively together to solve problems and share strategies. Previous studies have also reported how taking risks with mathematical reasoning were posed within the context of Pāsifika values (e.g., Bills & Hunter, 2015; Hunter & Anthony, 2011; Hunter, 2008). Hunter and colleagues (in press) highlight how drawing on home values can support students' risk taking behaviour around mathematical reasoning and sharing ideas with their class. Within the current study students' cultural home values are integrated with the social and socio-mathematical norms that shape their mathematical pursuits. Taking part in this classroom culture simultaneously supports their cultural identities and mathematical dispositions.

5.5 ENACTING AN ETHIC OF CARE AND RESPONSIVE TEACHER ACTIONS

Teachers have an important role to play in the facilitation of a collaborative mathematical learning environment. Within the current study students spoke about teachers asking students to continually repeat their mathematical explanations in order to enable complete understanding of ideas. Similarly, the teachers reported tactics of fostering explicitness in explanations. Franke and Kazemi (2001) highlight the importance of teachers listening closely to their students. Intercepting students at crucial moments of interaction ensures their ideas are noticed and celebrated (2001). In Manouchehri and Enderson's (1999) evaluation of teacher actions, they noticed that careful questioning and purposeful intervention allowed students to shift their reliance on the teacher to effective collaboration and challenge of their peers. Hunter's (2013) study noted that teachers framed questions so that solution strategies were directed toward specific clarification of mathematical explanations. Teacher actions reported in this study scaffold and reinforce collaborative group discussion and encourage students' use of mathematical practices that support their students' mathematical disposition development.

The ways in which teachers support their students to make deeper mathematical connections is an important process to consider. Students within the current study explicitly highlighted the value in teachers offering clues to solutions. They recognized that effective learning opportunities are not afforded through direct explaining and are instead fostered through challenges and effort. Previous Pāsifika mathematics research has captured similar student perceptions. Hunter and Anthony's (2011) study provided findings that suggested students desired clues from their teacher as it was more challenging. Heibert & Grouws (2007) describe the importance of struggle and outline its significance throughout mathematical learning. McIntosh (1997) also highlights the importance of perseverance and diligence within mathematical disposition conceptualizations. This study's findings also described teacher support that enabled students to make autonomous mathematical connections, and in doing

so supported students to gain richer mathematical understandings and develop their mathematical dispositions.

Having high expectations and setting challenging mathematics tasks supports students to engage in deeper levels of mathematical understanding. Students in this study consistently reported on the ways in which teachers challenged them in the mathematics class. Nodding's (2012) notion of 'ethic of care' is an important concept for the mathematics classroom. Hunter and colleagues (in press) assert that teachers who have high expectations of their students and enact an ethic of care that enables rather than disables their students, set problems that empower students to take risks and learn from mistakes. Teachers in Hunter's (2008) study promoted students' risk-taking behavior, instead of keeping students safe from making mistakes with mathematical practices. These actions, afforded students the opportunity to make deeper connections with mathematics. This study has described similar findings, where teachers' high expectations and incorporation of challenging tasks enabled students to make greater mathematical connections and afforded development of a mathematical disposition.

5.6 MATHEMATICAL DISPOSITION

Developing a mathematical disposition entails proficiently engaging in mathematical practices and believing in individual mathematical ability. Students within the current study highlighted positive affirmations of mathematics and reported enjoying the process of learning and using mathematics. This matches with the NRC's definition of mathematical disposition to include belief in one's own efficacy (Kilpatrick et al., 2001). McClain & Cobb, 2001 argue that proficiently and regularly using mathematical practices is expressive of mathematical autonomy. The students in this study described using effective mathematical practices and report engaging in mathematical discourse techniques conducive to a collaborative inquiry classroom. Research (e.g. Boaler 2002; Gresalfi & Cobb, Kilpatrick, Swafford, & Findell, 2001; Yackel & Cobb, 1996), which explored classroom structure that promoted such collaborative environments showed an enhancement of

students' mathematical dispositions. Research in the New Zealand contexts (e.g. Bills & Hunter, 2015; Hunter & Anthony, 2011; Hunter 2008) also highlighted how classroom ecology with an egalitarian spread of power promoted students' opportunity to engage in proficient mathematical discourse and develop their mathematical dispositions. Similar findings within the current study suggest that, culturally responsive actions of encouraging students' home language use and drawing on Pāsifika values to cultivate mathematical practices and social norms, encouraged students to engage in meaningful mathematical discourse that supported students' development of a positive mathematical disposition.

Mathematical disposition also encompasses a conviction of diligence within the learning process. Students within the study demonstrated this aspect of their mathematical dispositions through affirmation of the challenge they encountered in mathematical activities and interactions. The NRC's definition included a belief in diligence and highlighted that those with positive dispositions towards mathematics required a belief that "steady effort in learning mathematics pays off" (Kilpatrick et al., 2001, p. 131). Heibert & Grouws (2007) also captured the idea that learning mathematics should contain elements of struggle. Research by O'Dell (2017) highlighted a perseverance type of mathematical disposition which was related to the interplay of frustration and joy characterized by the productive struggle students experienced when problem solving. A 'productive struggle' was also captured within the current research where students' affirmed accounts of the mathematical challenges they experienced were likely reflective of mathematical disposition development. One final element of students' mathematical dispositions includes being able to perceive value or usefulness in mathematics. The students within the current study held utilitarian views of mathematics and categorized its usefulness in terms of future career goals and present value. The NRC's definition of mathematical disposition includes "a habitual inclination to see mathematics as sensible, useful and worthwhile" (Kilpatrick et al., 2001, p.116). Anthony & Walshaw (2007) contend that dynamic participation with mathematical ideas fosters specific student competencies and identities and affords students opportunities to create positive futures for themselves. Young-Loveridge (2006)

documented student accounts that considered mathematics in terms of immediate utility and future career orientations. Similarly, Boaler's (2008) study found that mathematical success afforded students access to mathematical careers, higher-level jobs and future financial security. Similar findings, within the current study suggest that students' utilitarian views of mathematics in terms of future orientations encompassed a developed mathematical disposition.

5.7 CULTURAL IDENTITY

Culturally responsive actions that support students' unique language, culture and identity ensure students' validation within educational settings. Students within the current study regularly revealed how it felt "normal" or "good" to be Pāsifika within their mathematics class. They also reported being able to freely speak their own language, and felt empowered by seeing their own culture represented in mathematical activity. Nakhid (2006) affirms that schools have a considerable influence on the identifying process and need to ensure students' cultural identities are accepted, respected and supported. Fletcher and colleagues (2005) also contend that for Pāsifika learners' cultural identity to be nurtured, students need space to practice cultural behaviors and have them feel valued in the school context. Findings in research (e.g. Bills & Hunter, 2015; Fletcher et al., 2005; Hannant, 2013; Hunter & Anthony, 2011) have illustrated that when Pāsifika students' cultural capital, language and heritage are supported, encouraged and validated students have space to develop positive cultural identities. Findings within the current study also suggest that the culturally responsive teaching that students experienced was conducive for cultural identity development.

Not only were students' identities validated within the current study, but also students were able to clearly conceptualize the benefits of working together in groups, and supporting each other to solve mathematical problems. Hunter and colleagues (in press) propose that students who conceptualize themselves as "mathematicians" because they question and reason, and a "good person" because they work collectively is significant to their mathematical dispositions and cultural identities. Indeed, research studies (e.g. Bills & Hunter, 2015;

Hunter & Anthony, 2011; Hunter, 2008) depict that by structuring mathematical inquiry classrooms around students' culture not only fosters students' mathematical dispositions but also reinforces students' collectivist and collaborative facets of their cultural identities. Similar findings identified in the current study demonstrate that culturally responsive actions which include use of students' home languages, connecting cultural contexts to the mathematics classroom and shaping Pāsifika values to support proficient use of mathematical practices enables students to develop positive cultural identities and mathematical dispositions.

5.8 TEACHING IMPLICATIONS

This study has highlighted a number of implications for developing the mathematical dispositions of Pāsifika students while having them maintain a positive cultural identity, such as to:

- Encourage the use of the students' home language in order to enhance understanding of mathematical concepts and problems;
- Select tasks that reflect the cultural contexts of their students to foster engagement;
- Engage with the students' parents to incorporate the home based mathematics in school based mathematical problems;
- Encourage students to take risks with their learning and celebrate mistakes, ask questions, clarify uncertainties, share mathematical strategies, and challenge others' thinking;
- Draw on Pāsifika values to ensure collective responsibility for participation in mathematical discussion and to support students to engage in respectful interactions with polite and friendly language; and
- Set challenging mathematical questions to engage students in deeper levels of conceptual understanding.

5.9 LIMITATIONS

The findings of this research are established on a small sample of students and teachers from two urban areas of a city. The perceptions and themes that

emerge are purely descriptive of the context. As a result, generalization of the findings for teachers and students of different classrooms around New Zealand is limited. However, the findings of the study do address important issues around culturally responsive practice of diverse students. Further studies are needed that take a strength-based approach and explore how a positive cultural identity can be maintained as students develop mathematical dispositions. Due to the complex nature of classrooms, teaching practices and learning orientations of students, interpretations of the results can only provide an emerging pattern of understanding on the development of Pāsifika students' cultural identity and mathematical disposition. The findings are based on one researchers' interpretation of data. Other interpretations may be possible, but triangulation of the data does strengthen the validity of the findings through complementing interview responses of students and their teachers.

Researchers themselves can bring their own limitations of personal judgments, assumptions, and values into their research studies. As Snape and Spencer (2003) highlight the relationship between the researcher and social phenomenon being investigated is interactive. Though reflexivity is an important concept in qualitative research (Hammersley & Atkinson, 1983), ensuring open and honest expression of potential bias is something the researcher has strived for, but cannot objectively measure and ensure.

5.10 OPPORTUNITIES FOR FURTHER RESEARCH

Examination of cultural identity and mathematical disposition of younger and older students who participate in culturally responsive classrooms would add to the research topic. In addition, identifying barriers to cultural identity and mathematical disposition development of students who participated in more traditional educational settings would provide a case for comparison. Studies that draw upon Pāsifika values to enhance engagement in mathematical discourse is relatively limited and further research would add to this field of knowledge. Research that investigates culturally responsive practices in mathematics classrooms within schools who teach a range of diverse learners would be beneficial to investigate also.

5.11 CONCLUDING THOUGHTS

The findings from the research have revealed that incorporating students' language, connecting students' culture into the mathematics class, shaping Pāsifika values to foster social norms and socio-mathematical practices which incorporate a range of mathematical practices support students to develop their cultural identities and mathematical dispositions. Through code-switching, strengthened mathematization opportunities, expected participation in mathematical practices, high expectations and challenge of teachers, students were able to confidently engage in mathematical discourse, attain deeper mathematical understanding and perceive value and usefulness in mathematics, factors all representative of a mathematical disposition. Experiencing freedom to express their cultural language, seeing their culture mirrored in mathematical problems, and engaging in participation patterns reflective of their Pāsifika values, wholly confirmed students' cultural identities.

Students within the study expressed engaging in collaborative environments that supported them to interact like mathematicians and as good people. Their affinity for supporting their classmates, sharing their knowledge (both mathematical and cultural), engaging in proficient mathematical practices and interacting in respectful ways fostered mathematical competencies and engaged them in their cultural ways of being. These respectful, inquiring and supportive ways of interaction within the collaborative learning environment simultaneously supported the cultural identity and mathematical disposition of the Pāsifika students.

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APPENDIX A – INTERVIEW QUESTIONS

Group Interview Questions

Where are you from?

What country or countries do you identify with?

How does it feel to be _____ in the maths class?

What languages do you use in the classroom?

What do you like about maths?

Do you think maths is important? Why?

How do you use maths outside of the classroom?/Do you ever use maths outside of the classroom? Can you give me some examples?

What kinds of things does your teacher do to help you to help you learn?

What kinds of things do you do to help each other learn?

What do you do when you don't understand something?

Student Interview Questions

What do you like most about maths?

What do you like most about your maths class?

What do you like most about being Pāsifika in your class?

What do you like about being able to speak other languages?

Why do you think it's important to speak other languages?

How would you feel if you couldn't speak _____?

What do you like about the small group work?

Do you ever joke about?

How does your teacher challenge you personally with your maths learning?

How does your teacher challenge the class as a whole?

Can you tell me a bit about the word problems you do?

How do you help your friends learn?

Teacher Interview Questions

What do you do when students are stuck on a problem?

What responses do you get from them?

How do you challenge your students?

How do you challenge you students to make deeper connections with the maths?

What would you do to engage uninterested students?

What do the students do to support one another's learning?

What aspects of the maths class help the students to make maths connections to their own lives?

What languages do you use in the class?

Why do you think speaking other languages is valuable?

What aspects of the maths class supports Pāsifika culture?

-Why is this important?

Can you think of an instant where a student or students really surprised you in the maths class? Explain.

What do you think is the most valuable thing *you do* that engages them in maths?

Do you see any barriers to their maths learning? If so what are they?

APPENDIX B- TEACHER INFORMATION SHEET & CONSENT FORM



MASSEY UNIVERSITY
INSTITUTE OF EDUCATION
TE KURA O TE MATĀURANGA

Pāšifika Identity in the Mathematics Classroom

TEACHER INFORMATION SHEET

My name is Rosie Curwen and am a student at Massey University. I am doing some research focusing on how cultural identity develops in the mathematics classroom. You, and your year 8 students as well as students and a teacher from another school are being invited to take part in this research.

As part of the research I would like to interview you. Therefore, I am writing to ask your permission for you to be audio and video recorded during these group interviews. The focus of the interviews include asking about how you conduct a typical mathematics class with your students and how you support their cultural and mathematical identities.

Please note you have the following rights in response to my request for you to participate in this study.

- decline to participate;
- decline to answer any particular question;
- withdraw from the study at any point;
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- be given access to a summary of the project findings when it is concluded.

If you have further questions about this project you are welcome to discuss them with me personally:

Rosie Curwen. Phone: 0211505928. Email: rosielcurwen@gmail.com

Or my thesis supervisor:

Bobbie Hunter: Massey University, School of Education. Phone: (09) 4140800 Extension 9873. Email. R.Hunter@massey.ac.nz ;

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director, Research Ethics, telephone (06) 350 5249, email humanethics@massey.ac.nz.



MASSEY UNIVERSITY
INSTITUTE OF EDUCATION
TE KURA O TE MATĀURANGA

Pāsifika Identity in the Mathematics Classroom

CONSENT FORM: TEACHER PARTICIPANTS

THIS CONSENT FORM WILL BE HELD FOR A PERIOD OF FIVE (5) YEARS

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree/do not agree to be interviewed individually.

I agree/do not agree to be audio taped during the individual interviews.

I agree/do not agree to be video taped during the individual interviews

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature:

Date:

.....

Full Name - printed

.....

APPENDIX C – PARENT INFORMATION SHEETS & CONSENT FORM



MASSEY UNIVERSITY
INSTITUTE OF EDUCATION
TE KURA O TE MATĀURANGA

Pāsifika Identity in the Mathematics Classroom

PARENT INFORMATION SHEET

My name is Rosie Curwen and am a student at Massey University. I am doing some research focusing on how cultural identity develops in the mathematics classroom. Your child, their peers and their teacher are being invited to take part.

As part of the research I would like to interview your child in small groups with their peers. Therefore, I am writing to ask your permission for your child to be audio and video recorded during these group interviews. The focus of the interviews would be to ask your child about their participation the maths classroom, their cultural identity and how they feel about mathematics. After the group interviews, your child may be invited to take part in one on one interviews, which would also be audio and video recorded. These interviews would cover similar topics as mentioned above.

All data recordings will be stored in a secure location, with no public access and used only for this research. In order to maintain anonymity the school name and names of all participants will be assigned pseudonyms in any publications arising from this research. At the end of the year, a summary of the study will be provided to the school and made available for you to read.

Please note you have the following rights in response to my request for your child to participate in this study:

- decline your child's participation;
- withdraw your child from the study at any point;
- you may ask any questions about the study at any time during your child's participation;
- your child provides information on the understanding that your child's name will not be used unless you give permission to the researcher;
- be given access to a summary of the project findings when it is concluded;
- decline your child being video recorded;

- decline your child being audio recorded;
- decline to allow copies of your child's written material to be taken.

If you have further questions about this project you are welcome to discuss them with me personally:

Rosie Curwen. Phone: 0211505928. Email: rosielcurwen@gmail.com

Or my thesis supervisor:

Bobbie Hunter: Massey University, School of Education. Phone: (09) 4140800 Extension 9873. Email. R.Hunter@massey.ac.nz ;

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director, Research Ethics, telephone (06) 350 5249, email humanethics@massey.ac.nz.



MASSEY UNIVERSITY
INSTITUTE OF EDUCATION
TE KURA O TE MATĀURANGA

Pāsifika Identity in the Mathematics Classroom
CONSENT FORM: PARENTS OF STUDENT PARTICIPANTS
THIS CONSENT FORM WILL BE HELD FOR A PERIOD OF FIVE (5) YEARS

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree/do not agree to my child being interviewed in small group interviews.

I agree/do not agree to my child being audio taped during small group interviews.

I agree/do not agree to my child being video taped during small group interviews.

I agree/do not agree to my child being interviewed individually.

I agree/do not agree to my child being audio taped during individual interviews.

I agree/do not agree to my child being video taped during individual interviews.

I agree to my child participating in this study under the conditions set out in the Information Sheet.

Signature:

Date:

.....

Full Name - printed

.....

APPENDIX D – STUDENT INFORMATION SHEET AND CONSENT FORM



MASSEY UNIVERSITY
INSTITUTE OF EDUCATION
TE KURA O TE MATĀURANGA

Pāšifika Identity in the Mathematics Classroom

STUDENT INFORMATION SHEET

My name is Rosie Curwen and am a student at Massey University. I am doing some research focusing on how cultural identity develops in the mathematics classroom. You, your peers, and your teacher as well as students and a teacher from another school are being invited to take part in this research.

As part of the research I would like to interview you and your peers in small groups. Therefore, I am writing to ask your permission for you to be audio and video recorded during these group interviews. The focus of the interviews would be to ask you about your participation in the maths classroom, your cultural identity and how you feel about mathematics. After the group interviews, you may be invited to take part in one on one interviews which would also be audio and video recorded. These interviews would cover similar topics as mentioned above.

All data recordings will be stored in a secure location, with no public access and used only for this research. In order to maintain anonymity, the school name and name of all participants will be assigned pseudonyms in any publications arising from this research. At the end of the year, a summary of the study will be provided to the school and made available for you to read.

Please note you have the following rights in response to my request for you to participate in this study.

- decline to participate;
- decline to answer any particular question;
- withdraw from the study at any point;
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- be given access to a summary of the project findings when it is concluded;
- have the right to ask for the audio/video tape to be turned off at any time during the observations;

If you have further questions about this project you are welcome to discuss them with me personally:

Rosie Curwen. Phone: 0211505928. Email: rosielcurwen@gmail.com

Or my thesis supervisor:

Bobbie Hunter: Massey University, School of Education. Phone: (09) 4140800 Extension 9873. Email. R.Hunter@massey.ac.nz ;

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director, Research Ethics, telephone (06) 350 5249, email humanethics@massey.ac.nz.

Assistant to the Vice-Chancellor (Research Ethics), telephone 06 350 5249, email humanethics@massey.ac.nz.



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TE KURA O TE MATĀURANGA

Pāsifika Identity in the Mathematics Classroom
CONSENT FORM: STUDENT PARTICIPANTS
THIS CONSENT FORM WILL BE HELD FOR A PERIOD OF FIVE (5) YEARS

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree/do not agree to be interviewed in a small group.

I agree/do not agree to be audio taped during the group interviews.

I agree/do not agree to be video taped during the group interviews.

I agree/do not agree to be interviewed individually.

I agree/do not agree to be audio taped during the individual interviews.

I agree/do not agree to be video taped during the individual interviews

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature:

Date:

.....

Full Name - printed

.....

APPENDIX E – PRINCIPAL CONSENT FORM



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Pāsifika Identity in the Mathematics Classroom

CONSENT FORM: PRINCIPALS

THIS CONSENT FORM WILL BE HELD FOR A PERIOD OF FIVE (5) YEARS

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature:

.....

Date:

.....

Full Name - printed

.....