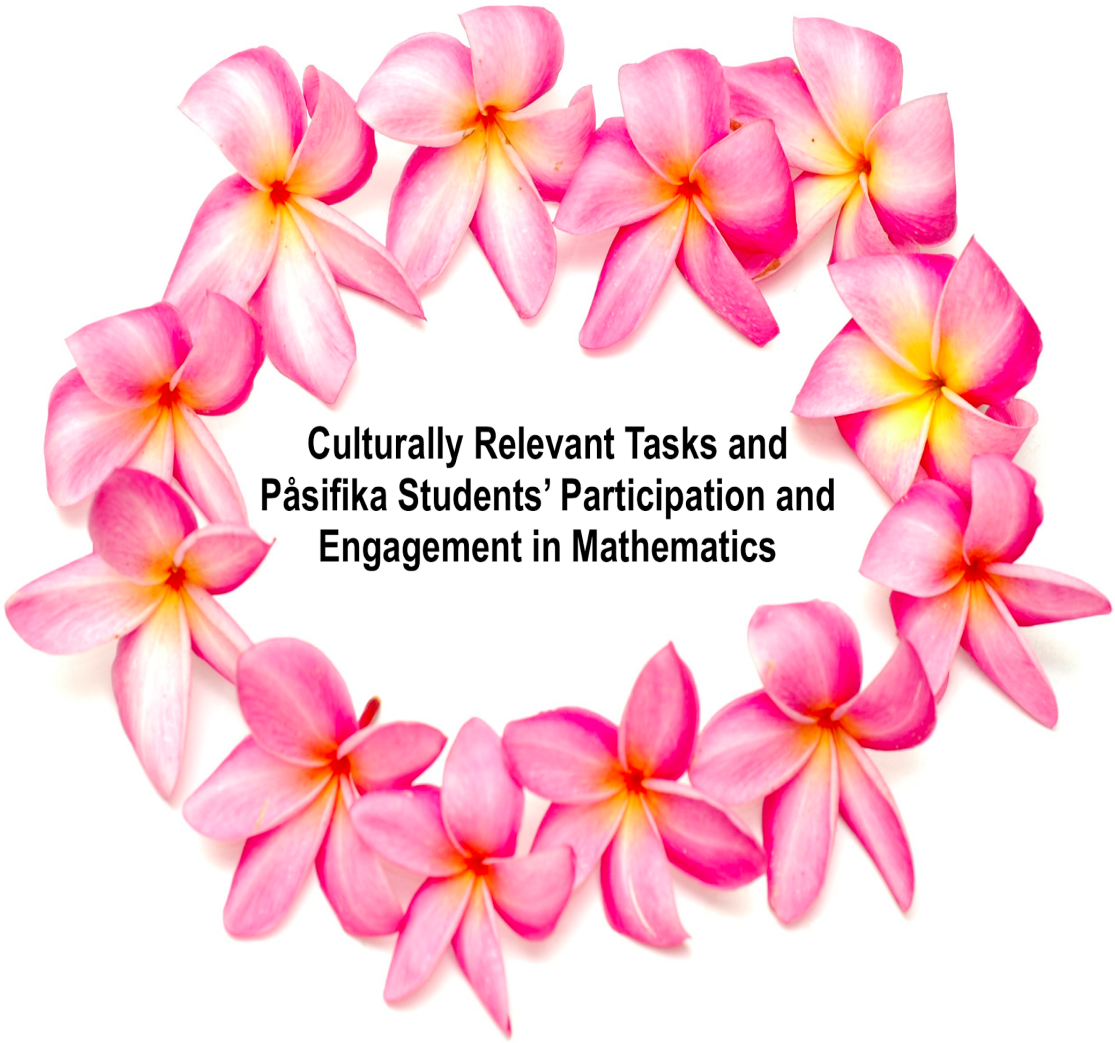

A thesis presented in partial fulfilment of the requirements for the degree of

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Abstract

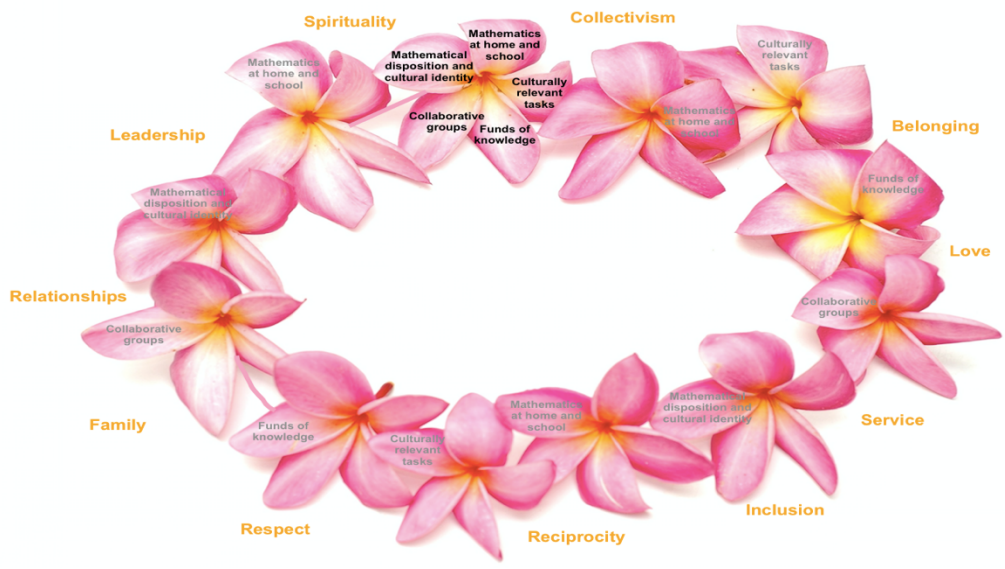
Pāsifika students' academic achievement in mathematics continues to remain a priority for New Zealand education (Ministry of Education, 2013). Research in both the New Zealand and international contexts identifies the need for New Zealand classrooms to foster culturally responsive and mathematical practices that align with Pāsifika students' cultural values, backgrounds, interests and experiences. As a result, Pāsifika students will have increased opportunities to participate and engage in mathematics while developing a cultural identity within New Zealand classrooms.

This study utilised the Pāsifika students' and their families' funds of knowledge to design culturally relevant mathematical tasks. These tasks were used within the students' mathematics classroom where the teacher was supported to implement culturally responsive and mathematical practices. It examined how the use of culturally relevant tasks while enacting the reviewed cultural and mathematical practices could foster Pāsifika students' participation and engagement in mathematics.

This study used qualitative research methods with an ethnographic case study approach while drawing on Pāsifika research frameworks (Lemanu, 2014; Sauni, 2011). 11 Year 5 and Year 6 students who descended from the Pacific Islands participated in this study. Semi-structured interviews were completed at the beginning and end to find out the Pāsifika students' perspectives about their experiences of their culture and mathematics. Throughout the study, photo-elicitation interviews were used to identify Pāsifika students' cultural funds of knowledge and mathematical experiences that they engaged in outside of school. This information was used to work with the classroom teachers to design culturally relevant mathematics tasks. Observations were made of the students' behaviour and interactions while working on these tasks within their

classroom setting. After each observation, focus group interviews were conducted to gain insight into the students' perspectives of the task and learning experience. The use of a variety of methods provided greater evidence of data that I drew on to support my findings.

The results illustrated key findings and recommendations that have been visually represented using a frangipani (kalosipani/ pua fiti/ fiti pua/ tipani)[1] ula-lei[2]. Each petal on the frangipani flower represents the key themes that emerged. These are as follows; mathematics at home and school, culturally relevant tasks, funds of knowledge, collaborative grouping and mathematical disposition and cultural identity. These key themes are supported by a group of learners which include parents, teachers and students and are bound together by the core Påsifika values. The key themes, community of learners and cultural values form the ula-lei. This study revealed these components as being effective practices that educators should develop to support Påsifika learners' participation and engagement in mathematics.



[1] The frangipani plant is translated to kalosipani in Tonga, pua fiti in Samoa, fiti pua in Niue and tipani in the Cook Islands.
[2] Traditional Pacific Island necklace

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Chapter One: Introduction

1.1 Introduction

This chapter explains the background information that framed this research. The description of the context in section 1.2 highlights the need for educators to consider developing cultural and mathematical practices that support Pāsifika students to successfully participate and engage in mathematics and maintain their cultural identity in New Zealand classrooms. The rationale for conducting this research is outlined in section 1.3. Section 1.4 provides the aims of the study and presents the specific research questions that this study investigates. Section 1.5 describes the visual representation used to symbolise this study. Finally, an overview of the chapters is presented in section 1.6.

1.2 Context

'Pāsifika' is a diverse term used to describe people living in New Zealand who descend from the Pacific Islands of Samoa, Tonga, Niue, Tokelau, Fiji, Cook Islands, Tuvalu and Solomon Islands (Coxon, Anae, Mara, Wendt-Samu & Finau, 2002). With only 11% of Pāsifika students achieving at the national standard in mathematics in Year 8 (Education Assessment Research Unit and New Zealand Council for Educational Research, 2015), Pāsifika students' academic success continues to remain a priority for the Ministry of Education (2013). Education policies are demanding educators to bridge the achievement gap between Pāsifika students and their peers in mathematics and reduce the challenges that they face in many New Zealand classrooms.

The population of Pāsifika students in New Zealand schools is continuing to grow. These students bring a wide variety of experiences and knowledge to New Zealand originating from their cultural heritage and background. Unfortunately, the learning experiences they encounter in New Zealand schools

is different and segregated from their home life and cultural experiences. The Ministry of Education (2013) emphasises the need for learning environments to respond to Påsifika students' culture, identity and language so that they align with the students' home environments. However, many schools in New Zealand are providing tasks and practices in mathematics classrooms that connect to and build on the dominant New Zealand European students, making it difficult for Påsifika learners to make connections to their culture and mathematics at school. Instead, Påsifika students believe that their culture and mathematics learning are not related which causes them to view school and culture as separate (Averill, 2012; Bills & Hunter, 2015; Hunter, Hunter & Bills, in press; Hunter & Hunter, 2018, in press; Hunter et al., 2016). As a result, many Påsifika students struggle to maintain their cultural identity in New Zealand classrooms causing them to disengage in mathematics.

Developing a culturally responsive pedagogy can be challenging for many New Zealand teachers, however it is important in assisting equity and creating equal opportunities for achievement (Averill, Anderson & Drake, 2015). Educators need to develop culturally responsive and equitable mathematical practices within their classrooms to further support their Påsifika learners to develop a cultural identity and successfully participate and engage in mathematics.

1.3 Rationale

My interest in this research has evolved from my experience as a classroom teacher in mathematics. Throughout my career, I have been concerned to see that Påsifika students continue to remain one of the most at-risk group of learners in mathematics academic achievement in relation to their peers in New Zealand. With this challenge, I decided to research into ways I could adapt my practice and support other educators with strategies to ensure engagement and achievement of diverse learners in mathematics.

International and New Zealand based studies (e.g., Boaler, 2002, 2015; Hunter & Hunter, 2018, in press; Rubel, 2017; Tate,1995) identified successful practices that educators could adopt to provide diverse learners with

opportunities to increase their participation and engagement in mathematics classrooms. These studies highlighted the importance of educators using culturally relevant mathematical tasks and practices that build on students' cultural values and funds of knowledge. They suggest that teachers use diverse learners' background, interests and experiences that they engage in outside of school as a resource for their classroom environment.

Developing culturally responsive tasks is an approach towards enhancing student outcomes and disparities between the mathematics students experience at school and home. This is a key practice that I wanted to investigate in my study to support Pāsifika learners. New Zealand researchers (e.g., Averill, 2012; Hunter & Hunter, in press; Hunter et al., in press) note how the lack of culturally responsive tasks in primary mathematics classrooms can lead students to take a deficit perception towards their own culture, often describing being Pāsifika as associated with a culture devoid of mathematics. Many other researchers (e.g., Civil, 2007; Dickie, 2011; Hunter & Hunter, in press; Joves, Siques & Esteban-Guitart, 2015) argue that teachers should utilise students' cultural funds of knowledge to inform their practice, using them as a vital resource for learning experiences. I became interested in the idea of using tasks where mathematics is embedded within the students' cultural experiences. This could allow Pāsifika students' to construct powerful connections between mathematics and their culture.

With traditional teaching approaches still prominent in classrooms, students struggle to identify the mathematics that is embedded within their everyday experiences (Boaler, 2002, 2015; Matthews, 2017; Wright, 2017). Linking learning experiences to life experiences allows students to make connections to their lived social and cultural worlds seeing the purpose and value of learning mathematics. Attard (2012) describes how students who can make connections between the mathematics they learn at school and outside of school allows them to value mathematics and discover the benefits of mathematics in their lives beyond the classroom. With this in mind, I was interested to learn from students what mathematics they see in their lives outside of school.

Påsifika people place great importance on working collectively and supporting each other with their learning and life experiences (Sharma, Young-Loveridge, Taylor, & Hawera, 2011). Collaboration and group work in mathematics aligns with the core cultural values of Påsifika learners which include reciprocity, community, collectivism, service and relationships (Anae, et al., 2001). Many studies (e.g., Bills & Hunter, 2015; Hunter & Anthony, 2011; Hunter & Hunter, 2018, in press; Hunter et al., in press; Sharma et al.) show the benefits of collaborative group work and the development of a teaching pedagogy that includes mathematical and cultural practices to promote equity and inclusion in mathematics classrooms for Påsifika learners. Collaborative grouping has been effective in raising diverse students' participation, engagement and achievement in many classrooms and is an effective practice that I wanted to implement within the study.

Importantly, the research studies mentioned above (e.g., Averill, 2012; Bills & Hunter, 2015; Hunter & Hunter, 2018, in press; Hunter et al., in press) identified successful mathematical and cultural practices that could support Påsifika learners in mathematics. In response to my investigation, I began to reflect on the contexts of mathematics problems and how they were implemented in my classroom and other classrooms across the school. It became clear to me that the problems that Påsifika students were engaging in and the practices that we were using within our classrooms did not align with the Påsifika students' lived social and cultural world. I thought this may attribute to the students being unable to participate and engage successfully in mathematics resulting in low achievement. As a result, I was interested to see if the use of culturally relevant tasks and embedding the cultural and mathematical practices that I have described above into the classroom would have an impact on Påsifika students' participation and engagement in mathematics.

1.4 A visual representation of the study

Figure 1.1. Frangipani ula-lei used as a visual representation of the research study and findings

A visual representation (see Figure 1.1) is used to illustrate the findings and symbolises the research study holistically. The frangipani plant (kalosipani/ pua fiti/ fiti pua/ tipani) [3]and ula-lei [4] which are special to many Påsifika people and have originated from the Pacific Islands are used. Inspiration behind this research stemmed from the need to ensure that Påsifika learners cultures are acknowledged and their cultural identity is maintained in mathematics classrooms. The visual representation symbolises my passion of establishing

[3] The frangipani plant is translated to kalosipani in Tonga, pua fiti in Samoa, fiti pua in Niue and tipani in the Cook Islands.
[4] Traditional Pacific Island necklace

learning environments where Påsifika students feel appreciated and valued and are provided with opportunities to achieve academic success in New Zealand classrooms. This will be summarised in more detail in Chapter Five.

1.5 Aims of the study

This research is focussed on Påsifika students' participation and engagement in mathematics. The study aims to investigate how the use of culturally responsive tasks along with cultural practices can foster Påsifika students' participation and engagement in mathematics.

As part of the investigation, I worked with a group of Year 5 and Year 6 Påsifika students to gain insight into mathematical experiences that they engage in outside of the classroom. The study looked at the students' perspectives around what they saw as mathematics in their experiences outside of school. I sought to build on Påsifika students' cultural funds of knowledge and cultural experiences that they engage in outside of school to design relevant learning experiences in their mathematics classrooms. The Påsifika cultural values are acknowledged and embedded within the classroom practices throughout the study.

The following research questions will be used to investigate the use of culturally relevant tasks and Påsifika students' participation and engagement in mathematics.

- What are the out of school mathematical perspectives and experiences of Påsifika students?

- How do Påsifika students describe the ways in which their culture is reflected in the classroom?

- What classroom practices support participation and engagement of Påsifika learners in mathematics?

1.6 Overview of chapters

International and New Zealand based literature that is focussed on effective cultural and mathematical practices is reviewed in Chapter Two. The literature review defines culturally responsive pedagogy, funds of knowledge and equity in mathematics education. It provides a detailed description of how using culturally relevant tasks, forming positive relationships, building on students' cultural values and appropriate task selection are effective practices that support Påsifika students' participation and engagement in mathematics.

The methodology selected for this study is presented in Chapter Three. The qualitative approach of using an ethnographic case study is explained. The participants are introduced and concerns with ethics and the role of the researcher are addressed. A description of the data collection and data analysis methods is provided.

Chapter Four integrates the findings and discussion to present the findings that emerged throughout each phase of the study. Each phase is analysed and supported by evidence. A detailed discussion which builds on theory discussed earlier in the literature review is embedded within each phase. The key themes that supported Påsifika students' participation and engagement within the study are identified.

Finally, Chapter Five concludes the research by summarising the research questions, key themes and recommendations for educators. It addresses the limitations and ideas for future research and provides a description of the visual representation used to illustrate the findings.

Chapter Two: Literature Review

2.1 Introduction

Accelerating the learning of Pāsifika students in mathematics remains a focus for the Ministry of Education (Ministry of Education, 2013). Pāsifika students have been identified as the most at-risk group of learners in relation to academic achievement (Ministry of Education, 2013). Research studies (e.g., Averill, 2012; Bills & Hunter, 2015; Hunter & Hunter, 2018, in press) link this to the mismatch between Pāsifika students' home knowledge, and the tasks and typical classroom practices which better suit the dominant groups used in New Zealand classrooms. This has resulted in students struggling to construct a positive disposition and maintain a cultural identity as successful Pāsifika learners within their mathematics classroom. Consequently, educators are challenged to bridge the marginalisation experienced by Pāsifika learners through the culture and practices in mathematics classrooms, to provide equitable opportunities for all Pāsifika students to participate and engage in mathematics and achieve academic success while maintaining their cultural identity.

This chapter will investigate Pāsifika students' participation and engagement in mathematics and their development of a mathematical identity while maintaining a cultural identity. Specifically, it will examine how the use of mathematical practices can be developed to align with the students' cultural contexts. Section 2.2 will define culturally responsive teaching, funds of knowledge and equity. Section 2.3 reviews how culturally responsive practices can provide mathematical experiences that build on Pāsifika students' and families' funds of knowledge. This will also include an examination of potential disconnections between classroom mathematics and home mathematics. Section 2.4 will identify key elements that influence engagement, with a focus on teacher and student relationships. Section 2.5 will review and describe a

range of practices for Påsifika learners that draw on their cultural values to achieve equity. Finally, section 2.6 will focus on task selection and design drawing together the key ideas discussed earlier in the chapter.

2.2 Culturally responsive teaching and equity

Culturally responsive pedagogy is when teachers build on students' cultural knowledge, experiences, and background to develop relevant and successful learning opportunities for diverse students to participate. Teachers use students' strengths and connect students' school experiences to their lived social realities (Cobb & Hodge, 2007; Gay, 2010; Rubel, 2017). Pang (2005) defines culturally responsive teaching as, "an approach to instruction that responds to the socio-cultural context and seeks to integrate the cultural content of the learner in shaping an effective learning environment" (p. 336). This includes; building positive relationships, developing a supportive learning environment that reflects the cultural and social values of all learners, and allowing all learners to access and engage in mathematics. Equity is achieved when all students are provided with opportunities to become successful learners. When students are supported and well equipped to succeed within diverse communities across the globe, the challenge for students to gain access and to engage in mathematics will be diminished (Averill, 2012; Cobb & Hodge; Gay; Hunter & Hunter, in press).

Utilising students' funds of knowledge can be used as an essential framework for culturally responsive teaching and equity. Moll, Amanti, Neff and Gonzalez (1992) define funds of knowledge as "historically developed and accumulated strategies or bodies of knowledge that are essential to a household's functioning and well-being" (p. 3). Within this frame, teachers are re-positioned as learners to gain insight into students' and their families' funds of knowledge (see Section 2.3). Students and families become the experts through sharing their cultural heritage, background and life experiences. Educators who capitalise on this knowledge to create learning experiences and resources for schooling assist equity as students are provided with opportunities to participate

in learning experiences that relate to their lived social and cultural world. The concept of funds of identity where educators communicate and interact with students to learn more about their interests, knowledge and skills complements funds of knowledge and places students at the center of the learning environment.

2.3 Culturally responsive tasks and funds of knowledge

Both New Zealand based studies and international studies (e.g., Averill, 2012; Hunter & Hunter, 2018, in press; Tate,1995, Wernet, 2017) demonstrate that frequently the problem contexts that students engage with in schools reflect the cultural capital of New Zealand European or middle class white students. Potentially this can mean that students from diverse backgrounds not only struggle with the mathematics within the problem, but also struggle with accessing the context within the problem. For example, in Averill's, (2012) study which observed 100 secondary school lessons, there was little evidence of teachers drawing on cultural knowledge from their Påsifika parents, students and community to develop culturally relevant contexts that they could use in their mathematics classroom.

Similarly, Rubel's (2017) research study set in the USA with 11 teachers who worked in secondary schools with a high percentage of Black and Latinx students, revealed that tasks the teachers implemented were related to general out of school contexts and were unconnected and irrelevant to the students' lived experiences outside of school. Rubel argues for the need to productively connect mathematics to students' experiences through teachers developing "ongoing practices around learning about their students and their students' interests, everyday activities, heritage, home language and more" (Rubel, 2017, p. 73).

Clearly, it is important for teachers to understand the students' cultural backgrounds, to inquire and collaborate with whanau, and learn about the everyday mathematical contexts from diverse students' home and community contexts that could be used as a basis for tasks in the mathematics classroom

(Civil, 2007). By getting to know their students and their interests, teachers will be able to create appropriate tasks that have a mathematical purpose and are relevant to students. Providing students with relevant and purposeful tasks allows them to apply prior knowledge of their lived experiences to mathematics which strengthens students' mathematical identities (McDuffie, Wohlhuter & Breyfogle, 2011). We can look to both international and New Zealand based studies which draw on a funds of knowledge approach (e.g., Civil; Hunter & Hunter, 2018, in press; Joves et al., 2015) to highlight examples of how the gap between home, community and school mathematics can be bridged.

Within funds of knowledge models, educators are encouraged to learn about students out of school mathematical experiences and use this knowledge to embed everyday mathematics in the classroom. In this way more equitable opportunities can be constructed through drawing on, the knowledge and experiences from the community. In Civil's (2007) funds of knowledge project, teachers visited their Latinx students' families homes, interviewing them to gain insight into their cultural heritage and experiences outside of school. The teachers designed learning experiences that built on the families' funds of knowledge shared throughout the home visits. After noticing that her students' families shared expertise in gardening, one of the teachers designed a mathematics unit based around container gardens that she created outside her classroom. Parents were welcome to help out and were used as classroom resources. Teachers viewed the students' parents and families as resources to create mathematics tasks that connected to the students out of school experiences which enhanced the trust and rapport between the parties. The students' engagement in mathematics increased as they had a personal interest in the tasks and outcomes.

Similarly, in Joves, Siques and Esteban-Guitart's (2015) study, a teacher interviewed a 7 year old Spanish boy and his family who were originally from Morocco to learn more about their prior knowledge and skills. The boy shared his funds of identity by illustrating and discussing what was important to him. After discovering that farming was significant in the child and his families' life, the teacher designed a social science unit based around farm animals. The unit

included a workshop that was led by the child's mother and a class visit to the farm where the father of the student worked. In this study, the teacher re-positioned herself from being the expert to the learner, using the parents and childs' funds of knowledge and identity as a classroom resource.

In the New Zealand context, research studies in mathematics and literacy have provided insight into how funds of knowledge can provide a basis for equity for Påsifika students. For example, Hunter and Hunter (2018) describe how the use of tasks relevant to students' culture and life experiences resulted in the students seeing a connection between their home and school mathematical lives and being able to achieve while maintaining their cultural identity. In the area of literacy, Dickie (2011) provided Påsifika students with cameras to document their life experiences outside of school related to literacy. Students provided teachers with photographs which they shared during rich discussions of the literacy embedded in the photographs. Instead of seeing the differences of the students' home literacy within a deficit framing, teachers incorporated culture into their classroom by selecting appropriate texts and activities. The data collected from the students' photographs allowed teachers to transform their pedagogy so it aligned with students' socio-cultural background and experiences. Student engagement increased because the link between home and school literacies strengthened and teachers developed programmes that reflected the knowledge shared by the students.

From these studies (e.g., Civil, 2007; Dickie, 2011; Hunter & Hunter, 2018; Joves et al., 2015) we can draw the conclusion that working with families and positioning them as experts results in positive partnerships and reduced deficit theorising on the part of teachers. This in turn, enables educators to make stronger connections and bridge the gap for students between home and school mathematics.

2.4 Student engagement and teacher-student relationships

Engagement in mathematics is the extent to which students develop a positive connection to mathematics, seeing it as purposeful and valuable (Cobb &

Hodge, 2007). Engagement is enhanced when students develop a positive mathematical disposition. This is formed when students value mathematics, make connections between the mathematics they learn in and out of school, and discover the relevance and importance of mathematics to their current and future lives (Boaler, 1998, 2002; Matthews, 2017; Wright, 2017). In Wright's (2017) study, three teachers adapted their practice from the teacher as dispenser of knowledge to students working collectively on real life tasks. Teachers highlighted the impact of ensuring links between mathematics and real life situations. They found that through the use of real life contexts, students shifted from characterising school mathematics as boring and irrelevant to discovering its purpose and appreciating mathematics and its application to real life.

Engagement is supported by positive relationships, having access to relevant content and opportunities for involvement in a supportive environment that promotes participation and equity for all learners (Attard, 2012, 2013; Bills & Hunter, 2015; Cobb & Hodge, 2007; Gay, 2010; Hunter & Hunter, 2018, in press). Attard (2012) completed a qualitative study that focussed on 20 students' engagement in mathematics over a three year period. Results illustrated that students valued positive and respectful relationships with their teacher, ones where the teacher considered themselves a learner alongside the students. Students preferred tasks that were challenging and related to life like situations, asking questions and having the opportunity to work in groups. Similarly, in Bills and Hunter's (2015) study, students worked as a family in small groups to solve challenging, relevant tasks. Students felt safe to take risks and supported each other with their learning.

The relationship between the teacher, student and students' peers can influence engagement. Teachers need to prioritise building a supportive learning environment that engages all students (Sharma et al., 2011). Developing a classroom culture where the teacher is part of the learning community embeds positive relationships between all members of the classroom (Boaler,1998, 2002; Jansen & Bartell, 2013, Mercer, 2002; Wright, 2017). In Boaler's (1998, 2002) research at Phoenix Park school in the United

Kingdom, students worked in mixed ability groups which resulted in many benefits for the students. A highlight was the skills students' developed around acting and ways of being. Students shared the ways it had taught them to be respectful of different people and ideas. They developed the skills to be open-minded, thoughtful, respectful of others, and learnt the principles of communication and support. This aligns with Wright's (2017) research study when three teachers developed a classroom culture where students worked collectively on real life tasks. When interviewed, teachers highlighted the impact that social grouping had on students and their relationships with the teacher and peers. Positive relationships were built based on mutual trust within an open and supportive learning environment. Students developed the required personal and social skills that reflected their personal situations and enabled them to become successful learners of mathematics.

Building positive relationships is important for all, however this is particularly important for Påsifika students (Ministry of Education, 2013). Many studies (e.g., Averill, 2012; Hunter et al., in press) involving interviews with Påsifika students within New Zealand, highlight that an influential factor on Påsifika students' engagement and achievement in mathematics, was the relationships they had with their teacher. Averill (2012) worked with six teachers and their students. Her findings suggest that both teachers and students believed in the importance of developing positive relationships. However, students also believed that their cultural heritage and mathematical learning were separate and none of the teachers mentioned how they linked the students' cultural heritage into their mathematics classrooms. The results from this study, emphasise the need for teachers to take the time to draw on students' interests and cultural background to engage students in mathematics. Therefore, students can make explicit links and identify their culture with the mathematics they do at home and school. Students will feel included in the classroom culture, strengthening the relationships between students, teachers and peers (Averill; Hunter & Bills, 2015; Hunter et al.). Hence, it is important for teachers to develop a reciprocal relationship with their Påsifika learners, where priority is given to, understanding students' interests, cultural background, and students

have opportunities to successfully engage in mathematics (Averill; Hunter & Bills; Hunter et al.).

Despite the need for positive relationships between teachers and students, both international and New Zealand studies highlight that many teachers have deficit views about their diverse students. International studies (e.g., Civil, 2007; Cobb & Hodge, 2007; Gay, 2010; Jansen & Bartell, 2013; Rubel, 2017) reveal that USA based teachers frequently hold deficit views of their African American and Latino students. Rubel's (2017) study investigated 12 teachers from 11 schools in America. The results illustrated that the teachers excelled with the dominant white middle class practices but struggled with the critical practices of connecting to students' experiences from diverse backgrounds. They found that prior to the study, teachers held deficit views about these students' backgrounds, causing resistance from teachers to visit students' households to learn more about their background. Similarly, in the New Zealand context Turner, Rubie-Davies and Webber (2015) found that teachers both held deficit views and attributed under-achievement to students' background, lack of motivation and aspirations. Views such as this, led to low expectations by teachers and a lack of opportunity for students. The deficit thinking of teachers and the mismatch between the students' home and school learning environment are roadblocks to the students' achievement and engagement in mathematics (Bills & Hunter, 2015; Hunter & Hunter, 2018, in press; Turner et al., 2015).

Equity can be achieved by providing all students with mathematical experiences that have an appropriate level of challenge. Boaler (2015) states, "if students are not given opportunities to learn challenging and high level work, then they do not achieve at high levels" (p. 109). In summary, we can see from the literature that students need to be provided with opportunities that allow for them to struggle, encouraging growth in learning. To increase student confidence, engagement and participation in mathematics, teachers need to portray high expectations to their students by expecting them to succeed and to create a risk-taking learning environment that supports students to rise to these expectations.

2.5 Drawing on cultural values in the classroom

Values are important personal beliefs that one holds which can influence students' behaviour within the classroom. To develop a culturally responsive practice, teachers need to understand what their students' values are and align their practice to incorporate those values. If school experiences contradict the cultural values and behaviours of the students' lives at home, students will struggle to see their cultural identity reflected in the classroom (Joves et al., 2015; Seah, 2016).

International studies, (e.g., Civil, 2007; Gay, 2010; Tate,1995) found that the classroom pedagogy in America frequently caters to the dominant white middle-class students, alienating those from diverse backgrounds. In Tate's (1995) study, the learning experiences that African American students participated in linked to the European values and traditions and excluded the African American experience. This caused students to isolate their school and personal lives and see them as separate. The cultural values and contexts contradicted those of the African American students which made it challenging for them to transition between their life outside of school and school experiences, consequently decreasing their opportunities in mathematics education.

New Zealand studies, (e.g., Averill, 2012; Bills & Hunter, 2015; Hunter & Hunter, 2018, in press) also report a disconnect in mathematics classrooms between the teachers' understanding of diverse students' cultural values and experiences. For example, classrooms within New Zealand frequently represent the values of the dominant New Zealand European culture. Påsifika values include reciprocity, respect, service, inclusion, family, relationships, spirituality, leadership, collectivism, love and belonging (Anae, et al., 2001). Teachers lack of understanding of the cultural values that students adhere to outside of school can cause misinterpretation of Påsifika students' behaviours within the classroom. The cultural values of Påsifika students influence their participation and communication in the classroom. These may significantly differ from those used within the classroom. For example, Påsifika students drawing on the value of respect may be reluctant to question and challenge other students (Hunter &

Hunter, 2018, in press). However, teachers may perceive this as a lack of participation from students. This disconnect signifies the urgency for teachers to understand and incorporate these values and develop teaching practices around these core values to engage Påsifika learners in mathematics.

Research studies (e.g., Hunter & Bills, 2015; Hunter & Anthony, 2011; Hunter & Hunter, 2018, in press) provide us with exemplars of how teachers can draw on students' values to engage Påsifika learners in mathematics. For example, Hunter and Anthony (2011) and Bills and Hunter (2015) investigated teachers developing a collaborative community in the mathematics classroom with predominantly Påsifika students. The students were encouraged to work together to solve challenging problems, inquire, explain their thinking and challenge others in a culturally responsive way. When students were working within their groups, all students were responsible to ensure that all members of their group had a shared understanding of the mathematical solutions. This drew on the concept of family which overlays all of the Påsifika values. Students accepted the responsibility that all members within their group understood and agreed on a shared solution, one they could all confidently explain to others. Other Påsifika values of reciprocity and collectivism were illustrated through the students and their interactions within their groups, as they were held accountable for not only their own understanding of the solution but also the understanding of other members of the group. The teachers passed on the responsibility of shared ownership to the students, becoming a member of the community rather than the feeder of knowledge. This allowed all students to access mathematics, producing engaged learners of mathematics. The expectation of working as a collective family reduced individualism and competition. Additionally, there was no longer a disconnect between the home lives of students and school when the values were embedded into the classroom environment.

2.6 Mathematical tasks

Many studies (e.g., Boaler, 2002, 2015; Cobb & Hodge, 2007; Gay, 2010; Wernet, 2017; Wright, 2017) highlight a disconnect between the mathematics learnt in school and the mathematics that students experience in the real world. Students struggle to see the relationship between school and home mathematics. This may be attributed to traditional teaching approaches which focus on developing procedural knowledge that students find difficult to apply in real world situations (Boaler; Matthews, 2017; Wernet; Wright). During Boaler's (2002, 2015) research at Amber Hill in the United Kingdom, she found that many of the teachers taught methods and rules to the students. The students developed a procedural knowledge without understanding. When students came across real life problems they could not apply what they had learnt in class and adapt it to new situations. Similarly, in Matthew's (2017) study, he worked with 419 secondary school Black and Latinx students. Classroom observations, surveys and cognitive assessments were implemented to measure the students' value for mathematics. Results from this study suggest that students were disengaged in mathematics, finding it repetitive and boring. Students did not see any value to the mathematics they learnt at school or how it could benefit their lives outside of school.

In contrast, teaching that is focussed on developing contextual and conceptual understanding allows students to apply and use mathematics that they have learnt in any context and make connections to mathematics in their everyday life (Wright, 2017). By providing students with realistic experiences and mathematical contexts in the classroom, will enable them to apply the conceptual knowledge learnt in school in real life situations. In Wright's (2017) study, three secondary school teachers in England adapted their practice by making a conscious effort to provide students with real life and meaningful contexts. Teachers described how it contributed to students gaining a deeper understanding of mathematical concepts. Students were able to apply what they had learnt in class and adapt it to new situations. Students became confident at solving problems in unfamiliar contexts.

Quality task selection is essential to gain a depth of understanding in mathematics and be able to use and apply this understanding in various contexts. Task selection in mathematics is important for student engagement and learning opportunities (Sullivan et al., 2015; Wernet, 2017). The choice of task is a key decision that the teacher makes. Many studies (e.g., Boaler, 2015; Sullivan et al., Stein, Grover & Henningsen, 1996) have focussed on the selection and design of rich tasks. Stein, Grover and Henningsen (1996) worked with teachers on designing tasks that were both cognitively demanding and had multiple solution strategies. From 620 tasks, they evaluated the impact that 45 of the tasks had on assisting students to engage in mathematics at high levels. They found that the most important feature of a task that engaged students at high levels was those tasks that built on students' prior knowledge and were pitched at an appropriate level of difficulty. Other factors that assisted high levels of engagement included those tasks that provided students with the opportunity to explain their solutions to others and tasks with multiple solutions, representations and multiple ways to access the problem.

When tasks are challenging and multi-level, it provides students with equal opportunities to access the problems, and can promote discussion between members of the groups. Students gain a sense of empowerment when they can access problems and share their knowledge and listen to others' knowledge. This creates positive learning outcomes for students. Other researchers (Boaler, 2015; Sullivan et al., 2015) completed case studies that highlight the positive impact the design of a rich task has on students. Boaler (2015) described how the students at Railside High School in San Lorenzo worked together on tasks provided by the teacher that were open ended and could be accessed and taken to different levels. Students from Railside High School were provided with challenging work and were supported by their peers, maximising their learning opportunities, increasing participation, engagement and achievement.

As previously discussed in section 2.3, New Zealand studies (e.g., Averill, 2012; Hunter & Hunter, 2018, in press; Hunter & Miller, 2018) highlighted the challenges that diverse learners face with unfamiliar contexts in many

classrooms. Hunter and Miller (2018) implemented 10 lessons with 29 Year Two students using Māori and Pāsifika contextual patterning tasks. The familiar context of using a traditional Cook Island tivaevae pattern, supported students to make connections to and develop an understanding of growing patterns. Similarly, Hunter, Hunter and Bills (in press) implemented tasks with Pāsifika students that were relevant to their lived social and cultural experiences. Examples of tasks used were., making cultural dishes, costumes for cultural dances and traditional celebrations such as hair cutting ceremonies. As a result, students saw a connection between their home and school mathematical lives and saw themselves as Pāsifika within their mathematics classrooms, allowing them access to the mathematics embedded within the tasks.

2.7 Conclusion

Teachers are encouraged to embed a culturally responsive pedagogy in their mathematics classrooms, which can be challenging but is vital to improve equity and equal opportunities for achievement (Averill, Anderson & Drake, 2015). As the literature review illustrates, if students and teachers are embedding cultural and mathematical practices while working collaboratively on tasks that build on students' cultural heritage, then Pāsifika students' participation and engagement in mathematics increases. The research method, philosophy and research design will be presented in the next chapter.

Chapter Three: Methodology

3.1 Introduction

The reviewed literature provided a theoretical framework for the current research study. This chapter provides an overview of the philosophy and methods that informed the research design. Section 3.2 describes qualitative ethnographic case study research building on Påsifika theoretical frameworks and how this approach is aligned with the current study. Section 3.3 introduces the participants, project outline and shares the ethical procedures that were considered. In section 3.4 the role of the researcher is identified, followed by an explanation of the data collection methods in section 3.5. Finally, section 3.6 describes the data analysis, and trustworthiness of the data is explained.

3.2 Qualitative research

Qualitative research focusses on the study of people and their interactions in different contexts within a natural environment (Atkins & Wallace, 2012; Punch & Omacea, 2014). It provides the researcher with an in-depth description of how people interact with each other and communicate their ideas to one another in a range of contexts. (Atkins & Wallace; Lichtman, 2010; Punch & Omacea; Stake, 1995). For the current study, a qualitative ethnographic case study was selected to gain a thorough understanding of the selected participants' perspectives and interactions that fostered participation and engagement in mathematics. The study involved working with a small group of Påsifika students, where the researcher collected data that focussed on students' participation and engagement in their mathematics classroom setting and their mathematical experiences that they engage with outside of school.

3.2.1 Case study

A case study is a common qualitative approach when the researcher studies a small group of people in detail. Case studies are effective for discovering connections and patterns through seeing and hearing interactions within natural contexts. They allow the researcher an opportunity to investigate holistically over a period of time the interactions of people in their everyday lives, providing evidence and understandings to support researchers' interpretations and conclusions (Atkins & Wallace, 2012; Punch & Omacea, 2014; Stake,1995). In the current study, students were observed in their mathematics classrooms working on tasks. The case study design allowed observations of students in their natural environment over a period of time to gather data. The data was used to provide information related to students' participation and engagement influenced by their interactions and communication with others.

A case study is most successful and reliable when more than one method of data is collected to ensure researcher bias is limited (Atkins & Wallace, 2012; Punch & Omacea, 2014; Stake,1995).The current study used interviews and observations throughout. Student responses and perspectives supported by observations of their interactions within their environment, provided rich descriptions and evidence to support analysis within an ethnographic frame.

3.2.2 Ethnography

Ethnography is a qualitative method of study that investigates people and their cultures. This research approach uses multiple methods to gather rich data. Ethnography involves the researcher exploring the participants' social and cultural behaviour within their natural setting (Atkins & Wallace, 2012; Cirocki, 2010; Punch & Omacea, 2014). For the current study, a small number of students were purposively selected as having family ethnic origins from the Pacific Islands. I gained insight into Påsifika culture and values, investigating the impacts that these had on students' social interactions within the mathematics classroom. I learnt about the participants' culture and values through engaging in rich discussions about their cultural experiences outside of

school and observed students interacting with their peers in the naturalistic context of the mathematics classroom. Ethnography allowed me to participate in the research, and study the students' actions within the classroom. I had the opportunity to construct descriptions and analysis through my interpretations that I had formed from interviewing and observing the students.

Figure 3.1. Talanoa model (as cited in Lemanu, 2014, p. 2)

To develop a rich understanding of Pāsifika culture and values and to support my role as a culturally competent respectful researcher, I drew on two theoretical frameworks. The Talanoa model (see Figure 3.1) (Manuatu, 2002; Vaioleti, 2006; Mahina, 1998; Seve- Williams, 2009) is used as a framework to support educators to communicate with Pāsifika students and their families (as cited in Lemanu, 2014). 'Talanoa' means to communicate and is made up of four key elements which include Ofa (love), Mafana (warmth), Malie (humour) and Faka'apa'apa (respect). These elements are important in fostering meaningful relationships and communication with Pāsifika families. The current study drew on these elements to support successful communication between the researcher, student participants and their families. Respect was given to students and their families when sharing their funds of knowledge throughout the study and during an initial workshop. I practised Ofa (love) and Mafana (warmth) when I worked with students to prepare cultural dishes for their families during the workshop. Throughout the study, participants taught me about important elements of their culture (e.g., cultural dances, how to make

traditional necklaces, cultural food). This supported me to develop positive relationships with them.

A second model I drew on was the ‘Ula’ (Sauni, 2004) Samoan research model (as cited in Sauni, 2011, p. 57) which was developed to foster successful relationships between the researcher (myself) and the participants and allowed me to establish relationships and effective connections. The Ula is a garland that is used to welcome guests and special visitors to cultural celebrations in Samoa.

Figure 3.2. Ula (Sauni, 2004) terms of engagement model (as cited in Sauni, 2011, p. 57)

In Figure 3.2, the Samoan values and principles surround the lei. The linking of the flowers reflects the ongoing demonstration of the values and principles. The space within the lei is where the researcher and participants establish powerful relationships throughout the research. Participants in this study were empowered as they became experts when sharing their knowledge with the researcher (myself). I took the role of a learner while acknowledging and respecting the students’ knowledge that they shared. Within the current study,

the cultural values were used as an umbrella for practices in mathematics lessons. This demonstrated appreciation for Påsifika culture and values.

The Talanoa (Lemanu, 2014) and Ula (Sauni, 2011) models provided a framework for the current study. They supported me to build positive relationships and communicate effectively with the Påsifika students and their families.

3.3 Participants and setting

Purposive sampling was used in this study. Letters were sent home and phone calls were made to all Påsifika students in Year 5 and 6 from one school. Students and families that were interested in the study attended an information session. 11 Year 5 and Year 6 students from a decile three[5]urban Auckland school (64% girls and 36% boys) agreed to participate in the study. Ethnically the families of the students were from Niue (18%), Tonga (36%) and Samoa (46%). Two classroom teachers and the 11 students' families were also involved in the study. Information gathered from the students and their families was used to support the development of culturally based tasks.

[5] deciles measure a schools' community socio-economic position. The deciles rank from 1 being the highest proportion of students from a low socio-economic background to 10 being schools with the least amount of students from a low socio-economic background.

3.3.1 Project Outline

The current study consisted of three phases over five months. The table below (see Table 3.1) outlines the research activities that were implemented during each phase of the study.

Timeline of research		
Phase One	**Phase Two**	**Phase Three**
● Initial information evening for participants and families ● Participant and family workshop ● First semi-structured interview ● Students received cameras to document mathematical experiences ● Three in class observations	● Photo elicitation interviews with participants ● Co-planning of culturally relevant tasks with classroom teachers ● Seven in class observations of students working on culturally relevant tasks ● Group interviews with participants after observations	● Final semi-structured interview

Table 3.1. Timeline of research activities implemented during each phase of the current study

Phase One

In the initial phase, all students were interviewed individually (see Appendix A1). Observations were undertaken of students working in their classrooms on tasks that were selected by their teachers. Parents of students were invited to a workshop with their child to bring in photographs of activities and share their funds of knowledge (Civil, 2007). This workshop enabled families to collectively share their cultural knowledge and to think about the mathematics involved in their everyday life and social settings. Students were given a camera to document the mathematics that they saw and participated in outside of school and to take photographs that could support them to share their funds of knowledge during interviews.

Phase Two

The second phase involved the design and implementation of culturally based tasks that built on from the knowledge shared by the parents and students (see Appendix B). Photo-elicitation was used to interview students when photographs were brought in. Tasks to use in the classroom were co-designed with the teacher and researcher (myself) and then observations were made of the students working on these tasks in class. After each observation, students were interviewed in focus groups to gather their perspectives around the task and the lesson (see Appendix A2*).*

Phase Three

The final phase, involved a final interview with students using similar questions as the first interview (see Appendix A3).

3.3.2 Ethical considerations

All ethical issues need to be considered when conducting research. After a research proposal is accepted, written consent needs to be sought from all participants (Ary, Jacobs, Razavieh, & Sorensen, 2006; Atkins & Wallace, 2012). It is essential that all participants of the research study understand what they are consenting too. This can be achieved by both the arrangement of initial information meetings and the provision of detailed information sheets

(Ary et al., Atkins & Wallace). In the current study, written consent (see Appendices C1, C2, C3, C4 & C5) was sought from the Board of Trustees, students, parents, and teachers. For the parents and students in the initial meeting, a power-point was used along with the information sheets to ensure that participants had clear details of what was involved throughout the research. Information was read orally to the participants and time was given for any questions to be answered. Separate information sheets were created because of the differing roles of the participants. These were appropriately written to cater to the specified audience (see Appendices D1, D2 & D3).

3.4 Role of the researcher

In an ethnographic case study, the researcher takes an important role and must "enter the culture of the participants, live among them, observing as many facts of their lives as possible" (Cirocki, 2010, p. 66). In the current study, this included identifying, analysing and interpreting the students' interactions within a classroom setting. These elements ensure that adequate and quality data is gained from the cases which are studied (Cirocki; Punch & Omacea, 2014).

During observations, researchers can become participant observers. A participant observer's aim is to be seen as an active member during the observations (Angrosino, 2012). Observation research in mathematics classrooms can be effective when researchers participate within the observations (English, 2008; McKnight, 2000). During these observations, the researcher takes on the role of a social scientist, working alongside the teacher using theory to support the teacher with their practice. This supports both the teacher and researcher to see if the theory has made an impact (Angrosino; English; McKnight). "Observation based educational research has tended to be reactive in nature; its findings were often used to provide feedback to teachers and administrators with the goal of improving teaching" (Angrosino, p. 166). In the current study, I took on the role as a participant observer. Rather than simply being an observer of the classroom interactions, I also participated in the lessons. I engaged in regular discussions with the students and supported the teacher to develop culturally responsive and mathematical practices. This

facilitated the participation and engagement of the students while working on culturally relevant tasks.

As a previous teacher at the selected school, many of the participants already had a relationship with me. This meant that the chances of participants feeling intimidated or uncomfortable were diminished when observations took place. However, conducting research within familiar contexts also has disadvantages. These include; confusion of role identity, relationships influencing participant behaviours and removing the risk of impartiality (Atkins & Wallace, 2012). My previous role as a teacher may have caused confusion for participants whenever I came in to carry out the observations. They may have perceived me as a teacher rather than a researcher role. Having a relationship with the participants and teacher may have influenced their behaviours throughout the observations. The participants may have behaved differently to 'please' or impress me. Another challenge was the ability to step back and look at the situation that I was so familiar with. With prior knowledge and experience of the setting and participants, I had to maintain a clear and unbiased view of the situation. The process of ensuring that the research was reliable and valid within a familiar context is further explained in section 3.6.1

3.5 Data collection methods

3.5.1 Interviews

Interviews are a common data collection method used in qualitative research. Interviews allow the researcher to identify the reality of the participants' thoughts and feelings about the situation (Punch & Omacea, 2014). "They are also a very flexible research tool which can be used to gather a range of data, views and opinions, personal narratives, which make them useful as a means of answering a wide range of research questions" (Atkins & Wallace, 2012, p. 86). However, interviews can be challenging and require both effort and careful thought. The interviewer should consider building trust and rapport with the participant, the type of interview and questions that will be asked, how the interview will be recorded and where the interview will take place (Atkins &

Wallace; Joseselson, 2013; Kvale, 2007; Punch & Omacea; Schensul & Le Compte, 2013). In the current study, three types of interviews were used; semi-structured individual interviews, semi-structured group interviews, and photo-elicitation interviews.

Power relationships can influence the responses given by participants during interviews (Atkins & Wallace 2012). This was important in the current study due to my role as a teacher in the school from the previous year. As I had previously taught some of the students, this may have influenced their responses. Students may have felt obliged to answer questions in a certain way to 'please' me or felt that they could not answer honestly. Consequently, it was arranged for an experienced external interviewer to conduct the interviews with the students. To ensure that the students felt comfortable having a stranger come in to ask them questions, I made sure all of the interviews took place in an environment that students felt comfortable. This reflects ofa/alofa (love) and faka'apa'apa (respect) through the Talanoa (Lemanu, 2014) and Ula (Sauni, 2011) research methodologies.

The Ula (Sauni, 2011) and Talanoa (Lemanu, 2014) Påsifika research methodologies provide a way to establish powerful relationships and effective communication between the researcher and participants. Within these perspectives, during an interview, the interviewer must first establish a positive relationship with the participant through making connections, building trust and rapport. They can demonstrate ofa/alofa (love) and mafana (warmth) through using positive body language and reactions, and showing interest and faka'apa'apa (respect) for what is being said (Lemanu; Sauni). This allows the participant to feel comfortable sharing their thoughts and experiences with a stranger. The relationship between the interviewer and respondent can influence the quality and reliability of the data collected (Joseselson, 2013; Kvale, 2007; Schensul & Le Compte, 2013). The Talanoa (Lemanu) model also encompasses effective communication. At the beginning of an interview, the interviewer should introduce themselves, share with the participant what the interview will be about and what will happen throughout the process. This establishes trust and mafana (warmth) between the respondent and the

interviewer. Ofa/Alofa (love) and faka'apa'apa (respect) can be communicated by showing gratitude, giving assurance of confidentiality and allowing the participant to ask any questions throughout the interview. "When people are reasonably assured that what they disclose is confidential, and they then feel interest and acceptance of the interviewer, they usually warm to the situation and take the opportunity to speak at a depth that may be quite surprising to them" (Joseselson, 2013, p. 5). In the current study, the interviewer built positive relationships with the participants by talking informally with the participants prior to the interview. They effectively communicated what the interview would involve and provided the participant with time to read through the questions and to ask any questions before they began the interview. Additionally, they assured them that all information would remain confidential.

All interviews were audio recorded. Audio recording supports the interviewer to establish rapport with the participants as the interviewer is able to focus solely on the responses rather than taking notes (Atkins & Wallace, 2012). This enables the interviewer to further acknowledge the respondent with mafana (warmth), ofa/alofa (love) and faka'apa'apa (respect). In the current study, this was important as the students did not know the interviewer. The audio recording allowed her to build rapport and subsequently probe students' responses so that a detailed record of the interview was generated to support the analysis.

Pilot interviews should be implemented to see whether the questions asked are easy to understand and the extent to which they enable opportunities for the selected audience to give sound responses. They allow the researcher to adapt and make changes to questions prior to interviewing the participants (Punch & Omacea, 2014; Rubin & Rubin, 2012; Schensul & Le Compte, 2013). In the current study, the interviewer and myself completed four pilot interviews with students who were not involved in the study. After each one, we made adjustments where necessary and modifications were made.

Semi-structured individual interviews

A semi-structured interview is structured by a set of questions to prompt the discussion, but allows opportunities for the interviewer to probe and make adaptations throughout the interview (Punch & Omacea, 2014; Rubin & Rubin, 2012; Schensul & Le Compte, 2013). Probing questions are used to support participants to answer the questions in more detail. This study used semi-structured individual and final interviews (see Appendix A1 & A3) to allow flexibility for both the interviewer and respondent. A semi-structured interview provides insight into students' perspectives allowing the interviewer to find out more about a response. It increases opportunities for the respondent to share their thoughts about a certain situation which provides rich data.

Semi-structured group interviews

A semi-structured group interview involves interviewing several people at the same time. Group situations stimulate rich discussions between group members about their views and perspectives. The interviewer acts as a facilitator of discussion asking semi-structured questions while monitoring and recording the group interactions and discussions (Punch & Omacea, 2014). In the current study, semi-structured group interviews took place (see Appendix A2) after participants were observed in their mathematics lesson. Any aspects, perspectives or insights that were not exposed during the observations were surfaced. Interviewing the students in groups created rich discussions about the selected topics. Group interviews were used to gather the participants' perspectives of the lesson and their thoughts around the task that they engaged in during the observations.

Photo-elicitation interviews

Photo-elicitation is the use of photographs during an interview situation to promote rich discussions and draw out new information from the use of a visual tool. This allows the researcher to gain insight into participants' perspectives by supporting participants to communicate activities and interactions in different contexts and situations (Allen, 2012; Clark-Ibanez, 2015; Meo, 2010; Miller, 2014). In the current study, students took photographs and brought photographs in of their lived experiences outside of school and then shared

these with me along with a description of the mathematics involved in the photographs. Using photo-elicitation as a tool provided insight into the mathematics that is involved in the students' lives and provided me with new knowledge to work with teachers to design mathematical tasks which contextually fitted with the students.

The process of photo-elicitation also has benefits for the participants as it provides them with a sense of empowerment. The participants are re-positioned as co-researchers as they collaborate with the researcher to share their knowledge and expertise about their social and lived worlds (Allen, 2012; Clark-Ibanez, 2015; Meo, 2010; Miller, 2014). Photo-elicitation enhanced my ethnographic case study as it allowed me to be immersed and to learn about the students' lives outside of school and develop enriched understanding of their culture.

3.5.2 Observations

Observations as a data collection tool provide the researcher with the opportunity to see and hear their selected participants' interactions and behaviours that evolve within their natural environment (Punch & Omacea, 2014). During observations, researchers will discover and interpret themes and patterns that may relate to their research questions. To ensure that rich data is collected researchers need to consider their role within the observation. At first they need to identify who, what and how often they will observe. Additionally, they need to clarify the type of observation and how they will record and analyse the data. (Angrosino, 2012; Punch & Omacea, 2014; Schensul & Le Compte, 2013).

Semi-structured observations are ones where the focus for each observation does not have to be predetermined and can evolve based on what emerges throughout the observation. They allow researchers to observe in an open ended way, and focus more holistically on students' interactions and behaviour (Angrosino, 2012; Punch & Omacea, 2014; Schensul & Le Compte, 2013). In the current study, semi-structured observations were used. Having the flexibility

to adjust the focus of the observations provided me with more opportunities to interpret the interactions and behaviours of the participants in different ways.

In order to ensure that the patterns and themes emerge often enough and over a period of time, semi-structured observations should be frequent and focus on the same group of participants (Angrosino, 2012; Punch & Omacea, 2014; Schensul & Le Compte, 2013). In the current study, 10 observations were made on the same group of students within their natural classroom environment during mathematics lessons working on a variety of tasks.

Videoing semi-structured observations allows the researcher to participate in the observations (Angrosino, 2012; Punch & Omacea, 2014). In this study, all observations were video recorded. This enabled me to immerse myself in the students' environment and participate throughout the observations. All video-recordings were wholly transcribed including quotes, interactions, body language, comments and timing of events. Also detailed notes after each observation were transcribed onto a record sheet (see Appendix E). This was analysed for any themes and patterns that evolved significantly throughout the observations.

3.6 Analysis of Data

Qualitative research analysis aims to share possibilities and interpretations that have explicit links to theory (Atkins & Wallace, 2012; Punch & Omacea, 2014). Data collected through qualitative research is used as evidence to support or contrast with theory and previous research. The researcher uses thematic analysis to develop interpretations and arguments. Thematic analysis involves the researcher making sense of the data, breaking it down and searching for patterns and themes that evolve and then linking these themes to research literature (Atkins & Wallace; Burnard, 1991; Gibbs, 2007).

A thorough and organised coding scheme allows the researcher to categorise data into themes (Atkins & Wallace 2012; Burnard, 1991; Gibbs, 2007). In the current study, coding was used to support thematic analysis of the transcripts.

The following five key themes were identified; mathematics at home and school, culturally relevant tasks, funds of knowledge, collaborative groups and mathematical disposition and cultural identity. Transcripts were coded and then excerpts were removed and grouped on to a table (see Appendix F). This included both the transcripts from the interviews and observations.

The themes that were developed throughout the study reflect the Påsifika theoretical frameworks and perspectives (Lemanu, 2014, Sauni, 2011). To support the findings, the themes are represented visually using an ula-lei made out of frangipani (kalosipani/ pua fiti/ fiti pua/ tipani) flowers. The visual representation draws upon Hannant's (2013) tipani symbolic representation and Sauni's (2004) ula model. This will be explained in more detail in Chapter Five.

3.6.1 Trustworthiness: reliability, validity and triangulation.

All research studies need to be reliable and valid. Wellington (2000) suggests that "we should undertake research that is systematic, credible, verifiable, justifiable, useful, trustworthy and valuable" (as cited in Atkins & Wallace, 2012, p. 20). Qualitative researchers make sense of their data and form interpretations about what they see and hear throughout their research. They are challenged to approach the research in a clear and unbiased manner. Reliability in research is the extent to which a research study can be undertaken by anyone in any circumstance. It is successfully done when all procedures and implementation of the research have been documented succinctly (Atkins & Wallace; Punch & Omacea, 2014; Stake, 1995). To strengthen the reliability of the current study, I made sure that throughout the interview process all students were asked the same questions and were all interviewed by the same person in the same setting. Each interview was pre-trialed and edited before it was conducted on the selected participants.

Validity is the extent to which the conclusions and findings formed by the researcher are trustworthy. The researcher must ensure that the claims that they are making can be supported by convincing evidence from the data (Atkins & Wallace 2012; Punch & Omacea, 2014; Stake, 1995). To strengthen validity,

it is necessary that participants' stories and voices are consistently represented and accurately communicated to their audience (Atkins & Wallace; Punch & Omacea; Stake). In the current study, analysis of the interviews were checked with the participants to see if they aligned with their perceptions.

The use of triangulation of multiple sources of data ensures both reliability and validity (Atkins & Wallace, 2012; Punch & Omacea, 2014; Stake, 1995). In the current study, conclusions were drawn from four sources of data collection; pre and post interviews, group interviews, photo elicitation interviews, and observations. The data collated from the interviews and observations were triangulated after thematic analysis took place. The themes and patterns that evolved from these methods were analysed together to validate that the data was telling the same story. Studying multiple cases broadened and increased the evidence to support the findings. Triangulation ensured that the data was reliable and trustworthy.

3.7 Summary

This chapter has examined the design of the research study. It has justified the use of a qualitative ethnographic case study for the research. It has explained how participants were selected and the variety of data collection methods used including interviews and observations. These methods were used concurrently and were analysed and triangulated to support the interpretations made. Finally the ethical processes, role of the researcher and measures to ensure reliability and validity have been discussed. The findings that have evolved throughout the study will be presented in the next chapter.

Chapter Four: Findings and Discussion

4.1 Introduction

This chapter presents the findings in relation to how the use of culturally responsive tasks can foster Påsifika students' engagement and participation in mathematics at school. Section 4.2 examines the initial experiences and perspectives of the 11 Påsifika students involved in this study related to the purpose of learning mathematics and their experiences of mathematics at school and home. Section 4.3 investigates the students' funds of knowledge and describes the mathematics embedded within their out of school experiences using photographs. Section 4.4 describes the implementation of the culturally relevant tasks and cultural and mathematical practices that were enacted in the classroom.
Finally, Section 4.5 presents the final interview data focussing on the shifts in student perceptions of mathematics at home and school.

4.2 Phase One: Students' initial experiences and perspectives of mathematics at home and school

4.2.1 Student interview data related to mathematics at home and school

Developing positive connections to mathematics is an important element of mathematical learning as students need to know the purpose and value for learning mathematics and how it will support them in their current and future lives (Boaler, 2002, 2015; Matthews, 2017; Wright 2017). In the initial interviews for this study, most students were unable to articulate a clear purpose for learning mathematics at school. For example, when asked why they learn mathematics, a number of students (n = 4) were unable to answer the question and responded with statements such as: *I'm not too sure.* A smaller group of students (n = 3) described mathematics as a subject which had general utility

for the future: *You might need to learn it for the future.* In follow-up questions, these students were unable to give any specific detail in relation to why they thought mathematics would be important for the future. Another group of students (n = 4) responded with a performance-based orientation: *So we can get better at it.*

To make positive connections to mathematics, educators can provide students with mathematical tasks using contexts that are relevant to students' interests and enact these in ways that align with their experiences outside of school (Matthews, 2017; Wernet, 2017; Wright, 2017). Other questions within the interview explored students' perceptions of their mathematics lessons at school. The initial responses from students (n = 4) illustrated that in their classrooms, mathematics was learnt in an individualised way: *Our teacher gives us questions and we go away and have to work it out.* The students' mathematical tasks were often focussed on procedures or worksheets (n = 5): *It looks like people just sitting by themselves but when we do activities we do lots of maths sheets for addition (and) division.*

To develop a strong, positive mathematical disposition it is important for students to see themselves and their culture reflected within their mathematics classroom (Averill, 2012; Bills & Hunter, 2015; Hunter & Hunter, in press, Hunter et al., in press). Initial interview data from this group of Påsifika students illustrated that within their mathematics lessons, tasks and problems that related to their culture were rarely if ever used. None of eleven students could describe or remember a time they had experienced a mathematics lesson based around their Påsifika culture.

Further questions investigated students' experience and use of mathematics outside of schooling contexts. Students demonstrated difficulty in recognising or describing the mathematical experiences that they engaged in outside of school. Students who responded to this question (n = 3) linked the mathematics they do at home to completing homework: *Yeah, you do homework at home and your mum can try help you.* One student responded to this question by describing mathematics work provided by a sibling: *Sometimes I have to get off*

the technology and my sister will sit there until we finish and she'll give us really tricky questions. Overall, the student responses indicated a view of mathematics as only related to a school context.

Analysis of the student responses in the initial stages of this study showed that the students struggled to see a purpose for learning mathematics. Their responses provided a window into their mathematical learning experiences which appeared to represent a traditional style of teaching where students worked individually to complete worksheets or other similar routine tasks. Similar to the findings of previous research (e.g., Boaler, 2002, 2015; Matthews, 2017; Wright, 2017), students' viewed mathematics as working out the answer to a procedure rather than linking the mathematics they do in school to real world experiences. These perceptions could be attributed to their classroom experiences. It appeared that like findings represented in both international and New Zealand based research (e.g., Averill, 2012; Hunter & Hunter, in press; Rubel, 2017; Tate, 1995) the classroom context in the current study did not align with these diverse students' experiences outside of school or within the community.

The student responses highlighted a disconnect between the students' lives outside of school and mathematics. The students were unable to see the mathematics embedded in their everyday lives and viewed mathematics as only related to school contexts. A divide between what is learnt in school and the mathematics that students experience in the real world has been well documented by researchers (e.g., Boaler, 2002, 2015; Cobb & Hodge, 2007; Gay 2010; Wright, 2017). These researchers explain that when a classroom mathematics programme does not reflect real life contexts that connect to students' lives, then students struggle to develop an appreciation for mathematics. Furthermore, the disconnect results in students being unsure of how mathematics could be applied to and benefit their lives outside of school.

4.2.2 Initial observations of students working in their mathematics classroom

Developing a classroom environment where students and teachers are working together on mathematical tasks and supporting each other with their learning is important and can support engagement and participation in mathematics (Attard, 2012, 2013; Boaler, 2015; Hunter & Hunter, 2018, in press). However, in initial observations of mathematics lessons in these classrooms, it was evident that productive collaborative group norms were not yet established or embedded for the students. For example, during the first classroom observation, students were working in groups of three on a problem. Five of the eleven students appeared to be taking a passive role within their groups where they watched the others solve the problem or spent long periods of the group-work time away from the group (e.g., going to the toilet or in other areas of the classroom). Two students appeared to be attempting to engage with their groups. However, the group members were not communicating with one another and other students were not listening to them. As a result, in the post-lesson interview, none of these students were able to explain how their group solved the problem.

Other productive group norms such as sharing ideas or asking other group members for help also did not appear to be established with the students. For example, in an initial interview one student shared how they struggled to ask others for help: *Some of them I don't really know and I am shy to ask other people.* Another student shared how they found it difficult to share ideas with others: *Sometimes people steal my ideas.*

Student behaviour is influenced both by their cultural values and beliefs from their home and community, therefore it is important for values and beliefs to be acknowledged and positively built upon within the classroom environment (Hunter et al., in press; Joves et al., 2015; Seah, 2016). In early observations the mismatch between the way in which these Pāsifika students were enacting core Pāsifika values and productive ways of learning in collaborative groups were evident. For example, specific students were positioned by others as

‘experts’ within the group and consequently the other students drawing on the value of respect stayed silent and did not question their solution strategies. This was highlighted in Observation Two shown in the vignette below:

Enacting respect
Three students are working on the task below. The school were doing some fund raising. They sold raffle tickets for $2 each. They sold cakes for $5 each. They sold 248 tickets and sold 65 cakes. How much money did they raise? Kim: Let’s do two times 248 and five times 65. Kim begins to systematically record equations to solve the problem (e.g., *200 + 200 = 400 then 40 + 40 = 80…*). She continues to solve the problem by herself while Manaia and Ani silently watch her. Kim reads what she has written to the group. Kim: Do you understand? Ani: Yes Manaia: Yes Teacher: Ani, do you think you could explain how your group solved the problem? Ani: I don’t know. Kim did it all. Observation Two

Alternatively, at other times, some students did not demonstrate the value of respect for each other which also caused a mismatch between students’ cultural values and learning mathematics in the classroom. For example, in an interview a student shared why he disliked working with others: *When other people get it right and I get the answer wrong, they laugh at me so I feel sad.* Similarly, another student shared how they felt embarrassed when working in

groups: *I get nervous because sometimes I might get it wrong and it's embarrassing.* One student expressed how students in their classroom struggled to demonstrate the value of love: *Some people don't show love in maths and they put other people down.*

Analysis of the initial observations and interviews highlighted that productive group norms were not established within the classroom environment. Participation in group work was uneven with some students appearing reluctant to share ideas or to ask questions. These findings are similar to Sharma et al's (2011) research, where students' perceived that sharing their ideas with others was inappropriate. This meant that some students were unable to recall their mathematical learning or group solution strategy. Previous research studies (e.g., Boaler, 1998, 2002; Jansen & Bartell, 2013, Wright, 2017) highlight the importance of fostering a classroom culture where students work collaboratively on challenging mathematics tasks. Developing collaborative interaction requires specific teacher action and interventions. Research conducted by some national and international researchers (e.g., Bills & Hunter, 2015; Hunter & Anthony, 2011; Mercer, 2002; Wright) found that setting up a collaborative and supportive classroom culture requires specific attention from the teacher in developing the norms with the students. When students productively work as a collective on mathematical tasks, they develop skills related to ways of being, while also learning communicative skills through listening, sharing ideas and asking questions (Hunter & Hunter, 2018; Mercer; Wright).

It appeared that the classroom environment lacked opportunities for Påsifika students to participate and communicate successfully with their peers because of a dissonance between the classroom culture and their cultural values. Påsifika values include reciprocity, respect, service, inclusion, family, relationships, spirituality, leadership, collectivism, love and belonging (Anae, et al., 2001). Initial observations in the current study highlighted the students enacting the value of respect by largely staying silent and positioning specific students as "experts". Similarly, Bills and Hunter (2015) and Hunter and Hunter (in press) reported that often Påsifika students are reluctant to challenge or question students who are seen as "more knowledgeable" or "superior" to them

out of respect. These researchers argue that teachers need to work actively with students to facilitate them to learn to challenge and question in a polite way which adheres to their cultural values. Students in this classroom also reported instances where their peers participated in group work in ways which did not conform with their cultural values. Many researchers (e.g., Bills & Hunter, 2015; Hunter & Hunter, in press; Sharma et al., 2011) explain how clear expectations, values and positive relationships need to be developed among all group members to ensure all students are engaging in successful group work.

4.3 Phase Two: Exploring students' funds of knowledge through photographs

To learn more about the students' lives and experiences outside of school, the researcher (myself) positioned herself as a learner in the current study. Over the course of the study, students both took photographs with cameras supplied by the researcher (myself) (n = 25) and brought in existing photographs to share (n = 27). The use of photo-elicitation interviews (see Section 3.5.1) with students provided a basis to discuss the experiences that they engaged in outside of school and investigate their funds of knowledge. Table 4.1 displays the contexts of photographs students brought in to share their out of school mathematical experiences.

Photograph context	Number of photographs
Cultural activities	7
Costumes	7
Sports	6
Leisure activities	8
Pets	2
Family trips	4
Environment/Nature	6
Arts and craft	4
Cooking	3
Total number of photographs:	**47**

Table 4.1. Contexts of photographs

Photo-elicitation interviews provided a format for students to provide descriptions of the mathematics that was embedded within activity represented in the photograph. Frequently, students described multiple mathematical strands for a single photograph. The following sections unpack the instance of measurement, number, geometry, and algebra identified by the students and provide examples of the descriptions given by the students. Interestingly, statistics and probability were not identified by any of the students.

4.3.1 Measurement

Most commonly, student responses (n = 85) identified instances from out of school mathematical experiences where measurement would be used. Table 4.2 outlines the number of responses categorised as different types of measurement.

Measurement	
Strand of measurement	**Total number of student responses**
Time	23
Money	8
Linear	26
Mass	8
Area	3
Volume/Capacity	13
Speed	4
Total:	**85**

Table 4.2. Student responses identifying different types of measurement

For the responses categorised as measurement, the most common response referred to forms of linear measurement. For example, Manaia began by sharing a photo of her pule-tasi[6] (see Figure 4.1). She then described how cultural artifacts were made: *Everything is handmade...the dresses are made by my grandma. All my birthdays I have a tapa*[7] *cloth that my grandma made.* She identified the mathematics embedded in this as: *How much material is needed to make the dress? What length is the dress?* Other examples of linear measurement included descriptions of mathematics related to distance and also to height. Time was another commonly used example of mathematics in relation to how long it takes to travel on family trips and measuring how long it takes to complete activities. For example, Kelly brought in a photograph of Rarotonga

[6] Traditional Pacific Island dress
[7] Handmade cloth made from bark

and described how it linked to mathematics: *How long was our plane trip from New Zealand to Rarotonga?*

Frequent reference was also made to money, specifically calculating the cost of items. An example of this is when Joseph described how making an ula-lole[8] (see Figure 4.2) linked to cost: *Counting how much money you will need at the shop to buy the materials and lollies* and also referred to calculating the cost when celebrating his mother's birthday at Valentines: *How much it costs for all of the guests?* Other areas of measurement included mass and volume. In referring to the mass of objects, one student referred to Påsifika mythology to describe a legendary rock in Tonga (see Figure 4.3): *This is a volcanic rock. This is from centuries ago when our god Maui. He ummm well I'm not sure if it is a legend or not but he woke up one morning and heard a lot of roosters and he keeps on getting annoyed and found a big rock and threw it at the roosters.* The mathematics embedded in this was described as: *How much does it weigh?*

[8] Traditional Pacific Island necklace made out of lollies

Figure 4.1. Pule-tasi

Figure 4.2. Making an ula-lole

Figure 4.3. Volcanic rock

4.3.2 Number

(n = 60) of the student responses highlighted the everyday use of number within their lives. Table 4.3 shows the amount of student responses that aligned with different elements of number. It is interesting to note that most commonly students could recognise links to addition and multiplication with relatively few links to subtraction or division.

Number	
Strand of number	**Total number of student responses**
Addition	26
Subtraction	1
Multiplication	21
Division	5
Fractions, proportions and ratios	7
Total:	**60**

Table 4.3. Student responses identifying different types of number

Descriptions of the use of multiplication in relation to food preparation or catering for guests was prevalent in student responses. The photographs provided a basis to talk about commonly made dishes. For example, Richard brought in a photograph (see Figure 4.4) of him making panikeke[9] and shared his perspectives of the mathematics involved: *This is a picture of me baking at my Samoan house. How many doughnuts are there on the tray?* Similarly, Joseph described how making an ula-lole (see Figure 4.2) involved multiplication: *How many lollies in one pocket? We made one with three lollies in each pocket so we thought we could do a question that involved how many lollies. We have nine pockets so it could be nine times three.*

Addition was identified in (n = 26) of the student responses as mathematics embedded in students' experiences outside of school. To illustrate this, Kayden brought in a photo of him playing rugby league and shared how addition would

[9] A traditional Samoan pancake

be included: *How many tries and tackles there were in the game?* He also mentioned how subtraction could be involved: *Working out the difference in the teams scores.* Division was used in relation to sports team organisation, sharing food and road trips. For example, Richard shared a photograph of a family road trip. He describes how division is embedded: *How many passengers on the road trip so you would have to know how many cars you would need?*

Figure 4.4. Baking in Samoa

A small group of student responses identified the everyday use of fractions, proportions, and ratios within their lives. Students linked fractions to their experiences of sharing out dishes they have cooked with family members or to making cultural artifacts. For instance, Kelly shared how she could use fractions when making lasagne and chocolate brownie for her family: *How can we divide the brownie and lasagne to feed eight people?* Additionally, a number of references were made to the use of proportions and ratios. For example, Manaia brought in a photo of a traditional feast (see Figure 4.5) stating: *Here you can see there are lots of trays right? There were lots of guests. How much food would they need? How much coconut and taro leaves would they need to feed all of the guests?* Similarly, Kayden shared a photograph of him giving his infant cousin a bottle. He described how ratios were involved in this experience*: The amount of milk and water in the bottle.*

Figure 4.5. Traditional celebration

4.3.3 Geometry

Less commonly, (n = 11) student responses highlighted the use of geometry within their lives. The types of geometry in student responses are shown on Table 4.4 below.

Geometry	
Strand of geometry	**Total number of student responses**
Shape	2
Angle	6
Position and Orientation	3
Total:	**11**

Table 4.4. Student responses identifying the different types of geometry

Students identified shape in relation to objects that they visited on family outings. For example, Joseph shared a photograph of his family outing viewing large boats and provided examples of mathematics that linked to shape: *How many shapes are on the boats because there are a lot of shapes used on boats like cylinders and rectangles.* Students identified angles in relation to cultural dances, sports and leisure activities. Illustrating this, Manaia described how dance moves linked to angles when sharing a photograph of her dancing (see Figure 4.2): *The angles and I am like on a different angle here.* Students also made links to position and orientation. Kayden described angles and directions when sharing his experience of driving a bumper car: *So angle of turns and amount of cars bumped and different directions.* Joseph associated these strands of geometry to playing rugby league: *Angles - each person has their own position. Some people are standing here and are facing on this angle to face the other team. Directions - where and what direction they run.*

4.3.4 Algebra

A small number of responses referred to algebra. As shown on Table 4.5 below, all of these responses were related to patterns.

Algebra	
Strand of algebra	**Total number of student responses**
Patterns	4

Table 4.5. Student responses related to types of algebra

Student responses that referred to patterns were often general and although students mentioned patterning, it was apparent that they found it difficult to identify this area of mathematics within their photographs. For example, Joseph in discussing his rugby league team shared his perspectives of the mathematics

he thought was embedded with the uniform: *How many patterns on your uniform*? Manaia shared how she thought patterning would be included in music while she played for the orchestra: *How many times you have to breathe cause you need a lot of air? And like…..How many beats? How many pieces of music?* Interestingly, the majority of the discussion was about mathematics that was constructed around the artifact instead of the mathematics embedded within cultural actions or artifacts. For example, Manaia did not mention the patterning involved in the hand movements of dance or the algebraic patterning in the design of cultural artifacts such as tapa or pule-tasi.

The use of photographs supported students to engage in rich discussions of activities that they did outside of school and within the community. This included cultural activities, sports, leisure, and places that were special to them. Similar to the findings of other researchers (e.g., Dickie 2011; Joves et al., 2015), in the current study, photographs were an effective way to investigate students' funds of knowledge from their home and community.

Drawing on the analysis of the photo-elicitation interviews, it is evident that over the course of the study, students were beginning to develop some understanding of the mathematics embedded in their everyday experiences. This could be described as emerging because although the students identified many different strands of mathematics, their perceptions were still tied closely to the mathematics which they observed on a surface level rather than the more complex mathematics involved in everyday situations. The students struggled to describe the mathematics that was embedded within the artifact and on many occasions described only the mathematics that surrounded it or gave responses that included contrived mathematical situations reflecting "school" mathematics type problems. It is clearly evident from the data, that at this stage they were not bringing an indigenous perspective to the mathematics within the cultural artifacts. Previous research studies (e.g., Averill, 2012; Hunter & Hunter, in press; Hunter et al., in press; Hunter & Miller, 2018; Wernet, 2017) have highlighted the importance of developing the use of authentic tasks in the classroom that encapsulate the mathematics grounded within students' cultural and lived experiences and perspectives. These researchers argue that this can

support students to acquire a better understanding of mathematics and its value to the world that is most important to them.

4.4 Phase Three: Classroom implementation of culturally relevant tasks and the development of cultural and mathematical practices

To shift classroom practices and student perceptions, culturally relevant mathematical tasks (see Appendix B) were co-designed by the researcher (myself) and teachers. These were coupled with specific pedagogical actions that drew on culturally responsive teaching actions based on Påsifika students' knowledge and values in the classroom. Tasks were designed in parallel with the photo-elicitation interviews and built on the data gathered from the interviews and Påsifika students' funds of knowledge. Other researchers (eg., Civil, 2007; Hunter & Hunter, in press; Joves et al., 2015) have utilised the funds of knowledge model and have highlighted how educators can use this knowledge to develop engaging and relevant mathematical experiences for diverse students in the classroom.

4.4.1 Drawing on Påsifika values

To lead changes in the classroom, the teacher began specifically building on the students' cultural values to develop more productive group norms. For example, when students were working on tasks, the teacher made explicit links to the value of family and the expectations of the contribution of each family member which implicitly drew on values of reciprocity, respect, inclusion and collectivism. The focus on the behaviours required of each group member linked to these values, supported the students to begin to develop the skills to work successfully in a group.

In the vignette below the teacher shares expectations for group work at the beginning of a lesson.

Drawing on Påsifika values
Teacher: Before we get started when we are thinking about working in our family groups today what do we need to make sure we are doing? Kayden: Making sure that everyone in your group knows exactly what you are doing. Ani: Sharing ideas. Joseph: Participating. Teacher: If you are not sure, what should you do? Tamara: Ask someone from your group. Teacher: If someone asks you a question from your group, what are you accountable for doing? Arnold: Answering their questions and explaining to them. Observation Six

Evident in the responses from the students are statements that link to a range of Påsifika values including reciprocity, service, communalism and collectivism.

As the study progressed, to further embed these skills and values into their classroom environment the teacher made explicit links to the expectations at the beginning of each lesson: *Today I am going to be looking out for and praising groups working as a family, sharing their ideas, explaining and asking questions.* This became a regular practice in launching mathematics lessons. Furthermore, during the lessons, the teacher consistently explicitly noticed and highlighted positive student behaviour which drew on collective values such as family: *I like the way this group is working together to solve the problem… great discussion and questioning. Keep it up families.*

The introduction and continuing reinforcement of these norms led to shifts in the ways in which students worked together in groups. Frequently at the beginning

of small group work, the students were observed to draw on the value of collectivism in ensuring that all group members understood the task: *So do you guys know what we need to do? Do you guys know what this problem is about?* The heightened accountability both for their own understanding of the solution strategy but also the understanding of other members of the group meant that students began developing their skills to ensure both understanding and agreement: *We need to make sure that everyone understands. Do we all understand? Do we all agree?* A shift towards a more collective way of working with small groups was observed. For example, in observation 10, a group of students worked on a task involving a Tongan cultural dance (see Figure 4.6).

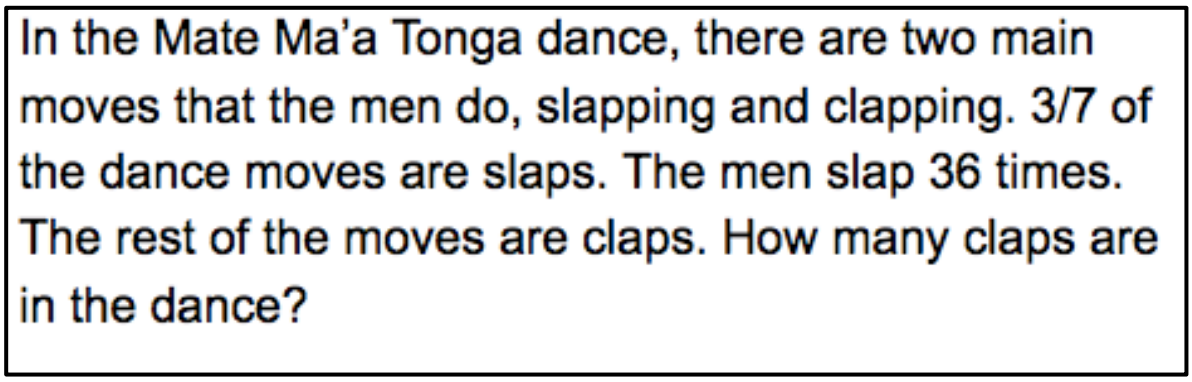

Figure 4.6. Tongan dance task

As the students worked together on the task, they drew on the values of reciprocity, and collectivism. Manaia begins by checking that her group agrees with her proposed solution strategy:

Manaia: So shall we draw this? (draws a circle that is split into sevenths)
Tamara builds on Manaia's reasoning and shades in four sevenths to represent the claps and three sevenths to represent the slaps.
Mary: Shall we do 36 divided by three sevenths?
Manaia: It is 12.
Tamara writes the numeral 12 in each of the sevenths on the circle.
Manaia: So the remaining four sevenths must be 12 plus 12 plus 12 plus 12 equals so that's our answer…48.

Student voice data gathered from group interviews following the lessons, indicated that the students valued opportunities to work in small groups. In contrast to the initial interviews, they began to express a preference for group work and highlighted the value for peer support. For example, during a discussion with Savannah she shared how her experiences of working with a group enabled her to enjoy and understand the mathematics: *I thought it was really good because we worked in groups and what was weird was ummmm that it was actually the first time I have enjoyed maths…[because] we were all working together and they explained it.* Similarly, Naomi shared her feelings when working with others and how this influenced her learning: *It was easy for me because I had a group to talk to. I found it amazing that people were asking me questions and I could work it out with my group.*

Previous research studies (e.g., Bills & Hunter, 2015; Joves et al., 2015; Seah, 2016) argue that the development of a learning environment that builds on and aligns with students' values can enhance students' participation and development of a cultural identity in the classroom. Similarly, in the current study, as the teacher drew on student values and used these to develop productive norms in the classroom, there were shifts in students' participation. Placing the students' values at the center of their learning experience gave the students' confidence to participate and collaborate with others which raised their status in small group work. These findings are similar to recent research (Bills & Hunter, 2015; Hunter & Hunter, 2018; Hunter & Hunter, in press; Hunter et al., in press), where Påsifika students constructed a cultural identity and developed strong social skills when their learning experiences aligned with their culture. As a result, students established powerful connections with mathematics and each other. As students developed personal and social skills with the support of their teacher, this also fostered more positive relationships with their peers. Many researchers (e.g., Boaler, 1998, 2002; Jansen & Bartell, 2013; Wright, 2017) highlight the importance of developing a classroom culture where the teacher is part of the learning community and is fundamental to establish positive relationships between all members of the classroom. Other researchers (e.g., Bills & Hunter, 2015; Hunter & Hunter, 2018; Hunter et al., in press; Sharma et al., 2011) also mention how positive relationships,

collaborative groups and students working together successfully can engage all learners in mathematics. As Hunter, Hunter and Bills (in press) explain, the use of the concept of family is important because it supports communalism rather than individualism. In the current study, the use of collaborative grouping and positive relationships provided Påsifika students with opportunities to become successful learners of mathematics as one community.

4.4.2 Drawing on Påsifika students' funds of knowledge and students working on culturally relevant tasks in their mathematics classroom

In order to support Påsifika students' participation and raise their status within their classroom environment, the teacher began to position these students' funds of knowledge as a valuable resource when working within their classroom on the tasks. This was achieved by the teachers integrating appropriate cultural contexts into tasks and utilising Påsifika students as experts within the learning experience.

For example, students shared their knowledge of cultural celebrations and taught their peers how to make cultural dishes before the mathematics task was introduced. Prior to a task focussed on otai[10], Kayden shared his knowledge of this drink with the rest of the class: *It is a drink that we have all the time in summer. It's yum. It's made of coconut milk, watermelon and any summer fruits. It's refreshing! My aunty is Tongan so she makes it heaps.* Similarly, in another example, the teacher specifically positioned the students as experts during a launch of the task*: I have never made an ula-lole before and don't know too much about them. I have seen at our prize giving that some of your parents have brought them in and you guys have worn them. Why do you make them?*

Additionally, Påsifika students were asked to bring artifacts into the classroom and share their knowledge about these with the class (see Figure 4.7). This was used as a precursor to the introduction of a mathematical task based on the artifact. Two examples of this based on tapa cloth and pule-tasi are shown in the next section.

[10] a refreshing summer drink

In the first example, before introducing a task involving a mat, a group of students presented this to the class and shared: *The women make these for traditional celebrations. We use this one for birthdays and any other family celebrations. It is made from trees and dirt and they beat it.*

Figure 4.7. Students sharing cultural artifact

Following this, the task (see Figure 4.8) was introduced to the rest of the group.

A traditional Pacific Island job for the women is to make mats out of bark called tapa/siapo/ngatu cloth. For the family feast, the ladies made cloths for 8 tables.
It takes the ladies when they are working together as a group 3 hours and 45 minutes to make each one. How long do they spend making all 8 cloths in hours?

Figure 4.8. Tapa cloth task

The context of the task which drew on the students' funds of knowledge provided them with opportunities to both communicate their reasoning and justify this using the context of the problem as shown in the vignette below.

Solving the tapa cloth task
Kayden: We went eight times three equals 24 Teacher: Where did you get the eight times three? Kayden: We got the eight from the tables and the three from the three hours (records *8 x 3 = 24 hours)* Kayden: Then we went 45 minutes plus 45 minutes which made one hour and 30 minutes. That is two tables. Kayden continues to share the solution strategy by relating it to the context of the problem. Savannah: Why did you go 45 minutes plus 45 minutes? Kayden: We were trying to make it up to eight tables. So eight tables times 45 minutes is six hours. Does that answer your question? Kayden:...Then we did 24 hours plus six hours. This equals 30 hours in total. Observation Five

Evident in the vignette is the student development of mathematical practices such as questioning and justifying their mathematical thinking. Clearly, the students are confident when asking each other questions and referring to the context throughout their mathematical explanations. Also notable was the shift in the student discourse to a collective framing of their solution strategy in the use of “we”.

In the second example, the students were given an opportunity to wear traditional clothing when the context of a task (see Appendix B) related to making pule-tasi. During the lesson, the pride in this acknowledgement of their

cultural identity was evident. For example, while Manaia was working on the task with her group and wearing her pule-tasi she stopped halfway and excitedly shouted: *I'm an Islander!*

The group interviews following the lesson provided insight into student perceptions of the shifts in their mathematics lessons. Some student responses recognised a change in the mathematical tasks relating to their culture: *I felt like happy for me because we usually do problems about like shoes and stuff but this one related to my culture and I'm not used to it.*
Frequently the students expressed enjoyment and excitement in response to the tasks relating to their culture: *I loved it because I dance to that song because it is a Tongan dance* or similarly another student stated: *I liked how it included otai. It made me excited for the problem.*

A key theme that was evident in the student responses following the lessons was the feeling of inclusion and a pride in their cultural identity. For example, one student stated: *It makes me feel included so I can properly solve it.* For other students, this inclusion went further than the mathematics lesson and they related this to their schooling experience: *I liked it because it included my culture. I felt more included into school.* This feeling of inclusion resulted in both feelings of pride in their culture and feelings of competency: *I feel good that it is about my culture. I share ideas.* Another student stated: *I really liked it because it was about my own culture. I felt good and it's the first time I have actually enjoyed maths before.*

The data from the group interviews indicated that students found the relevant and familiar contexts of the problems connected them to the mathematics. For example, one student stated: *I know what it is and I have seen it before.* The students also noted a sense of empowerment when sharing their funds of knowledge with others: *I liked the ula-lole task because we do it at church for celebrations and I got to share that.*
Finally, a number of students described positive attitudes towards being given challenging tasks. For example, one student stated: *I liked the question because it was a challenge. I liked it because it was confusing and I got to a*

point where I knew it. Other students spoke of their feelings of inclusion and pride when they solved a difficult problem: *At the beginning I was clueless about the problem but at the end I worked out the answer. It made me feel included and proud of myself.*

Drawing on the Påsifika students' funds of knowledge to design relevant contextual tasks, provided increased opportunities for the Påsifika students to access the mathematics. Many researchers (e.g., Averill 2012; Hunter & Hunter, in press; Hunter et al., in press; Rubel, 2017) discuss how relevant cultural contexts can support diverse students' participation and learning in the classroom. When contexts are irrelevant for learners they are faced with the challenge of making sense of the context before they can access the mathematics within the task. This is a challenge that many diverse learners face in mathematics classrooms both in New Zealand and internationally. Providing students with tasks that were built around their cultural knowledge and experiences allowed students to be positioned as experts while also accessing mathematics. Opportunities to access the mathematics embedded within the task was enhanced by students making connections between school and their cultural mathematical worlds. These findings are similar to earlier research conducted by Hunter and Hunter (in press) and Hunter and Miller (2018) who found that using contextualised tasks allowed students to construct powerful connections with their culture and mathematics while developing a sound understanding of the mathematics embedded within the context.

Analysis of the student voice data showed evidence that Påsifika students' participation and engagement increased when the context of the mathematics problems related to their culture. Students shared how they felt proud and excited for the problem. These findings are similar to previous research (e.g., Hunter & Hunter, in press; Hunter et al., in press; McDuffie et al., 2011; Tate, 1995) who also mention the use of relevant and meaningful contexts and how they can be used to foster participation and engagement in mathematics classrooms. Creating relevant learning experiences that built on the Påsifika students' backgrounds allowed students to make explicit links between their culture and mathematics at school and this made the mathematics in all

aspects of their life connected. When Påsifika students construct powerful mathematics connections to their world, it signifies that mathematics is an important and lived aspect of their life and a clear part of their cultural identity.

Clearly, evident in the data, high expectations and challenge were valued by the students. They were provided with tasks that required struggle and persistence, maximising learning for all. All students had equal opportunities to engage in challenging mathematical tasks. Research studies conducted by Boaler (2002, 2015) and Hunter and Hunter (2018, in press) found that when educators had high expectations of all learners and expected students to succeed within a risk taking environment, this cultivated students' confidence, engagement and participation in mathematics. In the current study, with the support of other students in their collaborative groups, the students were able to make mistakes and work together while solving the tasks and celebrating their success. These factors enhanced the positive mathematical dispositions they were constructing.

4.5 Phase Four: Shifts in students' perspectives of mathematics at home and school

4.5.1 Student interview data related to mathematics at home

The final interviews showed a shift in student awareness of the mathematics that they engage in outside of school. All students (n = 11) were able to provide examples of mathematics that they use in their everyday life. Table 4.6 outlines the student responses as to why mathematics is useful and important for them outside of school.

Mathematical context identified	Number of responses
Travel: Speed and road Signs	2
Sports	2
Music	1
Cultural costumes	1
Cost/Bills	3
Sharing food	2
Cooking	2

Table 4.6 Mathematical contexts outside of school identified as being important

As shown on the table, most commonly, students related the use of mathematics at home and in the community to food. This included both sharing food: *So you can divide stuff equally like pizza for dinner* and cooking: *Baking and cooking and stuff because you need to measure the ingredients you need and measuring them out.* Other students linked mathematics outside of school to financial experiences: *Going to McDonalds and my mum gave me money and I had to take a certain amount of money to the people and I did not want them to rip me off, so I had to work out how much change I would need.* Similarly, Joseph shared the importance of mathematics for paying bills: *Like how much my parents are paying for bills.*

Similarly, a shift was noted in student perceptions of the link between mathematics at school and their out of school experiences. In the final interviews, students shared how the mathematical problems that they were solving at school included their interests outside of school and contexts which they could relate to. These contexts included sports, cooking, cultural activities such as dance, and cultural artifacts such as ula-lole's or costumes such as pule-tasi. For example, when Joseph was asked if the mathematics problems in

his classroom are about things that he enjoyed outside of school, he stated: *Yeah…my rugby, traditional foods and necklaces…like ula-lole…this necklace with lollies around it.* Contrasting with the initial interviews in which most students experienced difficulty in explaining why they learn mathematics (n = 10) were able to identify why it was important to learn mathematics. Eight students highlighted mathematics as being important for their future and for living in the real world. For example, a student shared why mathematics was important to him: *I can have a better future and if I know it then it doesn't matter what maths problem I come across because I can work it out.* Two students linked mathematics as being important to supporting their family. To illustrate this, one student focussed on helping their children: *When you grow up you can learn to share money and help your kids learn.* The other student focussed on helping their siblings: *So we can teach younger children and sisters.*

It appears that using photographs from the interviews as a resource to design mathematical tasks strengthened the relationship between mathematics learnt at home and school. In contrast to the initial interviews, students were now confident at describing where mathematics was used in their lives outside of school. They transformed from seeing mathematics as numbers and homework to identifying real life situations where mathematics was used. Previous research studies (e.g., Civil, 2007; Joves et al., 2015) also highlight the success of using photographs from home and community settings and discussions of these as a resource for task design.

Analysis of the interviews demonstrates that a stronger link had been created between home and school for these diverse Påsifika learners. Clearly, the students were now able to articulate the contexts of problems being used in the classroom. The teacher used contexts that made connections to the students' everyday life. Similar results were noted by research conducted by Matthew's (2017) and Wright (2017) who suggest that when teachers ensure links are being made between mathematics and real life situations, students will develop a deeper understanding of the mathematics and become confident when solving problems across various contexts. Responses to questions about the

importance of mathematics highlight students' increasing awareness of the relevance of mathematics both within school settings and outside of school.

4.5.2 Student interview data related to shifts in their mathematics classroom

Clear shifts were noted in student perceptions of the classroom context and their role within mathematics lessons. The use of structured group work appeared to assist the students to feel more comfortable and supported in their learning. Student responses referred to an understanding of the skills required to work successfully in their mathematics groups. There was a shift in the Påsifika students' confidence to ask questions and share their ideas with their peers. Seven of the student responses identified the need for questioning when working in groups: *You can ask others for help if you need instead of just sitting there and not understanding what others say.* A number of student responses identified the importance of communication when working within their collaborative groups. For example, three student responses identified the need to listen to others: *Listening to others' ideas is important because other people have other opinions, not just you have one opinion.* A number of students (n = 8) referred to the need to be sharing ideas. These responses also made links to Påsifika values. For example, one student related sharing the values of family, reciprocity, and collectivism: *I should share what I know because it shows that you can teach your little brothers and sisters. I like it because we have more brains and we can work it out together.* The expectation that everyone in their group had a shared understanding cultivated participation because the students were responsible for their learning and also the learning of their peers. This reduced individualism and competition and promoted more equitable opportunities for participation.

The final interview responses highlighted that students valued high expectations from their teachers and being given challenging mathematical tasks. Two of the student responses specifically described how they viewed their teacher as having high expectations of them which established a positive relationship: *Some of them [tasks] are hard because the teachers want to challenge us with*

what is coming for us in the future and stuff. Also evident in the student responses (n = 3) was a growing understanding of the value of making mistakes and how this can support mathematical learning: *Sometimes when you make a mistake it helps you learn more.*

Further questions were asked in the final interviews about how the students felt being Påsifika in their mathematics classroom. In contrast to the initial interviews, all students (n = 11) were able to provide examples where they viewed a link between their cultural identity and their mathematical experiences. This included sharing experiences of mathematics lessons that used contexts related to their culture: *My teacher makes all these questions about our culture. We do them about our culture mostly…some about rugby but they are a maths thing. But it is mostly about the Påsifika cultures.* Students also expressed excitement at seeing their culture reflected within their mathematics classroom: *Excited because maybe you know a little bit about the stuff and you are from a different culture that other people might not know*. Building on this, a number of students (n = 4) referred to a sense of empowerment when given the opportunity to share their knowledge with others in the classroom. For example, one student stated: *Some of the maths questions are about my culture and I can explain because the maths is from my culture and I already know my culture so I can explain it to other people who don't know about my culture*. Students also shared how they felt appreciated when they were the expert*: I feel appreciated because some of the teachers are not from my culture and my islands and stuff and you might tell them a little bit about yourself.* A number of student responses (n = 4) indicated that the development of positive mathematical dispositions was linked to using culture as a context. One student specifically stated that irrelevant contexts led to disengagement: *When I am not interested in the maths question like Harry Potter or Minecraft and things like that.* In contrast, he shared that he found mathematics enjoyable when it was relevant including: *Questions around culture.*

Analysis of the student responses demonstrates that the students were beginning to consider the skills that are required of successful mathematicians when working collaboratively. This included the need for questioning for sense-

making, sharing their reasoning, and listening to others' explanations. These are skills that mathematics educational researchers (e.g., Attard, 2012, 2013; Bills & Hunter, 2015, Boaler, 2002, 2015; Hunter & Hunter, 2018; Wright, 2017) suggest are vital to the development of mathematical practices. In enacting these actions, the student responses indicated that they were beginning to think of their accountability both for their own learning and the learning of others while drawing on the Påsifika values of collectivism, reciprocity, family, and respect. The transformation of the classroom culture and learning activities provided these diverse students with greater opportunities to participate and engage successfully within their groups. These findings are similar to those of other researchers (e.g., Attard; Bills & Hunter; Hunter & Hunter, in press; Wright) who comment on the importance of developing supportive classroom environments, ones that cultivate respectful relationships where students develop the required personal and social skills to support each other with their learning.

The students noted the value of high expectations expressed by their teachers. Earlier research studies conducted by Boaler (2002, 2015) and Hunter and Hunter (2018, in press) found that when educators had high expectations of all learners and expected students to succeed within a risk taking environment, this cultivated students' confidence, engagement and participation in mathematics. Furthermore, in the current study, a shift was noted towards acceptance of making mistakes as a learning tool. It may be conjectured that this was also related to the structure of peer support in their collaborative groups so that the students were able to make mistakes and work together while solving the tasks and celebrating their success.

Evidence from the final interviews illustrated that the students now viewed their culture as included in their mathematics classroom. Utilising students' funds of knowledge to design learning experiences, provided the Påsifika students with tasks that related to their lived social and cultural world. These findings suggest that when the Påsifika students' culture was embedded within the mathematics they experienced in the classroom, they felt valued and appreciated. By the use of problem contexts that made their culture visible and a learning environment

that built on their knowledge and values, Påsifika students' cultural identity was enhanced. Students had begun to develop a belief that they could succeed as a Påsifika learner within their mathematics classroom. These findings are supported by earlier research conducted by Averill (2012), Hunter and Hunter (in press) and Hunter & Miller (2018) who also found that students' cultural identity was enhanced when they saw themselves and their culture reflected in the classroom.

Analysis of the student responses reflected an increase in students' involvement and engagement when they were utilised as knowledgeable resources within the mathematics classroom. Using the students as resources within the lessons to share their expertise, developed their appreciation and interest in the task. These findings are similar to those reported by previous researchers (e.g., Attard, 2012, 2013; McDuffie et al., 2011) who describe how students feel valued and more interested in the task when it is important to them. As a result, students developed a more positive attitude towards the mathematics they were participating in. Other researchers (e.g., Averill, 2012; Cobb & Hodge, 2007; Gay, 2010; Hunter & Hunter, in press) also state that when students make explicit links and identify their culture within their learning experiences then issues of equity are diminished.

4.6 Summary

This chapter has presented the initial findings of 11 Påsifika students' perspectives and experiences of mathematics at home and school. In response to these findings, it has summarised the students' funds of knowledge and descriptions of mathematics embedded within their out of school experiences. It has described the impacts of implementing culturally relevant tasks and the development of cultural and mathematical practices in relation to Påsifika students' participation and engagement within their mathematics classroom. Finally, the final interviews were analysed and the shifts in students' perceptions of mathematics at home and school were presented.

In this study, five key themes emerged throughout the analysis as significantly contributing to Påsifika students' participation and engagement in mathematics. They are as follows; mathematics at home and school, culturally relevant tasks, funds of knowledge, collaborative groups and mathematical disposition and cultural identity. The next chapter will present a summary of the themes identified, address the research questions and provide key findings and recommendations for educators to support all Påsifika learners to achieve academic success in New Zealand classrooms.

Chapter Five: Conclusion

5.1 Introduction

The purpose of this study was to investigate culturally responsive tasks and Påsifika students' participation and engagement in mathematics. Particular focus was on identifying cultural and mathematical practices that educators could use to support Påsifika students to develop and maintain a positive mathematical disposition and cultural identity in New Zealand classrooms. This chapter summarises the research questions, presents the key findings and recommendations, outlines the limitations and suggested areas for future research and describes the visual representation used to symbolise this study.

5.2 Summary of research questions

The literature discussed in Chapter Two was used as a framework for my research design with specific areas to focus on. In this section, I provide a summary of the research questions (see Section 1.5) that were outlined in the study.

5.2.1 What are the out of school mathematical perspectives and experiences of Påsifika students?

The research literature highlighted that when students engage in learning experiences in the classroom that align with the mathematics they use outside of school, they will see a purpose for learning mathematics and its benefits to their current and future lives. As a result, students will begin to appreciate mathematics while developing mathematical skills that can be used in a range of contexts (Boaler, 2002, 2015; Matthews, 2017; Wright, 2017). In the initial

phase of this study, many of the students struggled to describe the purpose for learning mathematics and could not explain how they used mathematics outside of school. It became apparent that there was a disconnect between learning experiences in their classrooms and their mathematical experiences beyond the classroom. Therefore, students struggled to connect mathematics learnt in school to real life contexts and were unsure how mathematics was important in their lives outside of school. In response to this, during phase two of the study students shared their out of school mathematical experiences using photographs. They engaged in rich discussions with the researcher about their culture and the mathematics embedded within their experiences. Interestingly, many of the students could not describe the deep mathematics embedded within their cultural artifacts and experiences. They could only identify surface level mathematics that surrounded them. During phase three of the study, students' cultural experiences were integrated into their mathematics classroom using them as contexts for mathematical tasks. Utilising students' interests and experiences for task design enabled students to link mathematics learned in school to real world experiences outside of school. In the final interviews, all students provided examples of the mathematics they experienced beyond the classroom as relating to life experiences rather than seeing mathematics as a set of numbers or homework. Additionally, students were able to articulate why mathematics was important. This stimulated the students' appreciation for learning mathematics and they discovered its benefits relative to their current and future lives. Students evidently developed a positive mathematical disposition. This was achieved through ensuring links between what is learnt in school to what students' experience in their lives outside of school were established. This in turn, provided opportunities for students to develop the skills to solve mathematical problems in a range of contexts.

5.2.2 How do Påsifika students describe their culture being reflected in their mathematics classroom?

The reviewed literature demonstrated how educators can achieve equity through developing a culturally responsive pedagogy and building a supportive learning environment that reflects the cultural and social values of all learners

(Averill, 2012; Cobb & Hodge, 2007; Gay, 2010; Hunter & Hunter, in press). When interviewed in the initial phase of this study, students could not describe how their culture was reflected in their mathematics classrooms or describe a time when their culture linked to their learning experiences. In response to this, the funds of knowledge model (Civil, 2007) was utilised as a framework and allowed students to share their cultural knowledge and experiences. The students' funds of knowledge were used as contexts for mathematical tasks in the classrooms. When these tasks were implemented in the classroom, the students were positioned as experts sharing their knowledge with their peers. During group and individual discussions, students expressed how they felt included and appreciated when the context of the task was about their culture. Students felt proud to be Påsifika which resulted in shifts of confidence and feelings of empowerment. It appeared that students were able to access the mathematics because of the relevant context. This raised their status and increased the students' opportunities to participate. Placing students' culture at the center of the learning environment supported Påsifika students' cultural identity to become visible in the classroom and strengthened links to their cultural and mathematical experiences.

5.2.3 What classroom experiences foster Påsifika students' participation and engagement in mathematics?

The literature reviewed cultural and mathematical practices that could support Påsifika students' participation and engagement in mathematics. The literature suggests that educators use collaborative groups that draw on Påsifika cultural values, relevant contexts and employing high expectations of all learners in the classroom (Hunter & Hunter, 2018, in press; Hunter et al., in press). In this study, students worked in collaborative groups that complemented the Påsifika students' cultural values. Drawing on these cultural values, provided familiarity for the Påsifika students' behaviours that they enact outside of school. During group and individual discussions, students shared how they preferred working in groups, expressing feelings of comfort and support. The evidence suggested that students developed confidence when sharing ideas, listening to others and asking questions. Many of the students' behaviours during the observations and

when describing their experiences of working successfully in their groups, reflected Påsifika cultural values such as reciprocity, service and collectivism. Another classroom experience that appeared to foster participation and engagement was the use of challenging tasks, ones that used interesting contexts. Many of the students enjoyed working on tasks that related to their culture and developed a sense of pride when they had solved problems that had a degree of challenge. The development of collaborative groups that acknowledged the Påsifika students' cultural values and using relevant challenging tasks reflected high expectations and established positive relationships. These experiences maximised opportunities for Påsifika students' participation and engagement in mathematics.

5.3 Key findings, recommendations and implications

As previously mentioned in Chapter Four (see Section 4.6), there were five key themes that emerged from this study. In this section, I summarise the five key themes, Påsifika cultural values, and home-school partnerships. These following components are the key recommendations resulting from this study of how educators can develop their classroom practice to foster Påsifika students' engagement and participation in mathematics.

Mathematics at home and school

It is important for educators to ensure that the mathematics students engage within their classrooms and the mathematics they engage at home and within their community is relevant. Students need to develop mathematical skills to solve problems in a range of contexts while also appreciating and seeing a purpose for mathematics in their lives beyond the classroom.

Culturally relevant tasks

Educators should acknowledge students' cultural worlds through incorporating culturally relevant tasks using contexts that diverse students are familiar with in their mathematics programme. This can increase opportunities for diverse students to access the mathematics and connect their cultural world to the mathematics that they engage with inside their classrooms.

Funds of knowledge

Utilising students' cultural funds of knowledge as a resource for their learning experiences can have a positive shift for diverse learners' classroom status. Students are re-positioned as experts which places them at the center of their learning environment. As a result, positive relationships are established and students gain confidence to participate and engage in the learning experience.

Collaborative groups

Educators should be encouraged to build learning communities where students are working in collaborative groups that acknowledge the core Påsifika values of their diverse students. Collaborative grouping builds positive relationships, develops the skills of communication and support and provides equal opportunities for all learners to participate and engage in mathematics.

Mathematical disposition and cultural identity

Educators need to ensure that students have a positive affiliation with mathematics and can see their cultures reflected in their classroom. Students should feel valued and discover a purpose for learning mathematics while establishing powerful connections to their cultural heritage. This constructs a positive mathematical disposition and supports them to maintain a cultural identity.

Påsifika cultural values

Educators should build a classroom environment that acknowledges and builds on diverse students' cultural values. The core Påsifika values are what students adhere to outside of school and influence their behaviour inside and outside the classroom. Having the Påsifika values embedded within the classroom practices can strengthen links between students' culture and school.

Home and school partnerships

Schools need to establish powerful connections between students and their families. Parents, teachers and students should develop positive relationships through effective communication, love and support. When strong links and

connections are embedded between home and school then opportunities for participation and engagement of all members will increase.

It is vital that educators understand these key recommendations and consider implementing these to shape their learning environments. These findings and recommendations that have been identified are all equally significant and important. If used as a collective, they can contribute to fostering Påsifika students' participation and engagement in mathematics.

5.4 Limitations

In this section, I address the limitations that arose throughout this study.

One of the limitations for this study included working with a small group of students. Working with a large number of students may have provided a broader range of student perspectives. A second limitation was the number of parents involved in the study. It was a challenge to organise times to meet frequently with the parents that suited their busy lives outside of school. After the initial workshop, it would have been beneficial to have more involvement and collaboration with the parents of the participants.

5.5 Suggested areas for future research

In this section, I summarise the suggested areas for future research. These areas were developed after reflecting on the research findings from this study.

More extensive research is needed with diverse learners from other cultural backgrounds to ensure that all students from any ethnicity are provided with opportunities to participate and engage successfully within their classroom environment. It would be useful to investigate the out of school mathematical experiences of a wide range of learners, including students from Pacific Island nations who were not included in this study.

Findings from this study highlight the need for further research to investigate how students can be supported to unpack the deeper mathematics of their culture. Although a shift was evident in the study with students beginning to identify mathematics outside of school, it would be helpful to extend this further. There is a need for further research focussed on identifying mathematics embedded within life experiences. Additional research could be based around the role of the facilitator to support teachers, students and families to view how to connect mathematics to real life. Similarly, it could focus on how facilitators can challenge teachers to identify deeper mathematics that is embedded within experiences not just mathematics that is constructed around the experiences.

5.6 Visual representation

In this final section, I provide a description of each of the components that combine to form the visual representation used to symbolise this study.

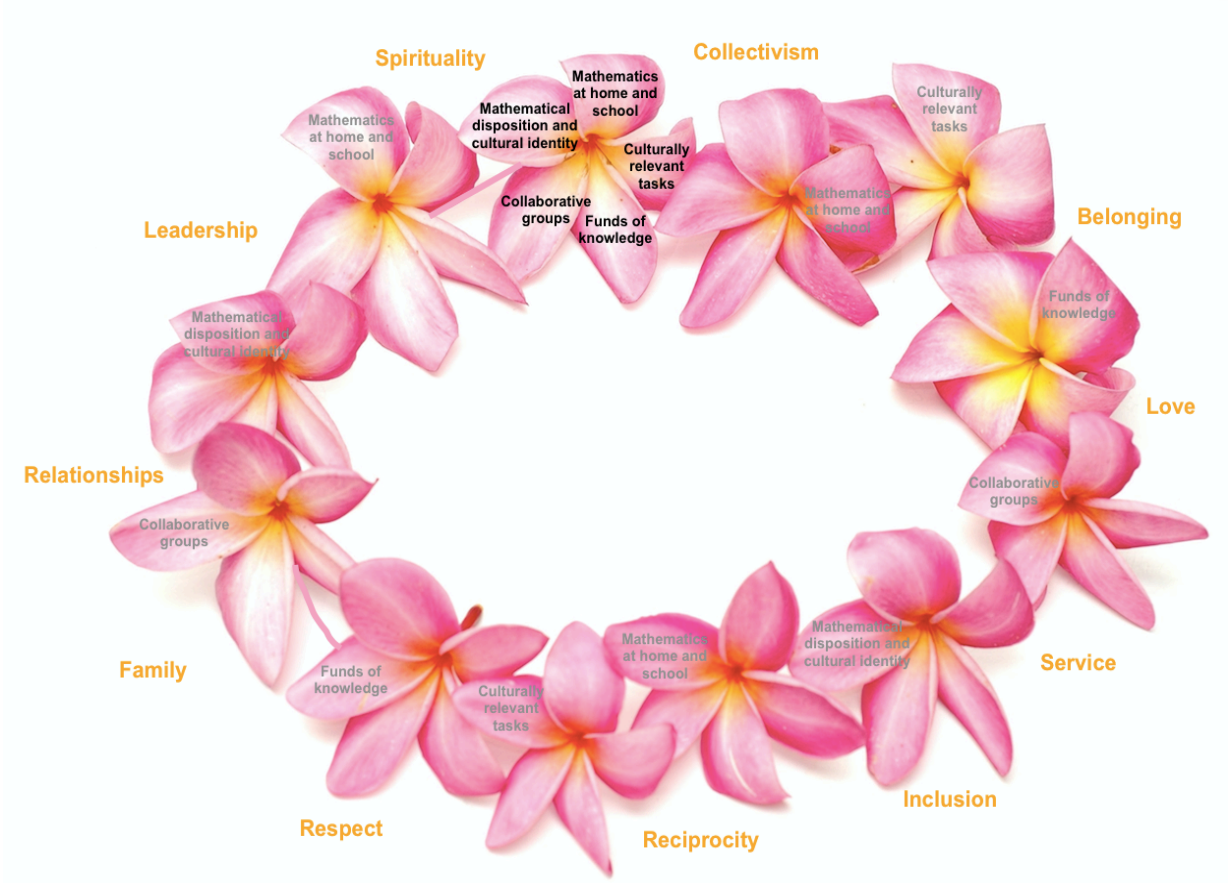

Figure 5.1. Frangipani ula-lei: A visual representation of the research study and findings

To integrate and display the findings from this study, I draw upon Hannant's (2013) tipani symbolic representation and Sauni's (2004) visual representation of the ula model. I have used a frangipani ula-lei (see Figure 5.1). The frangipani (kalosipani/ pua fiti/ fiti pua/ tipani) plant is frequently used to represent Påsifika and is predominantly found across the Pacific Islands. The ula-lei is a traditional necklace that is used for celebrations across the Pacific Islands. The frangipani plant is foreign to the Pacific Islands. This reflects its ability to produce and grow in an unfamiliar environment. I have used this as a symbol to represent all Påsifika learners in mathematics classrooms being provided with opportunities to learn and achieve in New Zealand. The ula-lei is used in the Pacific Islands to welcome others. I have used this as a symbol to recognise that all learners should feel appreciated and valued within their learning environment.

5.6.1 A group of learners

Each frangipani on the ula-lei represents a group of learners working collectively and as a community to support each other with their learning. Within this community are students, peers, educators and whanau. Påsifika education and research frameworks (e.g., Lemanu, 2014; Ministry of Education, 2013; Sauni, 2011) suggest that strong connections need to be made between students, educators and families to successfully engage in learning. When positive relationships and connections are formed then all learners involved as a collective can succeed within their learning environments.

5.6.2 Five petals: five themes

On each frangipani there are five petals. Each of these petals represent the five key themes that have emerged in the findings that support Påsifika learners' participation and engagement in mathematics. These include; mathematics at home and school, culturally relevant tasks, funds of knowledge, collaborative groups and mathematical disposition and cultural identity. Each petal complements each other and will support the learner to grow and succeed within their mathematics environment.

5.6.3 Formation of the ula-lei: core values

Each frangipani flower (learner) is held together by the Påsifika values to form the ula-lei. Påsifika values include reciprocity, respect, service, inclusion, family, relationships, spirituality, leadership, collectivism, love and belonging (Anae, et al., 2001). Educators, students and families employ these values which influence their behaviours inside and outside the classroom. The values are embedded within each theme to support the learners to successfully participate and engage in mathematics.

The frangipani ula-lei is successfully formed with five key themes and a community of learners that are bound together by the core Påsifika values. It is through all of these dimensions on the frangipani ula-lei that Påsifika students' participation and engagement in mathematics is enhanced. When educators utilise these themes and incorporate Påsifika values within a community of learners they will provide Påsifika students with increased opportunities to successfully participate and engage in mathematics.

5.7 Conclusion

The acceleration of Påsifika learners in mathematics remains a priority for the Ministry of Education due to the widening gap between Påsifika students' mathematics achievement and their peers (Ministry of Education, 2013). Although this study was small, it has provided insights into the cultural and mathematical practices that teachers can enact to provide Påsifika students with opportunities to participate and engage in mathematics while achieving academic success as Påsifika learners in New Zealand.

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Appendices

Appendix A1: Initial interview

Explain the purpose of the interview and make the student feel comfortable.

Hello, I am Nicole. Thank you for coming along to take part in this interview. I am looking forward to our conversation. The interview will ask you some questions about mathematics in your classroom and your experiences with mathematics.

If it is okay, I would like to record what you have said. All of the conversation will be kept confidential.

All about mathematics:

1.Why do you think we learn mathematics? How/Why?

2.What do you think it means to be good at mathematics?

I am interested in what you do in your classroom for mathematics...

3.Tell me about a typical day in your mathematics class? What activities do you do?

4. Do you like or dislike mathematics in your class? What are your favourite things to do in your mathematics class?

I am interested in the types of problems you solve in your mathematics class...

5. Are the problems that you solve in class about things that you are interested in outside of school. If yes, how?

6. What are the problems that you solve in your mathematics class about?

I want to know more about your feelings about the mathematics problems you do in class…

7. Are they:

- Boring or fun? Why?
- Easy or hard? Why do you find them easy/hard?
- Do they make you feel happy or sad? How?
- Do you like to work by yourself or with a group? Why?
- When the problems are hard do you feel nervous or excited? Why?

8. What are the things that you do when you are working with others to solve a mathematics problem in class?

I am interested in how your culture is included in your mathematics class...

9. How do you feel being a Påsifika student in your mathematics classroom?

10. Do you think your teacher thinks your Påsifika culture is important? What makes you think this? What do they do?

11. Does your teacher use problems in mathematics that relate to your Påsifika culture?

12. **Different people think different things are important ….** What is important to you and your family? Provide student with some examples and students can list them from most important to least important. With the top three things chosen, ask...

Are these things used in your mathematics class? If yes, how?

13. If you had one wish for your mathematics learning what would it be? Why?

Thank you for coming along to chat to me. Do you have any questions?

Appendix A2: Semi-structured group interview

1.What did you think of that mathematics lesson?

2.What did you like or dislike about the mathematics lesson?

3.What did you think of the task?

4.How did you feel during that mathematics lesson? How/why?

Appendix A3: Final interview

Explain the purpose of the interview and make the student feel comfortable.

Hello, I am Nicole. Thank you for coming along to take part in this interview. I am looking forward to our conversation. The interview will ask you some questions about mathematics in your classroom and your experiences with mathematics.

If it is okay, I would like to record what you have said. All of the conversation will be kept confidential.

All about mathematics:

1. Why do you think we learn mathematics? How/Why?

2. What do you think it means to be good at mathematics from the following:

- Getting the answer right quickly or working hard to solve a problem and sometimes making mistakes? Why?
- Knowing what to do straight away or asking others for help? Why?
- Sharing ideas or keeping ideas to yourself? Why?

3. Do you think mathematics is important in your life outside of school? How/why?

4.Do you see and use mathematics in your life outside of school?

5. Do you think taking photos helped you see and talk about mathematics outside of school? Yes/no? If yes how?

I am interested in what you do in your classroom for mathematics...

6.Tell me about a typical day in your mathematic class? What activities do you do?

7. Do you like or dislike mathematics in your class? What are your favourite things to do in your mathematics class?

I am interested in the types of problems you solve in your mathematics class...

8. Are the problems that you solve in class about things that you are interested in outside of school. If yes, how??

9. What are the problems that you solve in your mathematics class about?

I want to know more about your feelings about the mathematics problems you do in class…

10. Are they:

- Boring or fun? Why?
- Easy or hard? Why do you find them easy/hard?
- Do they make you feel happy or sad? How?

- Do you like to work by yourself or with a group? Why?
- When the problems are hard do you feel nervous or excited? Why?

11. What are the things that you do when you are working with others in your family groups to solve a mathematics problem in class?

I am interested in how your culture is included in your mathematics class...

12. How do you feel being a Påsifika student in your mathematics classroom?

13. Do you think your teacher thinks your Påsifika culture is important? What makes you think this? What do they do?

14. Does your teacher use problems in mathematics that relate to your Påsifika culture?

15. When the task is related to your culture how does it make you feel? Can you tell me more about that?

16. Do you find problems that you are interested in mathematics more helpful? How?

17 . **Different people think different things are important ….**

What is important to you and your family? Provide student with some examples and students can list them from most important to least important. With the top three things chosen, ask...

Are these things used in your mathematics class? If yes, how?

18. If you had one wish for your mathematics learning what would it be? Why?

Thank you for coming along to chat to me. Do you have any questions?

Appendix B: Culturally relevant tasks

Celebrations and large dinners

Pacific families and relatives often enjoy celebrations over big family feasts.
At a Sunday lunch/umukai the children had to set the tables for the feast. They set the tables up so that each guest has 50cm of space to sit at each table. Each table was 4.5m long and 1.5m wide.

*At the celebration there was **8/12/15** tables. How many guests are seated at each table? How many guests are at the whole celebration?*

Tapa cloths

A traditional Pacific Island job for the women is to make mats out of bark called tapa/siapo/ngatu cloth. For the family feast, the ladies made cloths for 8 tables.
It takes the ladies when they are working together as a group 3 hours and 45 minutes to make each one. How long do they spend making all 8 cloths in hours?

Tapa/Siapo/Ngatu cloths have a wide range of patterns and symbols on them. Here is a picture of some of a pattern that is used on a tapa cloth that Maria brought in.
The triangle rotates 1/4 turn clockwise. What position would the triangle be after 65 turns?
What about after 75 turns?

Traditional Costumes

The Påsifika women also spend lots of time making outfits for celebrations. The women make pule-tasi for the girls and ta-ovala for the boys. It takes 3.5m of fabric to make one pule-tasi and 1.25m of mat to make one ta-ovala.

In Kotare there are 33 girls and 29 boys. How much fabric would the women need to make a dress/pul-etasi for all the girls? How much mat would they need to make a ta-ovala for all the boys?

Otai

A popular and refreshing drink in the Pacific Islands is the drink called Otai. This is made out of watermelon and other fruits like pineapple and mango. Three children were having a competition to see who could scrape the most watermelon into their otai drinks. All of the watermelons were the same size.

Tania used up ½ of her watermelon to make her drink.
Kenzo used up ⅖ of his watermelon to make his drink.
Anna used 3/6 of her watermelon to make her drink.

Who came first, second and third in the competition? Prove it.

Panikeke

To make a traditional Samoan panikeke you need to make a batter. Each panikeke uses 1/4 of a cup of batter. How many cups of batter would you need to make 38 panikeke?

Cultural dances

In the Mate Ma'a Tonga dance, there are two main moves that the men do, slapping and clapping. 3/7 of the dance moves are slaps. The men slap 36 times. The rest of the moves are claps. How many claps are in the dance?

Ula-Lole's

A Pacific cultural tradition is to create lollie necklaces for celebrations. These are called ula-lole's.
Some parents were making them for their children for a prize giving celebration. They used 48 lollies to make the whole necklace.
¼ of the necklace were fruit bursts. 2/6 of the necklace were minties, ⅜ of the necklace were milkshakes and the final 2 lollies were mini crunchie bars.
How many of each lollie was used to make the necklace?

Appendix C1: Student consent form

MASSEY UNIVERSITY
INSTITUTE OF EDUCATION
TE KURA O TE MĀTAURANGA

Learning Mathematics Together: Mathematics at home and school.

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.

STUDENT CONSENT

I agree/do not agree (circle one) to my child completing two questionnaires.

I agree/do not agree (circle one) to my child being video-recorded during mathematics lessons.

I agree/do not agree (circle one) to my child completing an interview.

I agree/ do not agree to my child participating in this study under the conditions set out in the information sheet.

Date:

Student name:

Student Signature:

Parent/Caregiver name:

Parent signature:

Contact phone number:

Appendix C2: Parent consent form

MASSEY UNIVERSITY
INSTITUTE OF EDUCATION
TE KURA O TE MĀTAURANGA

Learning Mathematics Together: Mathematics at home and school

CONSENT FORM: PARENT 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.

PARENT CONSENT

I agree/do not agree (Circle one) to be video-recorded.

I agree to participate in this study under the conditions set out in the information sheet.

Date:

Parent Signature:

Full Name – printed:

Contact phone number:

Appendix C3: Teacher consent form

MASSEY UNIVERSITY
INSTITUTE OF EDUCATION
TE KURA O TE MĀTAURANGA

Learning Mathematics Together: Mathematics at home and school

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.

TEACHER CONSENT

I agree/do not agree (Circle one) to be video-recorded.

I agree to participate in this study under the conditions set out in the information sheet.

Date:

Teacher Signature:

Full Name – printed:

Contact phone number:

Appendix C4: Board of Trustees consent form

MASSEY UNIVERSITY
INSTITUTE OF EDUCATION
TE KURA O TE MĀTAURANGA

Learning Mathematics Together: Mathematics at home and school.

CONSENT FORM: BOARD OF TRUSTEES

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.

BOARD OF TRUSTEES CONSENT

I agree/disagree to participate in this study under the conditions set out in the information sheet.

Date:

Board Chairman Signature:

Full Name – printed:

Contact phone number:

Principal Signature:

Full Name – printed:

Contact phone number:

Appendix C5: Student photograph consent form

MASSEY UNIVERSITY
INSTITUTE OF EDUCATION
TE KURA O TE MĀTAURANGA

Learning Mathematics Together: Mathematics at home and school

PHOTOGRAPH CONSENT FORM

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

I would like to use some of the photographs you have given and taken for me of your activities that you enjoy doing that involve mathematics outside of school.

The photographs may be used and published as part of my study that I have been doing therefore, people will have access to the photos.

Please circle and either give consent or not for me to use your pictures.

STUDENT CONSENT

I do/do not (Circle one) give permission for Miss Cunningham to use my pictures for her research project and for others to see.

Date:

Parent Signature:

Full Name – printed:

Contact phone number:

Appendix D1: Student and parent research information sheet

MASSEY UNIVERSITY
INSTITUTE OF EDUCATION
TE KURA O TE MĀTAURANGA

Learning Mathematics Together: Mathematics at home and school

INFORMATION SHEET

Libby Cunningham (Masters student) and a team from Massey University (Prof Bobbie Hunter, Dr Jodie Hunter) are currently doing research that will focus on the out of school mathematical activities of students and their families and how teachers can use this in their mathematics lessons.

We want to know the activities that you and your family do outside of school which link to mathematics. This will help us work with your teacher to create mathematics problems for school.

We would like you to attend a workshop with your parent or guardian where we will discuss everyday mathematical activities at home and in the community. We would like you to take photos of the activities that you do outside of school and then talk to us about these.
To help us, we would like you to complete a short survey and be interviewed. We would also like to record video footage of you working on mathematics tasks within your classroom.

As coordinator of the project I am writing to formally request your permission to:

- Complete a survey at the start and end of the project.
- Participate in an interview at the start and end of the project and share the photos you have taken.

- Have some of your normal daily mathematics lessons video-recorded in the classroom.
- Attend a family workshop which is video-recorded.

All data (electronic audio files and surveys) 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 children 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 that you have the following rights in response to the request to participate in this study:

• decline to participate;
• decline to answer any particular question (in interviews and questionnaires);
• in any interview or video observation have the right to ask for the audio/video tape to be turned off at any time;
• 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:
Libby Cunningham: [redacted]

Bobbie Hunter: Massey University, School of Education. Phone: (09) 4140800 Extension 43530. 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 researchers 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 researchers, please contact Dr Brian Finch, Director, Research Ethics, telephone (06) 350 5249, email humanethics@massey.ac.nz .

Appendix D2: Board of Trustees research information sheet

MASSEY UNIVERSITY
INSTITUTE OF EDUCATION
TE KURA O TE MĀTAURANGA

Learning Mathematics Together: Mathematics at home and school

INFORMATION SHEET

Libby Cunningham (Masters student) and a team from Massey University (Prof Bobbie Hunter, Dr Jodie Hunter) are currently doing research that will focus on the out of school mathematical activities of students and their families and how teachers can use this in their mathematics lessons.

We want to know the activities that the selected participants and their family do outside of school which link to mathematics. This will help us to work with their teacher to create mathematics problems for the school.

We will get participants to attend a workshop with their parent or guardian where they will discuss everyday mathematical activities at home and in the community. We would like them to take photos of the activities that they do outside of school and then talk to us about these.
To help us, we would the students if they agree to complete a short survey and be interviewed. We would also like to record video footage of the students working on mathematics tasks within their classroom.

As coordinator of the project I am writing to formally request your permission to:

- Allow us to complete any parent/student surveys at the start and end of the project.
- Allow students to participate in an interview at the start and end of the project and share the that they have taken.

- Allow students to have some of their normal daily mathematics lessons video-recorded in the classroom.
- Allow for a family workshop to take place which is video-recorded (with parent and student permission)

All data (electronic audio files and surveys) 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 children 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 that you have the following rights in response to the request to participate in this study:

• decline to participate;
• 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:
Libby Cunningham: [redacted]

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Director, Research Ethics, telephone (06) 350 5249, email humanethics@massey.ac.nz

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Appendix D3: Teacher research information sheet

MASSEY UNIVERSITY
INSTITUTE OF EDUCATION
TE KURA O TE MĀTAURANGA

Learning Mathematics Together: Mathematics at home and school

INFORMATION SHEET

Libby Cunningham (Masters student) and a team from Massey University (Prof Bobbie Hunter, Dr Jodie Hunter) are currently doing research that will focus on the out of school mathematical activities of students and their families and how teachers can use this in their maths lessons.

We want to work with you to develop culturally based mathematics tasks based on the mathematical activities students and their families experience outside of school that you can use in the classroom.

To help us, we would like to meet with you to design and plan culturally relevant mathematics tasks. We would also like to record video footage of you using these mathematics tasks in your classroom.

As coordinator of the project I am writing to formally request your permission to:

- Have some of your normal daily mathematics lessons video-recorded in the classroom.
- Attend meetings where we will design culturally relevant mathematics tasks.

All data (electronic audio files and surveys) 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 children and teachers 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 that you have the following rights in response to the request to participate in this study:

• decline to participate;
• decline to answer any particular question (in interviews and questionnaires);
• in any interview or video observation have the right to ask for the audio/video tape to be turned off at any time;
• 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:
Libby Cunningham: [redacted]

Bobbie Hunter: Massey University, School of Education. Phone: (09) 4140800 Extension 43530. 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 researchers 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 researchers, please contact Dr Brian Finch, Director, Research Ethics, telephone (06) 350 5249, email humanethics@massey.ac.nz
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Appendix E: Record sheet used to transcribe notes from the observations

Date:
Time:

Observational Notes:	Qualitative Comments/Analysis

Appendix F: Thematic analysis table used to group data into themes

Theme:	Interview February – coded transcripts	Interview July – coded transcripts	Group Interviews - post observations
Mathematics at Home and School	Why do you think we learn maths? How/Why? So we can get better at it. (MM) Are the problems that you solve in class about things that you are interested in outside of school? Not really. (TK	Going to McDonalds and my mum gave me money and I had to take a certain amount of money to the people and I didn't want them to rip me off, so I had to work out how much change I would need[KI	It was relatable (KF) I liked that we just didn't talk about we also made the ula lole after. (RP)
Culturally Relevant Tasks	Does your teacher use problems in maths that relate to your Pasifika culture? Not really (MM)	My maths group, my teacher … I normally see stuff that is related to my culture. Traditional foods.	I liked it because it involved my culture[I felt more included into school. Because I made something and did maths about something that related to my culture (ES)
Funds of Knowledge		Some of the maths questions are about my culture and I can explain because the maths question is from my culture and I already know my culture so I can explain it to other people who don't know about my culture and stuff like that(JV)	how we do it at church for celebrations and that and how I shared that(KI)
Collaborative Groups	some of them I don't really know and I am shy to ask other people. (JV)	Yeah because other people have other opinions, not just you have one opinion. They might have lots of other opinions that they might want to tell everyone.	I like working in groups because we get to work with new people. I can get help, not leaving anyone out and helping out.
Mathematical Disposition and Cultural Identity	but I feel when I am bored it's because I already know stuff, I feel like I'm not learning new things(SL) . sometimes I don't know the answers and I get stuck so it makes me sad(SL)] .	Agree because sometimes when you make a mistake it helps you learn more instead of I can do this better than last time and I know how to do this now. (CF) But if it was fun and you had a group with each other, they can give you some ideas and stuff and make it fun for you(CF)	I thought it was really good because we worked in groups and what was weird was ummm that it was actually the first time I have enjoyed maths[SL] It was nice I really liked it because it was about my own culture. What did you like about it that it was your own culture. I felt good and it's the first time I have actually enjoyed maths before

PHOTO ELICITATION: Students' using photos to describe mathematics outside of school.				
Photo elicitation transcripts: In terms of the dance what type of maths could be involved in the dance? Umm..how many moves? And the angel and i am like on a different angle here? Oh and how many versus there are and the beats. Oh awesome. So where are you in this photo? What is happening in this photo? We took a photo of our tag team. Great who is in your tag team who are all of these people? Its like all the people from my church and some of my cousins. That's great. When do you guys play? The beginning of every year. So it's kinda like a celebration game for church??				
Observation Themes and Analysis Overview				
Mathematics at Home and School	**Culturally Relevant tasks**	**Funds of Knowledge**	**Collaborative Groups**	**Mathematical and Cultural Identity**
Observation Three: Task 1 J goes straight into thinking about the numbers not reading into the context of the problem. J asks his group " What strategy do you think we should use plus, minus or division" before even reading and discussing the problem.	Students talk to their groups: its about drinking otai and who makes the most otai. Teacher had students working on reading the question. He then got them back into a whole group setting to share what they thought the story was about.	All pasifika students were used as experts and the teacher drew on their funds of knowledge. The students enjoyed sharing with their peers and all had smiles on their faces. J reads the word umu and the teacher asks for Maria to share to the class what this means "Msays it's a big feast in samoa and the pacific islands.	If someone asks you from your group what are you accountable for doing?? Answering their questions and explaining to them. Today when I get people to share their thinking I am not going to tell you who is going to share it should be anybody it's up to you to work with your group your maths family	M stops half way through excited in her costume "I'm an islander!!"