What do Culturally Diverse Middle School Students Value for their Mathematics Learning?

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ABSTRACT

Mathematics education values concern what students perceive to be worthy or of importance in mathematics, and relate specifically to learning and pedagogy (Seah & Andersson, 2015). These values take place in the context of activities and decisions that are made to enhance the learning and teaching of mathematics (Seah, 2016). This study explores the types of mathematics education values espoused by diverse middle school learners in New Zealand, focusing on a cohort of Pākehā/European, Asian, Māori and Pāsifika students. This study also examines the relationship between the students' cultural values and what they value for their mathematics learning.

The methodology used in this study involved a comparative case study to investigate student perceptions of the most and the least important mathematics education values. Using a survey format, students ranked twelve mathematics education values in order of their importance, with follow up interviews to better understand the reasoning for students ranking of certain values. The use of a range of methods provided a more holistic approach and allowed for greater diversity of student perspectives.

The results demonstrated that culturally diverse middle school students shared three mathematics education values, that is *utility, effort/practice* and *flexibility*. The commonality of these mathematics education values reflects shared educational and societal values. However, students from different cultures (and from different mathematics learning environments) were found to endorse alternate values as most and least important for their mathematics learning. These mathematics education values were reflective of the students' cultural values as identified by earlier research and policy documents (Hofstede, Hofstede, & Minkov, 2010; Ministry of Education (MoE), 2011, 2013). The Māori and Pāsifika students identified most strongly with the mathematics education values *collaboration-group work* and *family*, reflecting the collectivist cultural values of these students. Conversely, the Pākehā/European and Asian students espoused independent mathematics education values including *teacher explanations* and *mathematical understanding/clarity,* reflecting New Zealand's individualist values, and values relating to the teacher-student power imbalances amongst many East Asian cultures. An unintended outcome of this study was the impact of classroom norms and pedagogy on students' mathematics education values, specifically, the influence of an inquiry based classroom intervention upon the Māori and Pāsifika students' collaborative mathematics education values.

The findings from this study provide insight into what is valued by culturally diverse middle school mathematics learners. It is hoped that the results from this study may assist teachers to develop culturally responsive mathematics pedagogy which aligns with the values of their students, leading to enhanced mathematics learning outcomes for diverse middle school students.

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TABLE OF CONTENTS

SUMMARY OF TABLES ....

SUMMARY OF FIGURES ....

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

1.1.1 MATHEMATICS, CULTURE AND CULTURAL VALUES

Mathematics is inherently cultural, it is foundational to human enterprise and discovery, and deeply embedded in our histories (De Toffoli & Giardino, 2016). In a broad sense, culture is defined as "the collective programming of the mind" distinguishing members of one group of people from another (Hofstede, Hofstede, & Minkov, 2010, p. 6). Culture is built upon an organised system of values that are transmitted both formally and informally to group members (McConatha & Schnell, 1995). Universally and in all cultures, mathematics can be observed as the following six behaviours or activities: counting, measuring, locating, designing, explaining, and playing (Bishop, Clarkson, FitzSimons, & Seah, 2000). Each activity is reflective of the culture, and the values held by the people demonstrating it (Bishop, 2001), therefore, to understand the importance, and use of mathematics by people from different cultures, we must first recognise their cultural values.

The values endorsed by a culture mediate the importance, and purposes of mathematics amongst people from that culture. For example, Chinese Confucian values often emphasise future directed behaviours (Hofstede et al., 2010) and thus for Chinese people, counting (one of the six universal mathematical activities), may be important, or valued, for future predictions such as astrological calculations (Wong,

Wong, & Wong, 2012). Māori and Pāsifika people hold collectivist cultural values, which emphasise community and family (Averill, 2012b), consequently for Māori and Pāsifika, the activity of counting may be viewed as important for sharing items amongst a group. In the context of the mathematics classroom to understand the importance and purposes of mathematics for students from different cultures, we must first recognise their culture and values.

1.1.2 AFFECT AND VALUES IN MATHEMATICS EDUCATION

For many years mathematics education has focused on skills, techniques, and knowledge acquisition, (i.e., mathematics is something students do) (Seah, Andersson, Bishop, & Clarkson, 2016), often ignoring the affective states of the students, that is their beliefs, attitudes, emotions, and values. Values are considered to be the most internalised and stable out of the four affective dimensions (Bishop, FitzSimons, Seah, & Clarkson, 1999; Grootenboer & Marshman, 2015). Until recently mathematics, unlike other subjects such as English, has often considered to be value free (Bishop, 2001). However, there is now widespread consensus that mathematical teaching and learning is deeply affective and value laden ((e.g., Averill, Te Maro, Easton, Rimoni, & Smith, 2015; Bishop et al., 1999; Seah, 2016). Despite this consensus, there appears to be very little research exploring values in the mathematics classroom, particularly for students from indigenous or marginalised cultures.

Mathematics values are sociocultural in nature, in that they are shaped by cultural factors, norms and climates, and the experiences built into our communities over generations (Keller, 2008; Keown, Parker, & Tiakiwai, 2005; Seah & Andersson, 2015). Values in mathematics education are "the deep affective qualities which education aims to foster through the school subject of mathematics" (Bishop, 1996, p. 169), and are reflected by the "convictions which an individual has internalised as being the things of importance and worth" (Seah & Andersson, 2015, p. 169). Bishop (1996) proposed three types of values found in mathematics education: moral or general education values (e.g., *fairness*), mathematics discipline values (e.g., mathematics is about *control*), and mathematics education values (e.g., valuing *group work*). The present study will focus on the third subtype, that is mathematics education values, as these values contribute to effective mathematics learning because they reflect the personal and cultural learning preferences of both teachers and students (Seah, 2016).

1.1.3 VALUES, VOLITION AND ENGAGEMENT

Values are considered to be volitional in nature (Seah & Andersson, 2015). The act of using ones will or "volition" means to have the determination to maintain a course of action, especially when motivation wanes in the face of competing obstacles and actions (Keller, 2008). As an example, if a student lacks interest in a particular mathematical task, valuing *achievement* may drive this student to achieve despite this competing obstacle, that is a lack of interest (Seah & Andersson, 2015). Valuing *achievement* may also help this student remain engaged, even though he/she may not be interested or motivated in the mathematical task at hand.

Mathematics values can also predispose students to prefer certain mathematical activities, further contributing to their engagement during these tasks (Bishop &

Kalogeropoulos, 2015; Kalogeropoulos & Bishop, 2017; Seah & Andersson, 2015). For example, Kalogeropoulos and Bishop (2017) presented several case studies where teachers successfully re-engaged their students by attending to conflicting values in the mathematics classroom. They reported how one Year 5/6 teacher successfully re-engaged his students by responding to value conflicts in his classroom. During a challenging mathematical word problem, his students complained that the task was too difficult, and quickly became disruptive and disengaged. After recognising that these students valued *small group work*, the teacher repositioned the class to work in pairs, resulting in the students becoming successfully re-engaged.

1.1.4 THE MIDDLE SCHOOL PERIOD

The current study focuses on the middle school period, which in New Zealand falls between primary and secondary school, and includes years seven and eight. Research studies (e.g., Barber & Houssart, 2011; Cheeseman & Mornane, 2014), have shown that many students begin primary school with a positive affective outlook, and often complete their primary years with a similar positive mathematical disposition (Caygill & Kirkham, 2008; Grootenboer, 2003). However, by the time students reach secondary school, many will experience a negative and detrimental affective shift, with a decline in their academic engagement (Attard, 2011; Grootenboer & Marshman, 2015). During middle school, many learners develop negative affective reactions towards mathematics and frequently become disengaged from their learning (Anderson, Jacobs, Schramm, & Splittgerber, 2000; Attard, 2010; McGee, Ward, Gibbons, & Harlow, 2003). It is suggested that these affective reactions are often the result of the schooling experience (Grootenboer & Marshman, 2015). To determine changes in student mathematical engagement over the middle school period, Attard (2013) found that the students in her study reported feeling less engaged at the end of the middle school transition. Seah and colleagues (2016) argued that these negative affective reactions towards mathematics can be attributed, in part, to a lack of attention to values in the mathematics classroom. Recognising what middle school students value (or do not value) in the mathematics classroom may offer teachers pedagogical strategies to enhance engagement for middle school students, and develop their sense that mathematics is valuable and important.

1.1.5 THE NEW ZEALAND CONTEXT

New Zealand classrooms, like those in many other counties, are becoming increasingly culturally diverse. The latest Ministry of Education reports (MoE, 2016) show that 51% of all New Zealand school students identify as Pākehā/European, 24% as Māori, 10% Pāsifika, 11% Asian, and 2% Middle Eastern/Latin American/African. Over the past decade, the proportion of Asian and Pāsifika students has doubled, and Māori have increased by 5% (MoE 2006). The term Pāsifika refers to a multi-ethnic group of individuals, some of whom were born in New Zealand, and others who have migrated from the Pacific Islands. This group identifies themselves with the islands and/or cultures of Cook Islands, Samoa, Tonga, Tokelau, Niue, Fiji, Tuvalu, and the Solomon Islands (Coxon, Anae, Mara, Wendt-Samu, & Finau, 2002). Asian students comprise all nationalities on the Asian continent, whereas Māori are the Indigenous culture of, and are typically born in New Zealand.

International mathematical assessment data, including results from Programme for International Assessment (PISA), and Trends in International Mathematics and Science Studies (TIMSS) (Mullis, Martin, Foy, & Hooper, 2016) consistently show a correlation between ethnicity and mathematical performance. According to these assessments, New Zealand has one of largest mathematical achievement gaps in the developed world, with Māori and Pāsifika students much more likely to underachieve comparable to all other ethnicities. The 2015 Mathematics results of National Standards reported 80% of Pākehā/European and 83% of Asian students in years one to eight, achieved at or above national standards, compared to 65% and 63% of Māori and Pāsifika students' respectively. The *Ka hikitia* Accelerating Success Plan 2013 – 2017 (MoE, 2013a), and the Pāsifika Education Plan 2013 – 2017 (MoE, 2013b) call for improved achievement outcomes for Māori and Pāsifika students. According to these policy documents, to achieve equitable education outcomes teachers are encouraged to draw upon Māori and Pāsifika values, language and culture, and link these to their curriculum. Despite this, there appears to be minimal research investigating the values held by Pāsifika and Māori mathematics students, and "within the New Zealand school curriculum, there has been a lack of research into the nature and effect of values" (Notman et al., 2012, p. 2). This research project aims provide a useful starting point for developing an evidence base in New Zealand. By identifying the mathematics education values held by diverse learners, teachers can harness these values to implement culturally responsive and equitable mathematics teaching strategies.

1.1.6 CULTURALLY RESPONSIVE TEACHING AND VALUES ALIGNMENT

One of the largest challenges faced in mathematics education is inequity of access to opportunities for learning. This means that educators need to ensure that classrooms are inclusive and suitable for the diversity found in many schools (Averill et al., 2015). To facilitate equity, reduce achievement disparities, and acknowledge and strengthen students' cultural identities, mathematical classrooms require culturally responsive teaching practices (MoE, 2013a; 2013b). Culturally responsive teaching attends to the mismatch between the culture of the student and the classroom (Ladson-Billings, 2009). It achieves this by firstly, recognising students' cultural characteristics (for example, traditions, language, values, etc.), secondly, enacting positive and reciprocal teacher-student relationships (for example, through knowing and valuing their students), and thirdly, holding high student expectations for students (Bishop, Berryman, Cavanagh, & Teddy, 2009; Hunter et al., 2016; Ladson-Billings, 2009).

One strategy for enacting equitable and culturally responsive mathematics teaching is through values alignment. Values alignment concerns negotiating a shared goal or vision between teacher and students, and is concerned with:

> Providing a cooperative and collaborative process whereby members (of a classroom)….not only support those values that have been previously been clarified as being essential for the ultimate success of the group as a whole but also supported by majority of the people within the group (Branson, 2008, p. 383).

Values alignment is not the same as values inculcation, in that alignment is not about classroom members all espousing the same values (Seah & Andersson, 2015). Rather values alignment facilitates the coexistence of different values to achieve a shared vision in the classroom. By aligning values in the classroom (and minimising value conflicts) students recognise that their knowledge, culture, dispositions and skills are valued. Thus, values alignment can be used as a tool to promote inclusivity in the mathematics classroom (Seah & Andersson, 2015). Research studies (e.g., Bishop, Berryman, Tiakiwai, & Richardson, 2003; Hunter et al., 2016) have shown that when values are aligned, students' mathematical engagement and learning are enhanced and cultural identities are affirmed. To illustrate, Cheung (2015) reported how one teacher accelerated his Pāsifika students' mathematical engagement and achievement by aligning Pāsifika values of *family* with his pedagogy, thus encouraging collective responsibility during group work to represent cohesive *family* values. Mathematical learning and engagement can be enhanced when the teacher aligns the values of their students to the values reflected in their pedagogy and instruction.

1.2 RESEARCH OBJECTIVES

The purpose of the present study is to explore the types of mathematical education values held by diverse learners in middle school. This study will draw upon student voice to better understand what Pākehā/European, East Asian, Pāsifika and Māori students value most, and least for their mathematics learning. Considering this, the following research questions will be addressed:

1. What are the most and least important mathematical education values espoused by Pākehā/European, East Asian, Pāsifika and Māori students?

2. How do these students’ mathematical education values reflect their cultural values?

1.3 OVERVIEW

Chapter two explores the concept of mathematical affect in greater depth, as well as reviewing both national and international literature relating to cultural values and values in mathematics education. From the research, links are made between students’ cultural values and their mathematical education values.

Chapter three describes the methodology used in this research. This includes the research setting, study sample, data collection, research schedule, quantitative and qualitative data analysis, and ethical considerations.

Chapter four presents the findings of the study. This includes quantitative ratings for twelve different mathematical education values, and qualitative interview results exploring values espoused as most and least important. These values are compared across cultural group to determine similarities and differences.

In Chapter five, the findings are discussed in relation to international research. This chapter examines the most and least important mathematics education values held by students from different cultures, and how these values reflect the students’ cultural values.

In Chapter six, the conclusions of the study are discussed and suggestions are made for areas of further research.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

The previous chapter introduced the values concept, and outlined the growing awareness of the role values play for mathematics teaching and learning, particularly in the middle school period. The New Zealand curriculum (MoE, 2008b) emphasises the importance of values to promote learning and develop equity in schools. Despite this, there appears to be minimal research exploring the values held by mathematics learners, particularly in New Zealand. In this chapter, both national and international research will be reviewed investigating the cultural and mathematical values held by diverse students.

Section 2.2 explores the concept of the affective domain, encompassing our beliefs, attitudes, emotions and values. Section 2.3 builds upon the definition of values by proposing values as an affective, volitional and a sociocultural construct. Section 2.4 considers values as the core of culture, and examines differences in cultural values amongst various nationalities. Section 2.5 explores the cultural values held by New Zealand Māori and Pāsifika peoples. Section 2.6 reviews the types of values embedded in mathematics education. In Section 2.7, international literature is reviewed to compare the types of mathematical values held by students in Asia, Europe, Australia and New Zealand.

2.2 THE AFFECTIVE DOMAIN

Since the 1970s, there has been growing interest of the role affect plays within mathematics education (Grootenboer & Marshman, 2015), and it is now widely accepted that learning mathematics is inherently affective (Grootenboer & Marshman, 2015; Hannula et al., 2016). McLeod (1992) first identified affect as our beliefs, attitudes, and emotions. Later, DeBellis and Goldin (1997) incorporated values as the fourth dimension. These four dimensions as shown in Figure 2.1, are now widely accepted as fundamental aspects of the affective domain. Despite an increasing interest in affect, there is still considerable debate surrounding the definition of these four dimensions. However, to ensure future research validity, consensus is needed on how best to define our beliefs, attitudes, emotions and values systems.

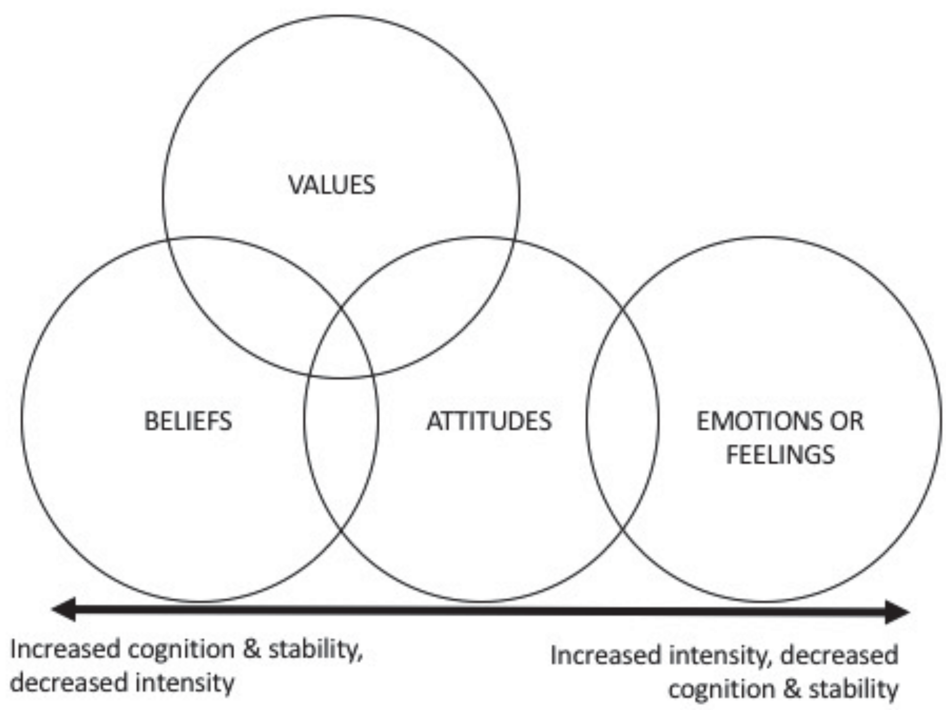

Figure 2.1. A model of the affective domain (Grootenboer, 2003)

2.2.1 THE BELIEF DIMENSION

Beliefs can be viewed as subjective personal assumptions of truth, which act as predispositions to action (Rokeach, 1968). More recently Philipp (2007) defined beliefs as "psychological held understandings, premises, or propositions about the world that are felt to be true…Beliefs might be thought of as a lens that affect one's view of some aspect of the world…" (p. 259). In terms of mathematical beliefs, these can be beliefs about mathematics as a subject (for example, mathematics is about rules), mathematics learning and teaching (for example, mathematics is about memorisation), or self and social context (for example, I can/cannot do mathematics) (Goldin, 2002; Op 't Eynde, 2002). As shown in Figure 2.1, beliefs, attitudes and values share many commonalities. Nevertheless, to distinguish beliefs from other affective dimensions in their research, Seah and Peng (2012) asked themselves, "Is this (conviction/statement) a reflection of what is considered to be true or correct?". Beliefs, particularly when created through experience, are typically more stable than attitudes, and much more stable than our emotions (McLeod, 1992). Nonetheless, beliefs can change over time, for example, Wigfield, Eccles, Mac Iver, Reuman, and Midgley (1991) found students' mathematical self-beliefs became more negative over the primary to secondary school transition.

2.2.2 THE ATTITUDE DIMENSION

Compared to other dimensions in the affective domain, attitudes have the longest history in mathematics education research, however, they are also the most widely contested affective dimension (Hannula, Evans, Philippou, & Zan, 2004). It is attitudes that are most commonly used by teachers to explain the success or failure of their students (Di Martino & Zan, 2010). Despite this, attitudes are often confused with similar terms such as anxiety, motivation, confidence, enjoyment, and feelings (Grootenboer & Marshman, 2015). Figure 2.1 shows the interconnectedness of attitudes with all other dimensions, which may explain this persistent terminological ambiguity. Attitudes have been defined as manners of acting, feeling or thinking (Philipp, 2007) which are of moderate intensity, and reasonable stability. McLeod (1992) asserted attitudes are less stable but more intense than beliefs, however more stable and less intense than our emotions (see Figure 2.1). In terms of mathematics education, students' attitudes can be created through repeated emotions towards mathematics (for example, enjoyment, anxiety) in response to a particular task or event, such as mathematics lessons or tests (McLeod, 1992). Examples of mathematical attitudes may include "I like/dislike mathematics"; or "mathematics is/is not worthwhile" (Tapia & Marsh, 2004).

2.2.3 THE EMOTION DIMENSION

Emotions (or feelings) are perhaps the most fundamental affective concept, and yet there has been no final agreement of what emotions are. However, there is wide agreement that emotions generally involve various physiological reactions, such as excessive perspiration, they are also functional, and play a role in human coping and adaption) (Goldin, 2000; Hannula et al., 2004). Emotions can also be temporary and unstable, as shown in Figure 2.1 (Grootenboer & Marshman, 2015). Pekrun, Elliot, and Maier (2006) categorised academic emotions into four groups: positive activating emotions, for example pride, enjoyment; positive deactivating emotions, such as relief; negative activating emotions including anxiety and anger; and negative deactivating emotions such as hopelessness or boredom. In terms of mathematics education, there has been a strong focus on the emotion dimension, particularly anxiety (Grootenboer & Marshman, 2015; Ma, 1999; McLeod, 1992). Mathematics anxiety can cause apprehension and fear of situations involving mathematics (Beilock & Willingham, 2014) and can greatly impact upon mathematics performance and achievement (Ma, 1999).

2.3 VALUES: AN AFFECTIVE, VOLITIONAL AND SOCIOCULTURAL VARIABLE

The values dimension (the focus of this thesis) was introduced in the previous chapter. Values are a recent addition to the affective domain, and until recently, values research has been scant. Values have been conceived as an affective construct (Bishop et al., 1999; Grootenboer & Marshman, 2015; Krathwohl, Bloom, & Masia, 1964), a motivational dimension (Hannula, 2012), or more recently as a volitional variable (Seah & Barkatsas, 2014) and a sociocultural construct (Seah & Andersson, 2015). This study adopts the view that values can be affective, volitational, and sociocultural in the following ways. Values are: an internalised psychological conviction relating to what we find important (affective); they influence our behaviour by providing us with the will and determination to maintain our course of action (volitional); and they are shaped by cultural factors, norms and climates, and experiences built into our communities over generations (Keller, 2008; Keown et al., 2005; Seah & Andersson, 2015).

2.4 CULTURAL VALUES AND EDUCATION

Culture is defined as "the collective programming of the mind that distinguishes the members of one group or category of people from another" (Hofstede et al., 2010, p. 6). Cultural groups or categories may include societies, ethnicities, organisations, or even age and genders (Hofstede, 2001). Further, culture is manifested through "an organised system of values which are transmitted to its members both formally and informally" (McConatha & Schnell, 1995, p. 81). In mathematics education, researchers are increasingly interested in how particular values impact upon teaching, student performance and learning in the classroom (Averill, 2012a; Hunter et al., 2016; Seah, 2016). A recent review of over 500 published studies by the Nuffield Foundation, found that in school mathematics, "high attainment may be much more closely linked to cultural values than to specific mathematics teaching practices" (Askew, Hodgen, Hossain, & Bretscher, 2010, p. 12). Nevertheless, different cultures influence values in different ways (Bishop et al., 1999). If we are to improve mathematics education, we must first familiarise ourselves with the cultural values within the classroom.

Values are a stable element at the core of culture (Hofstede et al., 2010). Therefore, research exploring cultural differences often begins by measuring differences in values. Research studies by Hofstede and colleagues (2010) measured cultural values across 70 countries over a forty year period. The researchers proposed a framework to explain differences in cultural values consisting of six value continua. These continua can be applied to differences in cultural values within the classroom.

1. Power Distance
2. Individualism – Collectivism
3. Femininity - Masculinity
4. Uncertainty Avoidance
5. Long-Term Orientation
6. Indulgence - Restraint

The first continuum—power distance—indicates the acceptance that power is distributed equally amongst all participants. Drawing on the work of Hofstede (2001), Table 2.1 summarises how power distance values may operate in the classroom. Research shows Asian cultures typically have large power distance indices, whilst European cultures have smaller indices (Hofstede, 2001). New Zealand has one of the smallest power distances comparable to other cultures (Perry, 2011). However, diverse groups within New Zealand such as indigenous Māori and Pāsifika peoples may hold larger power distances than national norms (Hunter et al., 2016; Mead, 2016). Whereas, Fijians (the only Pacific nation included in the research) hold large power indices (Hofstede, 2017).

Table 2.1. Power Distance values in the classroom.

Small Power Distance Cultures	**Large Power Distance Cultures**
Equal distribution of power in the classroom	Teacher respected and followed
Teachers treat students as equals	Teachers encourage obedience
Students expect to be consulted	Students expect to be told what to do
Learning is a two-way enterprise between teacher and student	Learning is about truths and facts and the teacher is the expert

The second continuum—individualism-collectivism—describes the degree to which individuals are integrated into groups. Drawing on the work of Hofstede (2001), Table 2.2 summarises how these values can be applied to the classroom. Individualist cultures value individuality and personal achievement. Collectivist cultures act as members of a cohesive group or organisation. Research shows Europe and New Zealand are individualist countries. This contrasts with Asian countries, which generally have strong collectivist values (Hofstede, 2001). Similarly, Māori and Pāsifika peoples, including Fijians, hold collectivist cultural values (Hofstede, 2017; Hunter et al., 2016; Mead, 2016).

Table 2.2. Individualist-collectivist values in the classroom

Individualist Cultures	**Collectivist Cultures**
Students encouraged to individually speak up in class	Students wait for group approval and will respond only when asked directly
Personal opinion is expected	Opinions determined by the group
Students are supposed to take care of themselves and immediate family only	Students are born into extended families/clans that protect them exchange for loyalty
Students form groups ad hoc	Students form into ethnic subgroups in class

The third continuum—femininity-masculinity—refers to gender equality and distribution of emotional roles. Masculine cultures value competiveness, materialism, assertiveness, ambition and power. Feminine cultures value relationships and quality of life. In masculine cultures, the gender roles are more dramatic and less fluid than feminine cultures, where men and women have the same values. Table 2.3, adapted from Hofstede (2001), summaries how these values operate in the classroom. Asian cultures have mixed scores, Japan and China hold masculine values, Taiwan, Korean and Thailand hold feminine values. Europe and New Zealand have higher feminine scores (Hofstede et al., 2010). Fijians hold intermediate scores (Hofstede, 2017).

Table 2.3. Masculine-feminine values in the classroom

Feminine Cultures	**Masculine Cultures**
Students should be modest and caring	Students should be assertive and ambitious
Being an average student is the norm	Being the high achiever is the norm
Friendliness in teachers is valued	Expertise and brilliance in teachers is valued
Have compassion for those who perform poorly	Admire those students who excel

The fourth values continuum—uncertainty-avoidance—describes a cultures tolerance of uncertainty and ambiguity. Cultures which have high uncertainty avoidance minimise situations that are new or different. Low uncertainty avoidance cultures accept and feel comfortable with change. Drawing on Hofstede and colleagues (2010) research, Table 2.4 summaries how these values can be applied to the classroom. All Asian countries (apart from Japan and Korea), have medium to low scores. Whereas New Zealand and Fiji hold medium (Hofstede, 2017), and European countries hold mixed scores (Hofstede et al., 2010).

Table 2.4. Uncertainty-avoidance values in the classroom

Low Uncertainty-Avoidance Cultures	High Uncertainty-Avoidance Cultures
Students believe each day is uncertain and accept each day as it comes	Uncertainty is a continuous threat which must be fought
Students feel comfortable with self-directed learning or open ended questions	Students feel comfortable with structured learning environments
Teacher may say "I don't know"	Teachers are supposed to have all the answers

The final two dimensions are relatively new additions, and not included in Hofstede's (2001) original study. The fifth values continuum—long-term orientation— is based on a Chinese study of Confucian values (Bond, 1988; Hofstede & Minkov, 2010). This dimension relates to the choice of focus for peoples' efforts: past and present versus the future. Table 2.5, adapted from Minkov and Hofstede (2012), demonstrates how short and long-term orientation values can be applied in the classroom. Long-term orientation scores are typically found in East Asia, China, Hong Kong and Japan. In contrast the Americas, Western Europe and New Zealand hold short-term orientation scores (Minkov & Hofstede, 2012). Interestingly, mathematics results from the 1999 Trend in International Mathematics and Science Study (TIMSS) correlate significantly with long-term orientation scores (Hofstede, 2001) from East Asian countries. This provides further evidence of the potential link between cultural values and mathematical learning and performance.

Table 2.5. Long-term orientation values in the classroom

Short-Term Orientation Cultures	Long-Term Orientation Cultures
Students value events that occurred in the past or are taking place now	Most important events in life will occur in the future
Students value steadiness and stability	Students value adaptation in the classroom
Cultural traditions are very important	Traditions can change for circumstances
Collaboration and reciprocation to others is important	Thrift and perseverance are important
Students attribute success and failure to luck	Students attribute success to effort and failure to lack of effort

The sixth dimension—indulgence and restraint—is based on the world value study on subjective well-being (Hofstede et al., 2010). This dimension is concerned with affect and emotions, including happiness, life control and valuing leisure. Drawing on Hofstede and colleagues (2010) research, Table 2.6 summarises how these values can operate in the classroom. Indulgent cultures include the Americas, Western Europe, and New Zealand, whereas cultures valuing restraint are found in Eastern Europe and Asia (Hofstede, 2011).

Table 2.6. Indulgence- restraint values in the classroom

Indulgent Cultures	Restrained Cultures
High importance of having friends	Lower importance of having friends
Students have high value of leisure	Lower value of leisure
Students more likely to remember positive emotions	Students less likely to remember positive emotions
Speaking freely in class is important	Speaking freely in class not important
Less moral and cultural discipline	More moral and cultural discipline

2.5 NEW ZEALAND MĀORI AND PĀSIFIKA CULTURAL VALUES

New Zealand is a multicultural society, consisting of 74% Pākehā/European; 14.9% Māori, 11.8% Asian; 7.4% Pāsifika, and 1.2% Middle Eastern/Latin American/African (Statistics New Zealand, 2014). One criticism of the large scale multinational values studies is their failure to capture the true breadth of cultural values within a nation, particularly those from indigenous or other minority backgrounds (Hofstede et al., 2010; World Values Survey, 2014). Moreover, survey based methodologies can lack sensitivity, denying self-generated values.

There appears to be a scarcity of values research amongst Māori and Pāsifika peoples, particularly from the perspective of the learner or self-reporting of values. Furthermore, except for Fiji (Hofstede, 2017), all South Pacific nations are absent from multi-national comparative value studies, limiting Pāsifika value comparisons. The world values survey recently included values from New Zealand, however only 16% of respondents identified as Māori, whilst no participants identified as Pāsifika (Perry, 2011). Using this dataset, Grimes, MacCulloch, and McKay (2015) compared the values of Māori and non-Māori respondents. Key findings included much stronger values in relation to collectivism/collaboration, kinship ties, non-materialism and the environment for Māori when compared to non-Māori. Other large scale national surveys have explored the attitudes and values of Pāsifika and Māori people: for example, the New Zealand attitudes and values study, which includes the multi-dimensional model of Māori identity and engagement study (Houkamau & Sibley, 2010) and the Pāsifika identity and wellbeing study (Manuela & Sibley, 2013). Nevertheless, the values sampled in these surveys concern social attitudes, health and wellbeing, and cultural connectedness and identity, as opposed to identifying specific cultural and/or educational values.

Māori values can be viewed and understood though the concept of *Tikanga Māori*, meaning Māori values (Mead, 2016). *Tikanga Māori* is built upon several Māori cultural aspirations, including respect, caring relationship, family, community, and relatedness (Graham, Meyer, McKenzie, McClure, & Weir, 2010). The Ministry of Education (MoE) (2011) lists pertinent values or “cultural competencies” necessary for teaching Māori. These included: *wanaga* (participating in robust dialogue); *whanaungatanga* (nurturing relationships); *manaakitanga* (integrity, sincerity toward Māori); *tangata whenuatanga* (affirming Māori culture and identity); and *ako* (learning outside the classroom). The New Zealand Ministry of Education Pāsifika Education Plan (2013b) lists similar Pāsifika values, including respect, reciprocity, service, inclusion, spirituality, leadership, love, belonging and family.

Positive relationships built around trust, reciprocity and respect, are one of the most central and enduring cultural values for both Māori and Pāsifika peoples (Averill, 2012a; Hunter et al., 2016; Mullane, 2011), and "a core value of indigenous education…and central to personal as well as group identities" (Thaman, 2003, p. 3). Research (e.g., Averill, 2012b; Bishop et al., 2003) consistently shows both Māori and Pāsifika learners place a very high value on the kind and strength of their relationships at school. During focus groups, Year 9 and 10 Pāsifika students maintained a key factor to their success at school was the strength of their teacher-student relationship (Knight-de-Blois, 2015). Likewise, narratives and interviews with primary, secondary, and tertiary Māori and Pāsifika students found that the quality of educational relationships were the most influential factor affecting students' engagement and achievement (Bishop et al., 2009; Hawk, Cowley, Hill, & Sutherland, 2002).

Values concerning love (that is *as'ofa* or *aroha*) and family (that is *whānau* or *kaingha*) are also central to the identity of Pāsifika and Māori (Durie, 2001; Hunter et al., 2016). The concept of family extends beyond the immediate family to include extended family, neighbours and local members of the community (Hunter et al., 2016). Embedded within the notion of family are other cultural values including reciprocity, collectivism, communalism and service (Civil & Hunter, 2015). Pāsifika and Māori students frequently cite family as a major driver of their motivation and achievement (Hannant, 2013; Hunter et al., 2016). To illustrate this, during an interview a successful Pāsifika university student expressed "all my motivation comes from my family" (Hannant, 2013, p. 20). These cultural values concerning relationships and family, can be applied to the Hofstede and colleagues (2010) cultural values framework, with Māori and Pāsifika people being defined as a collectivist culture.

2.6 VALUES IN MATHEMATICS EDUCATION

There is widespread belief amongst teachers, parents, university mathematicians and employers that mathematics is the most value-free of all school subjects (Bishop, 1988). Yet some feel mathematics is just as much a human and cultural enterprise as any other field of knowledge (Clarkson, Bishop, FitzSimons, & Seah, 2000). Towards the turn of the century Bishop (1996) argued forcefully that mathematics education is value laden and has its own social and moral responsibilities. Based on Bishop's seminal work, values in mathematics education can be categorised into three broad domains: a) general education values; b) mathematical discipline values; and c) mathematical education values. These categories are not mutually exclusive (Seah & Bishop, 1999). For example, the value *curiosity,* can be both a general education value and a mathematics education value.

2.6.1 GENERAL EDUCATION VALUES

General education values typically include moral, civic, nationalistic and other values (Seah & Bishop, 1999). The New Zealand education system, like many others around the world, is enshrined in the teaching and promotion of general education values (MoE, 2008b). The importance of these values is reflected in the speech from the previous Minister of Education, Hon Heki Parata (MoE, 2014b), outlining in her Statement of Intent 2014-2018: "Our education system performs well overall and in global terms, and it must if young New Zealanders are to be equipped with the values, knowledge and skills to be successful in the 21st Century" (p. 4). In New Zealand, individual schools are encouraged to add/omit values based on the culture and community of their school (Keown et al., 2005). Schools can advocate, teach and model general education values within the mathematics classroom, a process termed by Seah (2016) as "values through mathematics education" (p. 2).

2.6.2 MATHEMATICS DISCIPLINE VALUES

Mathematics discipline values are concepts which mathematics as a discipline finds important. Bishop (1988) proposed three dimensions of complementary mathematics discipline values in "western mathematics"

Ideology: Rationalism and Objectivism

Sentiment: Control and Progress

Sociology: Openness and Mystery

The first dimension, *ideology* is concerned with the ideals of mathematics. Valuing *rationalism* means appreciating reasoning, argument and explanations. *Objectivism* means appreciating mathematical objects, analogical thinking, symbolising and presentation of data. The second dimension, *sentiment,* is concerned with attitudes and feelings. Valuing *control* means appreciating certainty through rules, facts and procedures. *Progress* means valuing the growth of mathematical ideas through alternative theories and questioning. The third dimension, s*ociology,* is concerned with the relationships between people, and who can do mathematics. Valuing *openness* means appreciating mathematics as a democratic subject, open for anyone to use and learn, and the public verification of procedures and assumptions. *Mystery* means valuing the wonder, imagination and mystique of mathematics. As these are "western mathematics" discipline values (Bishop, 1988), their applicability and validity to students from different cultural groups (e.g., Māori and Pāsifika) is not entirely clear. More research is needed to better understand the mathematical values held by these diverse learners in New Zealand classrooms.

2.6.3 MATHEMATICS EDUCATIONAL VALUES

Mathematical educational values are those which relate specifically to learning and pedagogy and take place in the context of activities and decisions that are made to enhance the learning and teaching of mathematics (Seah, 2016). These values can influence students' preference for types of learning activities and pedagogies. Mathematical education values are highly sensitive to cultural influences and can vary depending on the culture of the learner (Lee & Seah, 2015). For example, a Pāsifika learner who values *caring relationships* and *reciprocity* (MoE, 2011) may value a shared end result rather than an individual end result, and may also show preference for the mathematical tasks involving *collaborative group work* (a mathematics education value).

Research studies (e.g., Österling, Grundén, & Andersson, 2015; Seah & Peng, 2012) have identified a range of mathematics education values. For example, Clarkson and colleagues (2000) consulted with Australian teachers and noted common mathematics education values which included: *clarity, flexibility, consistency, open-mindness, persistence, efficient working, systemic working, enjoyment, effective organisation,* *creativity* and *conjecting*. In another study, Seah and Peng (2012) triangulated lesson observations, interviews, and artefacts (for example student photographs), to identify mathematics education values held by Australian and Swedish students. These researchers reported the following mathematics education values: *explanations* (peer/teacher), *sharing*, *fun*, *teacher certainty*, *clarification/questioning*, *collaboration*, *competition, concentration, efficient working, worked examples, hints, independence, personalised-help, relaxed classroom, accessible resources*, and teacher *strictness*.

2.7 INTERNATIONAL RESEARCH INVESTIGATING MATHEMATICS VALUES

Values research in mathematics education is a relatively new field (Bishop, 2008). Much of the research in this area has originated from an international research consortium "The Third Wave Project", which aims to discern how values can be harnessed to optimise mathematics teaching and learning (Seah & Wong, 2012). A recent study by this group called the "What I Find Important in mathematics learning" (WiFi) study aimed to identify mathematics discipline, educational and cultural values held by students and teachers. It incorporated an online survey, with 64 Likert items, 10 slider ratings, and 6 open ended questions (Seah, Zhang, Barkatsas, Law, & Leu, 2014). The Third Wave consortium included eleven nations, from Australia, North and South America, East Asia (China, Hong Kong, Japan, Taiwan, Malaysia), and Western Europe (Sweden, Turkey and Germany). However, in general most research related to values in mathematics education is focused on Asian countries.

2.7.1 EAST ASIAN MATHEMATICS EDUCATION VALUES

East Asian students consistently outperform Western students on international mathematics assessments, as shown with the Programme for International Assessment (PISA), and Trends in International Mathematics and Science Studies (TIMSS) (Mullis, Martin, Foy, & Hooper, 2016)). Similarly, cross-cultural comparisons within New Zealand, reveal students of Asian descent outperform all other cultural groups in mathematics (Caygill & Kirkham, 2008; Ministry of Education). International studies (e.g., Chiu, 2012; Hannula, 2012; Zhao & Singh, 2011) provide some explanations for this disparity including differences in motivation to achieve; extracurricular mathematics activities; influence of parental help, self-confidence in mathematics; or emphasis on effort. In conjecturing further, or alternative explanations for higher achievement of Asian students, some researchers argue that we should include greater consideration of differences in cultural and mathematics values (Hofstede et al., 2010; Seah & Andersson, 2015).

After reviewing the East Asian values literature (Law, Wong, & Lee, 2011; Lee & Seah, 2015; Lim, 2015; Zhang et al., 2016; Zhang & Seah, 2015) across all studies, the most consistently reported mathematical values included *achievement*, *effort,* and *practice*. For example, Lim (2015) found Malaysian students valued effective teaching and pedagogy which emphasised *practice* and *drill exercises*. Similarly, several research studies (i.e., Cao & Bishop, 2001; Lee & Seah, 2015; Lim, 2015) found students in Malaysia, mainland China, and Indigenous Taiwan all valued *effort* and *practice* as factors important for success in mathematics. Likewise, Cao and Bishop (2001) found Chinese students valued *effort*, and their *environment* (i.e., the teacher) as factors most important for success in mathematics, and a *lack of effort* for mathematical failure. Valuing *achievement, effort,* and *practice* by East Asian mathematics students is likely attributed to their Confucian values. Confucian values emphasise academic success can be achieved through effort and hard work as opposed to differences in ability, and educational success results in upward social mobility (Hofstede et al., 2010; Rao, Ng, & Sun, 2016). Valuing *effort* and *practice* may also be linked to school examination pressures in East Asian countries. Confucian cultures are highly examination orientated, where state examinations in China were established from the sixth century (Wong et al., 2012). Therefore, many, but not all East Asian mathematics teachers may emphasise valuing repetitive practice for examination success (Leung, 2006; Ng & Rao, 2008; Wong et al., 2012). To illustrate, a Malaysian student photographed drill exercises (that is, valuing *practice*), as a moment of effective mathematics learning/teaching (Lim, 2015), he responded to the photograph "Teacher gave us worksheets to practice…if those that the teacher photocopied are similar to the ones in examination, then we will know what to do" (translated) (p.10).

A high proportion of teacher directed mathematics values also appear in the reviewed East Asian values literature (Law et al., 2011; Lim, 2015; Zhang et al., 2016; Zhang & Seah, 2015; Zhao & Singh, 2011). With nearly two thirds of the reported mathematics values directly relating to teacher actions or qualities, for example, teacher *led activities, teacher creativity, explanations, strictness, board work, multiple methods,* and *humour*. Chinese mathematics classrooms are typically teacher centred as opposed to student centred, and a power imbalance exists between the teacher and students (Wong et al., 2012). Hofstede and colleagues (2010) term this a large power distance culture or classroom (see Table 1). Due to traditional Confucian values, Chinese teachers are treated with respect, and are expected to be more knowledgeable than their students (Ho, 1994). Teaching approaches are often centered around the teacher, focusing on the transmission of expert knowledge from teacher to student (Rao et al., 2016). From the reviewed East Asian literature, the consistency of teacher directed values, highlights the importance of the mathematics teacher for these learners.

2.7.2 WESTERN EUROPEAN AND AUSTRALIAN MATHEMATICS EDUCATION VALUES

It appears that there is limited research on students' mathematics values in Western cultures (W.T. Seah, personal communication, 20 March 2017). From Europe, there are three published studies exploring the mathematical values of students in Sweden (Österling & Andersson, 2013; Österling et al., 2015; Seah & Peng, 2012). Two studies (Österling & Andersson, 2013; Österling et al., 2015) reported Swedish students valued *memorisation/recalling facts,* which Österling argued may have been inculcated by the Swedish mathematics curriculum, which focuses around the textbook. However in contrast, the same students also valued deeper learning strategies such as *problem solving* (Österling & Andersson, 2013). Other mathematics values reported in these reviewed Swedish studies include, intrinsic values relating to academic behaviours, for example *effort/practice* and *concentration;* values relating to teacher actions/qualities, for example *teacher explanations, personalised help, quiet classroom, relaxing classroom, teacher strictness;* and values related to mathematical pedagogy, that is, *connecting mathematics to real life, independent* *working, fun lessons.* These Swedish students also espoused two collaborative learning values, that is, *sharing* and *collaboration.* Across the three reviewed Swedish studies, over 80 percent of the students' mathematics values, relate to independent learning, for example, *quiet classroom, independent working;* or teacher focused values, such as *personalised help*. These mathematics values reflect the Swedish students' individualist cultural values, and highlight the importance of independent and teacher centred learning for these students.

Values held by Australian mathematics students have been explored in three studies (i.e., Cao & Bishop, 2001; Seah & Barkatsas, 2014; Seah & Wong, 2012). Cao and Bishop (2001) compared Chinese and Australian students' attributions towards success and failure in mathematics. They found the Australian students valued the mathematical *task* itself and their *environment* (i.e., the teacher) as important for success in mathematics but *task difficulty* was attributed to mathematical failure. In comparison, the Chinese students perceived a *lack of effort* led to mathematical failure, suggesting Australian students value extrinsic factors (i.e., their teacher and pedagogy), as opposed to intrinsic/personal factors as important for mathematical success. Likewise, Seah and Wong (2012) also reported a high proportion of teacher directed mathematics values held by Australian students such as valuing teacher *explanations, certainty, clarification, hints, multimodal representations* and teacher worked *examples*. These Australian students also valued teacher centred pedagogical strategies, that is the availability of learning *resources,* mathematical and not exploratory *working,* and a *fun* classroom; as well as one collaborative value, *sharing*. Using the WiFi questionnaire, Seah and Barkatsas (2014) reported Australian primary students most valued: *achievement, open-endness, humanism* (*open-endness* and *humanism* relate to Bishop's (1988) mathematics discipline values), *relevance* and *information and communication technology (ICT)* for their mathematics learning. However, Seah and Barkatsas (2014) argued their predominantly migrant study sample may have impacted upon the value *achievement*, as new migrant parents typically put pressure on their children to succeed. Taken together, like the Swedish students, Australian students hold a high proportion of teacher directed and independent learning mathematics values, with only one value, *sharing,* directly relating to collaborative learning. These mathematical values reflect Australia's individualist cultural values.

To summarise the reviewed international values literature, the Swedish and Australian students frequently valued their teacher, and teacher centred pedagogy to facilitate effective mathematical learning and understanding. All but two, (that is *sharing* and *collaboration*) of the reported values related to independent learning strategies, with the values *independence, personalised help, concentration*, and *quietness* particularly focused on independent mathematics learning. The reviewed literature also shows East Asian students hold many teacher directed values. The dominance of these teacher directed and independent learning values may reflect the large power distance values of the Asian students, and individualist cultural values of the Australian and Swedish students (Hofstede et al., 2010). However, the East Asian students also consistently valued personal/internal factors as important for success in mathematics (that is, *achievement, effort, practice*). These were often valued for surface learning purposes, for example, examination success. In comparison, the mathematical values *effort* and *practice* were reported in one Swedish (Österling & Andersson, 2013) and no Australian research studies. Nevertheless, it can be challenging comparing values across the literature due to the inconsistencies in methodologies and ambiguity relating to the interpretation of values. For example, the mathematics values generated through interviews (e.g., Lee & Seah, 2015) may be very different to the values generated through questionnaires (e.g., Österling et al., 2015). Thus, to make valid cultural comparisons in mathematics values, consistent methodologies are required.

2.7.3 MATHEMATICS EDUCATION VALUES IN NEW ZEALAND

It appears that there are no studies specifically exploring the types of mathematics education values endorsed by learners in New Zealand. Nevertheless, there are several studies which provide some insight into valuing by New Zealand mathematics students. For example, Anthony (2013) explored students' perceptions about what it meant to be a "good" mathematics teacher and student. Anthony reported that students from a high decile (with predominantly Pākehā/European and Asian students) and a low decile (with a larger cohort of Pāsifika and Māori) school valued a "good" teacher as someone who *cared* about his/her students, and who provided *clear explanations*. In terms of perceptions about a "good student, Anthony found that students in the high decile schools endorsed predominately independent learning values (for example, *effort and practise*, and knowing *multiple strategies*). In contrast the students in the low decile school endorsed a greater proportion of collaborative values (for example, *sharing, mathematical communication*, *respect*). Likewise, several studies (i.e., Bills & Hunter, 2015; Hawk et al., 2002; Hunter & Anthony, 2011;

Sharma, Young-Loveridge, Taylor, & Hāwera, 2011) investigating Māori and Pāsifika perspective on learning experiences in the mathematics classroom, affirmed that Māori and Pāsifika mathematics students often endorsed collectivist orientated values, for example *respect* and *positive relationships* with peers/teachers*, reciprocity* and helping others*,* and *collaboration –group work* as important for their mathematics learning.

From the emergent findings in the reviewed New Zealand research, it appears that students from different cultures (for example Pākehā/European, Pāsifika and Māori) endorse alternative mathematics values, and these values may align with the students' individualist-collectivist cultural values.

2.8 SUMMARY

This chapter outlined the types of cultural and mathematics values which may be found in the mathematics classroom. The reviewed literature suggests students from different cultures hold alternative mathematics education values, which are likely shaped by differences in their cultural values. East Asian students tend to hold high power, and collectivist cultural values, whereas Pākehā/European hold low power and individualist cultural values. Due to their collectivist values, Māori and Pāsifika hold strong communal, relationship and family values. There is an increasing awareness that to facilitate equitable mathematics learning, particularly for indigenous and marginalised students, we must first recognise and attend to the values of the students. Despite this, there is a scarcity of values research in mathematics education, particularly outside Asia. Furthermore, it is unlikely the true breadth of student mathematical values can be captured solely through self-reporting surveys (Grootenboer & Marshman, 2015). Much of international values literature adopts a quantitative survey methodology, such as the WiFI research group, and therefore values interpretation is often guided by the researchers' perspective, rather than the perspective of the student. Considering this, more mixed methods and qualitative approaches are needed to allow for student voice to guide values interpretation.

CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

This chapter provides an overview of the theoretical underpinnings, methodological design, and methods used in this study. Section 3.2 justifies the reasons for using a mixed method approach. Section 3.3 details the theoretical framework of this study, including the epistemology, theoretical perspective, methodology, and methods. Section 3.4 explores the use of student voice in educational research. Section 3.5 discusses the role of the researcher and cultural considerations. Section 3.6 explores the research setting and sample. Sections 3.7 and 3.8 detail the research schedule, and how the qualitative and quantitative data were collected and analysed. Section 3.9 summarises how ethical standards were upheld throughout the study. Sections 3.10 and 3.11 describe the research limitations, and measures taken to ensure the research findings were valid, reliable, and trustworthy.

3.2 JUSTIFICATION FOR THE METHODOLOGY

The aim of this study is to compare the mathematics education values espoused by New Zealand middle school learners from different cultural groups, including Pākehā/European, East Asian, Māori, and Pāsifika.

After reviewing current literature, a mixed methods triangulation convergence design, with a comparative case approach, was deemed most suitable. Suitability was determined against the three criteria as follows. Firstly, values tend to be implicit, thus many children may find it challenging to make their mathematical values linguistically explicit. To address this, the study used a forced response quantitative survey component based on pre-established concepts and theories. Secondly, it appears that there are no research studies that have investigated mathematical values held by New Zealand students. Therefore, there is an exploratory qualitative component to this research. As values are deep personal convictions, it is important to also allow students to self-generate their mathematical values using an interview format. Thirdly, several prominent academics (e.g., Mertens, 2007; Tashakkori & Teddlie, 2003) advocate the use of mixed method approaches to address power imbalances and issues of social justice. As this study explores the values of students from indigenous and minority cultures, using a range of methods allows greater opportunities for those whose voice has typically been excluded, provides a more holistic approach, and allows for greater diversity of views. Lastly, a duality of research approaches combines the strengths and minimises the weaknesses of both qualitative and quantitative methodologies.

3.3 THEORETICAL FRAMEWORK

All research is based upon a theoretical framework, consisting of four basic elements depicted in bold in Figure 3.1 (Crotty, 1998), with each element being influenced by the element preceding it. Figure 3.1 summarised how each of these elements has influenced this study.

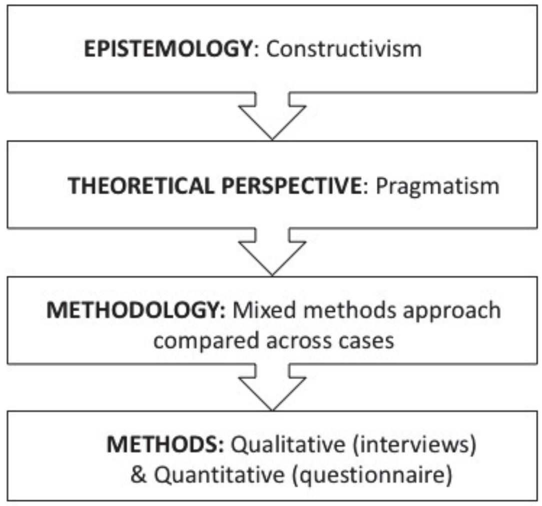

Figure 3.1. The four elements of a theoretical framework. Adapted from Crotty, (1998)

3.3.1 EPISTEMOLOGY

Research is based on paradigms, or assumptions about the world and what constitutes the nature of reality and knowledge (Barnes, McCreanor, & Huakau, 2008; Punch, 2014). This study is based upon the epistemological perspective of constructivism. Constructivism purports knowledge is not discovered, but constructed through the interactions of people and their world. This knowledge is socially and experimentally based, and depends upon the individual or group who holds it (Crotty, 1998). In this study, a constructivist approach can be applied to values and valuing. Values can be interpreted as clusters of knowledge or personal truths, created through internal psychological process and shaped by interactions of the learner with their world, that is, social, cultural, and societal influences.

3.3.2 THEORETICAL PERSPECTIVE

The theoretical perspective relates to the philosophical stance informing the chosen methodology. This study is influenced by pragmatism, an approach typically associated with mixed methods research that places an emphasis on the practical aspects of research, that is, what works best for answering the research question (Tashakkori & Teddlie, 2003). Pragmatism is inclusive and complementary, with researchers encouraged to find workable solutions regarding method selection and data analysis (Johnson & Onwuegbuzie, 2004). Pragmatism recognises the existence and importance of emergent social and psychological worlds, including culture, language, and subjective thoughts (Punch, 2014). Pragmatism fits with this research for the following reasons. Firstly, pragmatism (and a mixed methods approach) addresses concerns related to the difficulty of measuring values (Clarkson et al., 2000). As such, it addresses criticism of previous research that have focused on one method of data collection. Secondly, as values are a sociocultural construct, pragmatism recognises that realities are shaped by our social and cultural worlds.

3.3.3 METHODOLOGICAL DESIGN

This research adopts a mixed methods triangulation convergence design, with data compared across cases. This methodology is represented diagrammatically in Figure 3.2.

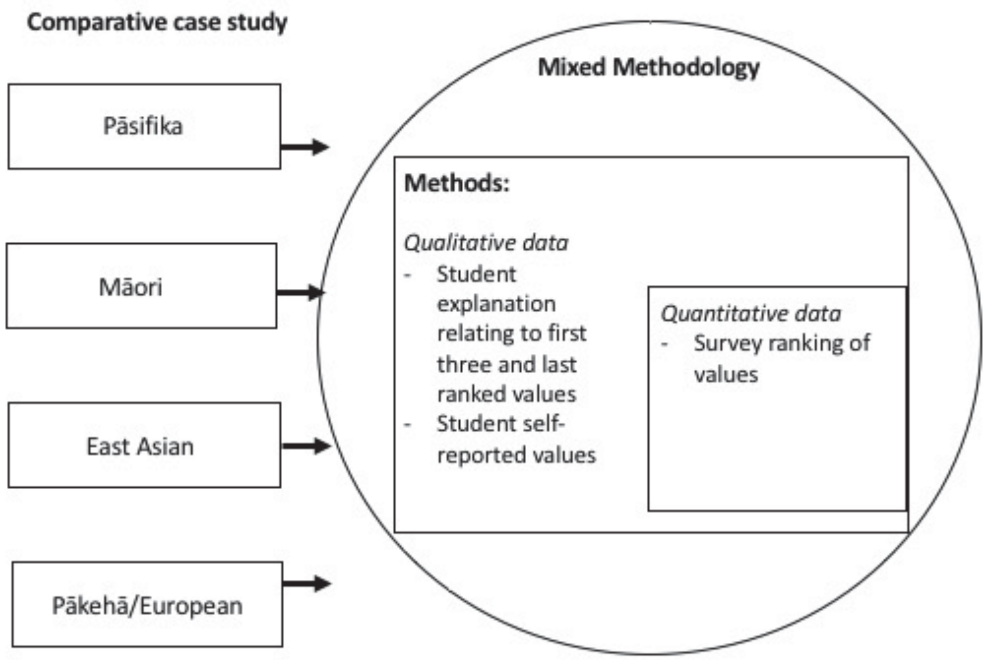

***Figure 3.2*.** Methodological design of this study

3.3.4 MIXED METHODS RESEARCH

According to (Creswell 2003) a mixed methods approach can be defined as a:

> Collection or analysis of both quantitative and qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve integration of the data at one or more stages in the process of research (p. 711).

The mixed methods triangulation convergence model aims to collect different but complementary data on the same topic (Morse, 1991). It is a one phase design, where qualitative and quantitative data are collected concurrently and with equal weight.

However, the qualitative and quantitative data are initially analysed separately for the same phenomenon. The results from both datasets are then converged (by contrasting and comparing the different results by case), and reported during the interpretation phase. The purpose of this model is to end up with valid and well substantiated conclusions about a single phenomenon (Creswell & Plano Clark, 2007).

A mixed method approach brings together the strengths and non-overlapping weaknesses of both qualitative and quantitative methods (Kington, Sammons, Day, & Regan, 2011). Qualitative research is an umbrella term, representing any research which is naturalistic and contextual. Qualitative methods collect and use descriptive data, focus on process as opposed to outcomes, utilise inductive analysis for theory building, and focus on meaning and participant perspective (Bogdan & Biklen, 2003). The analysis strives for depth of understanding (Merriam, 2009).

Quantitative research uses the collection and analysis of numerical data through mathematical methods to explain phenomena (Muijs, 2004). Quantitative methods focus on deduction, confirmation, theory or hypothesis testing, prediction, explanations, and standardised data collection (Onwuegbuzie & Leech, 2004). Quantitative research has many advantages, including larger sample sizes, possible generalisability beyond the participant group, and a repeatable design.

Because this study includes learners from a range of cultures, there is potential for cultural discrepancies to arise between researcher and participant. According to Tashakkori and Teddlie (2010) a mixed method design is appropriate for research situated across a range of cultural contexts in that the mixed method approaches can capture the range of macro- and micro-influences on human behavior (Schrauf, 2016). Furthermore, due to the duality of approaches, mixed methodologies allow for a greater diversity of views and opinions, an important component of cross cultural research.

3.3.5 COMPARATIVE CASE STUDY

Aiming to compare the mathematics education values held by learners from different cultural groups, the comparative case study design provides a holistic approach that enables one to preserve and understand the wholeness of the cases (Punch, 2014). Bounded cases of learners across four different sites (schools) within the natural school environment were defined by student ascribed ethnicity affiliations as Pākehā/European, East Asian, Māori and Pāsifika.

3.4 STUDENT VOICE AND PERSPECTIVE

Identifying student voice and perspective in education is a relatively recent enterprise (Rudduck & Flutter, 2000). Such research is supported by the United Nations Convention on the Rights of the Child (1989) which states:

> Parties shall assure to the child who is capable of forming his or her own views the right to express those views feely in all matters affecting the child, the views of the child be given due weight in accordance with the age and maturity of the child (Article 12).

Effective mathematics teaching and learning can be better understood by incorporating student perspectives (Hunter et al., 2016; Young-Loveridge, Taylor, Sharma, & Hāwera, 2006). Rudduck and Flutter (2000) argued that students are “expert witnesses” (p. 82) who should be consulted by teachers and schools. Authorising students’ perspectives can directly improve educational practices. In particular, when teachers listen to and learn from their students, it can help teachers enact pedagogies which are more accessible and relevant to their students (Cook-Sather, 2002).

Legitimising student perspectives also helps address power imbalances and inequity in mathematics classrooms (Bishop et al., 2009; Cook-Sather, 2002). For example, in a study in New Zealand classrooms, Bishop and colleagues (2003) found that students reported feeling more empowered when their voice was heard—in this case through student feedback surveys. As discussed in Chapter one, inequity exists for Pāsifika and Māori mathematics learners. To improve the mathematical outcomes for Māori and Pāsifika, we need to listen to their narratives and learn about and from their values. This study adds to the limited research investigating the mathematics education values espoused by these learners.

3.5 RESEARCHER ROLE AND CULTURAL CONSIDERATIONS

As this research comprised a duality of methods my role as a researcher was twofold. For quantitative research, the researcher’s role is theoretically non-existent because the participants act independently of the researcher to ensure research repeatability, and under the same conditions (Johnson & Christensen, 2008). For qualitative research, the researcher is considered the sole instrument for data collection and analysis (Merriam & Tisdell, 2016). For the qualitative component, my role was etic as opposed to emic, meaning I took on the role of an outsider from the participants, rather than an insider or a full participant in their daily activities or programs.

Researchers from the dominant culture (such as myself) typically presume their assumptions, activities, practices, and values are not cultural (Sue, 1999). However, when working with Māori, "non-Māori researchers must understand that their previously dominant role in research has been re-evaluated and they must position themselves accordingly" (Hāwera & Taylor, 2014, p. 153). Therefore, I had to familiarise myself with my own cultural values and biases, and recognise potential power imbalances between myself and the participants. For example, in line with my own cultural values, an interviewee who remains silent during an interview could be perceived as being disrespectful. However, for Māori and Pāsifika, their cultural values may contribute to these students feeling reluctant to engage in conversation with an unknown interviewer of different ethnicity to themselves (such as myself). Because for Maori and Pasifika people, trust and positive relationships are developed over time and are necessary for successful and meaningful discussions (Cook-Sather, 2009).

Most literature by non-Māori/Pāsifika researchers focuses on research findings, rather than telling the story of Māori and Pāsifika peoples. Barnes and colleagues (2008) argue that to minimise power imbalances, the researcher must subsume a more consultative role or position. To encourage this consultative position in this study, I have incorporated interview methods. Quantitative consultation, however, can be more problematic, as tools are pre-selected by the researcher, and surveys are often incorrectly perceived to be value free (Barnes et al., 2008). To ensure my survey was culturally responsive in terms of Māori and Pāsifika values, I consulted with a supervisory team who are of Cook Islands descent. I also included survey tools which specifically addressed, and included Māori and Pāsifika collectivist values as outlined in policy documents, including family, love, inclusion, reciprocity, respect, love, relationships and belonging (MoE 2011, 2013b).

3.6 THE SETTING AND STUDY SAMPLE

This research was conducted during term four in the 2016 school year, within four Auckland schools: Anytown (decile one), Daceyville (decile one), Frankton (decile one), and Summerville (decile nine)[1,2]. Students' attending the decile one schools live in predominately low socioeconomic (SES) Pāsifika communities. Students' attending Summerville live in predominately high SES communities, and are predominately Pākehā/European and Asian ethnicities.

The three decile one schools (Anytown, Daceyville and Frankton) were participating in the Developing Mathematical Inquiry Communities (DMIC) programme (Hunter, Hunter, & Bills, in press). DMIC is an equity-focused approach to teaching and learning mathematics, with the intention of accelerating Pāsifika and Māori students

[1] Each school has been assigned a pseudonym

[2] Each state and integrated school is ranked by decile, from one to ten. Deciles indicate to extend to which a school draws students from low-socioeconomic communities. The lower the decile, the lower the socioeconomic status of the school, and the more funding it receives.

mathematical performance. As part of this programme, students were arranged into heterogeneous collaborative groupings. Mathematics lessons focused on developing students' conceptual understandings of the big important ideas in mathematics, through carefully designed activities which incorporated key concepts and misconceptions the students were likely to bring to their learning. Mathematical activities were designed to be cognitively demanding and students were given multiple opportunities to question, inquire and engage in mathematical practices (for example, explaining, justifying and mathematical debates). At the time of data collection, Daceyville was in its third year of the DMIC programme, Anytown and Frankton were in their fifth year.

At the time of the study, the Summerville classrooms were loosely following the New Zealand Numeracy Project (MoE, 2009), with certain aspects adapted to suit the needs of the teachers and students. Students were grouped into ability groups (based on the achievement of specific goals) within their own classes. Mathematics lessons involved some elements of teacher demonstration of strategies along with students being given targeted mathematical goals. Students usually worked independently, or within small groups to achieve these goals and frequent teacher assessment of individual students was undertaken to ensure the students' targeted mathematics goals had been achieved.

3.6.1 DEMOGRAPHICS

In total, 227 middle school students (Years seven and eight) participated in the study with the demographic data summarised in Table 3.1. For the purposes of this study students were allocated to a specific cultural group based on self-reported ethnicities and the Ministry of Education (2014a) Ethnic Codes (Level 1). Cultural groups included: Pāsifika (all Pacific island ethnicities including Tuvaluan, Fijian, Niuean, Tongan and/or Samoan), Māori, Asian, and Pākehā/European. To minimise cultural group ambiguity, two students who identified as both Māori and Pāsifika, and two students who identified as Māori, Pāsifika and Asian were omitted from the study. Additionally, to align with the published values literature, only East Asian students were included (that is China, Korea and Japan), with seven South Asian students (that is Indian, Pakistani and Sri Lankan) omitted.

Table 3.1. Demographic data for each cultural group

Students per Cultural Group (*n*)	**Students per School (*n*)**	**Total Class-Rooms (*n*)**	**Students per Ethnicity (*n*)**	**Per Gender (*n*)**		**Per Year Group (*n*)**	
				M	**F**	**Yr 7**	**Yr 8**
Pāsifika (131)	A (32) D (67) F (29) S (3)	17	Cook Islander (19), Samoan (69), Tongan (24), Niuean (4), Mixed Pāsifika (15)	57	74	65	66
Māori (41)	A (25) D (12) F (3) S (1)	10	NZ Māori (41)	24	17	19	22
Pākehā/ European (30)	A (1) D (0) F (0) S (29)	5	French (1), South African (2), Australian (3), United Kingdom (1), NZ European (23)	16	14	14	16
Asian (25)	A (0) D (1) F (0) S (24)	6	Chinese (15), Japanese (1), Korean (9)	15	10	12	13

Note, schools are A=Anytown; D=Daceyville; F=Frankton; S=Summerville. Mixed Pāsifika included students who identified with two or more Pacific ethnicities

3.7 DATA COLLECTION AND RESEARCH SCHEDULE

This research followed a mixed methods triangulation convergence design, consisting of a single phase of data collection over a two-month period (November to December 2016). All schools and students provided consent to participate in the study prior to data collection. From each school, whole classes of students were invited to participate. Data collection involved three processes, firstly, a single interview question was used with individual students to probe naïve mathematics value responses. Secondly, students completed a mathematics education values survey. Thirdly, individual students elaborated on why they had selected their first three (or most important) values, and the last (or least important) value in the survey.

3.7.1 QUANTITATIVE SURVEY

Due to their implicit nature, values can be difficult to make linguistically explicit. As Clarkson and colleagues (2000) contend, even adults have difficulties conveying the values they hold, due in part, to differences in how people define and interpret the term 'value'. Moreover, it can be challenging to engage in a shared vocabulary between researcher and participant, particularly relating to specific categories of values. To circumvent these language difficulties, this study incorporated a forced response survey that directed students' attention to pre-specified mathematics education values. It was hoped that the inherent reliability of the survey methods would allow the research to make generalisations about the population sampled (Clarkson et al., 2000).

The survey (Appendix C) instructed students to rank twelve different mathematics education values in order of their importance: from one being most important for the student, to twelve being the least important. The students were provided with the following instructions:

> *When you're doing maths, which of these statements do you feel are most important for you? Please number all the statements in order of their importance, from one to twelve. The statement that is the most important for you, put a number one next to it, the second most important put a number two next to it, and so on, all the way down to number 12 which is the least important*

As children may find it difficult to relate and respond directly to particular values, each value was incorporated into a specific mathematical learning activity or statement. For example, the statement "to be good at maths I need to practise with lots of questions" was assessed to indicate the value of *effort and practice* in mathematics. Whereas, "I learn more in maths by working with other children" was assessed to indicate the value of *collaboration-group work*.

In the study by Österling and Andersson (2013) value statements were used to indicate the three value dimensions as shown in Figure 3.3. However, unlike Österling and Andersson (2013), this study focused on mathematics education values and cultural values, and not mathematics discipline values. The reason for this choice was because mathematics education and cultural values more closely reflect the personal and cultural learning preferences of both teachers and students (Seah, 2016), and thus understanding these values would more likely have direct implications for effective mathematics learning.

Nine of the twelve mathematics education values (that is, *collaboration-group work*, *collaboration-communication, mathematical clarity, teacher explanations, effort/practice, persistence, accuracy, flexibility*, and *utility*) were drawn from the literature reviewed in the previous chapter. Five of the twelve values also reflected Māori and Pāsifika collectivist values (that is, *collaboration-group work*, *collaboration-communication, respect, belonging, and family*).

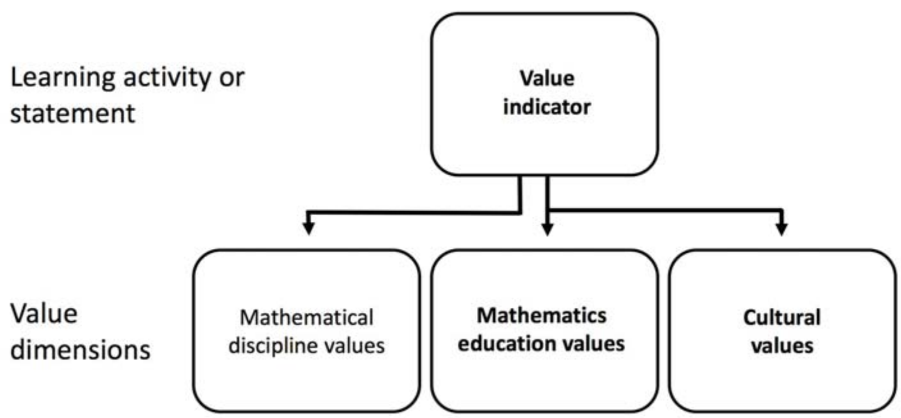

Figure 3.3. Use of learning activity or statement to indicate value dimensions (Österling & Andersson, 2013)

3.7.2 QUALITATIVE INTERVIEWS

Interviewing is necessary when it is difficult to observe behaviour, feelings, or how people interpret their world (Creswell, 2009). As reviewed in the previous chapter, values are implicit and internalised, therefore value driven behaviour is often difficult to measure. In contrast to surveys, interviewing is one way to obtain student voice and perspective.

For successful discussions, particularly with Māori and Pāsifika students, a positive relationship between researcher and student is paramount (Bishop et al., 2009; Cook-Sather, 2002). To build a sense of rapport, time was allocated at the beginning of the interviews to engage in general conversation and introductions (*mihimihi*) with all the students.

After the introductions, and prior to the survey, the students were asked to discuss their mathematics education values (Question 1), that is, *what things are important to you in your maths lessons*? A similar version of Question 1 was used by Österling and Andersson (2013) to investigate Swedish students' mathematics values. Question 1 was administered prior to the survey, as following pilot testing it was suspected that the survey was influencing students' responses, such that, the students were choosing values listed on the survey.

The purpose of Question 1 was to assess the validity of the survey. If majority of the values overlapped—that is the self-generated values from Question 1 aligned with values in the survey—this would indicate that the survey was validly measuring the students' mathematics education values.

After the survey was administered the students were asked to elaborate on why (Question 2) they chose the first three (or most important) values and the last (or least important) value. Question 2 was intended to address the lack of student perspective guiding values interpretation noted in previously published survey research (e.g., Seah & Barkatsas, 2014).

Question 1: *What things are important to you in your maths lessons*?

Question 2: *Why did you rank these* (value statements) *as the most and least important?*

3.8 DATA ANALYSIS

3.8.1 QUANTITATIVE ANALYSIS

Results from the survey were exported into Statistical Package for Social Scientists (SPSS) in order to investigate the statistical relationships among variables. From 227 participants, 219 (96.7%) completed the survey. The independent variables were cultural group, and school decile rating. The dependent variable was the students' value rankings/responses. As the survey consisted of ordinal ranked data, non-parametric statistical tests were used. Kruskal-Wallis tests determined if students' value rankings significantly differed across the four cultural groups. Where differences were statistically significant, further testing was undertaken using Mann-Whitney tests. The Mann-Whitney test, a non-parametric alternative to the independent sample t-test, compares sample means for ordinal data. Results were all controlled for Type 1 errors using a Bonferroni adjustment. Effect sizes (r) were also calculated, and using Cohen (1988) criteria judged to be a small effect for r =0.1; medium effect r =0.3, or large effect r =0.5. The strength of a correlation was measured using Spearman's coefficient. A value of zero denotes no relationship, the closer it is to -1 or 1 the stronger the relationship (Pallant, 2011).

3.8.2 QUALITATIVE ANALYSIS

Interview data were wholly transcribed and exported into NVivo software. NVivo manages qualitative data through recording, sorting, matching, and linking data to assist in answering research questions (Bazeley & Jackson, 2013). Interview data were coded into descriptive nodes. For example, the student response: "a clear understanding and making sure I am listening to my teacher", was coded into the nodes *clarity and understanding* and *respect* (see Section 4.3 for examples of responses coded at each node). The majority of these nodes were interpreted as the mathematics education values held by the students. A small quantity of nodes which did not reflect mathematical education values, for example they reflected attitudes, were excluded from the findings.

3.9 ETHICAL CONSIDERATIONS

This research was designed and conducted in accordance with the Massey University (2016) code of ethical conduct. An information statement and consent form was emailed to all school principals. The principals oversaw the distribution to middle school staff, who verbally and voluntarily consented to participate. Once the teachers had agreed, students were invited to participate. As all students were under the age of fifteen years old, consent was also obtained from the students' parent/s or guardian (see Appendix A and B for all ethics forms).

Prior to engaging in the survey/interviews, across all the classes for participating teachers, students provided verbal assent to the researcher. Once again, the students were reminded they could withdraw from the study at any time without prejudice. Students were informed the interviews would be voice-recorded, and they provided verbal consent for recording to occur.

Sensitivity to social and cultural issues was always observed, and for Māori and Pāsifika students I provided a brief introduction (*mihimihi)* prior to any data collection. Confidentially was upheld, through the anonymisation of all data. All names were withheld, and data sheets were identified by a participant identification number, school and class name, gender and ethnicity of each participant.

3.10 VALIDITY AND RELIABILITY

Validity can be interpreted by the question: "How well does the data represent the phenomena for which they stand?" (Punch, 2014, p. 321). In this study, validity concerns: How well does the quantitative and qualitative data measure the mathematics education values held by students from different cultures*?* Internal validity refers to the internal consistency or logic (Punch, 2014). For quantitative research, this typically asks if the data or instrument, is measuring what it is supposed to (student values). For the qualitative component, it is asking if the research findings match with reality.

The literature review highlighted the debates and terminological ambiguity pertaining to the values construct. Moreover, many researchers highlight the difficulty of “measuring immeasurable values” (Österling & Andersson, 2013, p. 1). To ensure that what I was measuring were indeed student values (as opposed to another affective dimension) I used the criteria developed Seah and Peng (2012), where they continually asked themselves: “Does this express what is being regarded as important here?” (related to values), “Am I satisfied this is not an expression of likes or dislikes?” (related to attitudes), “Am I satisfied that this is not a reflection of what is considered to be true or correct?” (related to beliefs) (p. 75). As noted above, this steered the decision to omit a small number of qualitative responses which reflected beliefs or attitudes, rather than values.

The Internal validity of the questionnaire was also strengthened by including value statements/indicators from peer reviewed values literature (e.g., Seah, 2016). Quantitative surveys have the benefit of directing attention to specific values of interest, ensuring only values are being measured. Furthermore, following the survey, “member checking” (Punch, 2014, p. 241) with the student responses to Question 1 confirmed that the students were ranking their values correctly. Across the qualitative and quantitative data, the degree of values overlap, (that is, the overlap of self-generated and surveyed values) was also used to assess the validity of the survey.

External validity refers to the generalisability or transferability of the research findings to other people in a wider population (Punch, 2014). Generalisability presents a common challenge in educational research as the variable effects of different classrooms, teachers, schools, and communities are almost impossible to control. Further, much educational research focuses on case studies with some critics arguing cases cannot be generalised (Tellis, 1997). As this study combined a large and diverse research sample (*n*=227 across four schools), with rich and descriptive data (mixed methods triangulation design), the possibility of generalising to similar contexts within New Zealand is available (Merriam & Tisdell, 2016; Muijs, 2004).

Reliability, or trustworthiness, refers to the comprehensiveness and accuracy of the research. This represents either consistency over time (stability) or internal consistency (items are consistent with one another) (Punch, 2014). In this study, questionnaire and interview items were mostly derived from previously validated and published values questionnaires (for example, the what I find important [WIFI] in mathematics survey (Seah & Wong, 2012)). Lastly, a mixed method triangulation design ensured trustworthiness was maximised as multiple sources of data provided wider and deeper perspective to alleviate bias arising from a single data source.

3.11 LIMITATIONS OF THE RESEARCH

Despite efforts to ensure validity and reliability, the study is not without limitations. The study limitations concerned potential language barriers, a lack of randomisation with the questionnaire, and the confounding effects of SES and classroom DMIC experience. Regarding language barriers, many students included in the study were English language learners. Despite the survey and interview being constructed with student friendly, age appropriate language, a small number of students reported reading and language difficulties. In such instances, these student responses were excluded from the study. However, as reading ability was not assessed, there was no certainty that all students experiencing language difficulties were excluded.

Another limitation was the lack of randomisation within the ranking survey. With each student receiving the same values survey there was a risk that items listed last were also ranked as least important. However, a retrospective correlational analysis revealed no significant correlation between the order the item was presented, and the student value ranking (r = -.11, n = 14, p = .7).

In terms of SES, Pāsifika and Māori students are more likely to attend lower decile schools, compared to students of Pākehā/European and Asian ethnicities (Ministry of Education, 2016). This was reflected in the current study, where Pāsifika/Māori and European/Asian students attended predominantly decile one and nine schools respectively. Therefore, challenges arise separating the impact of culture with SES. Consequently, it could be questioned whether the mathematics education values measured in this study are a reflection of the students' cultural group, or of their SES, or a combination of both? From the results, the same values differed significantly by both the school decile ranking, and by the culture of the students. However, as mathematics achievement, ethnicity and SES are highly correlated in New Zealand (Caygill, Marshall, & May, 2008), it can be difficult disentangling these effects.

Lastly, in investigating the mathematics education values held by students from different cultural/ethnic groups, a limitation of this study was the unaccounted impact of classroom experience on students' mathematics education values. In this study, the majority of the Pāsifika and Māori students were participating in the DMIC programme, whilst the Pākehā/European and Asian students were not—thus confounding the mix of SES and programme type with cultural values. Therefore, the impact of classroom experience, in addition to cultural values on students' valuing in mathematics cannot be discounted. For example, it is unclear the extent to which the reported Pāsifika and Māori students' mathematics education values were a reflection of their cultural values, their classroom norms endorsed by the DMIC programme, or a combination of both. In a research study of this scope the variable effects of classroom experience are difficult to distinguish.

3.12 SUMMARY

A mixed methods comparative case study was selected as the most appropriate design for this study. To explore the values held by learners from different cultures, multiple sources of data were collected through a survey and interviews. Reliability and validity were maintained through clear documentation of the data, and triangulation of multiple datasets. Ethical principles were adhered to throughout the study to minimise risk of harm or breach in confidentiality of the students. The findings of this study are reported in Chapter Four.

CHAPTER FOUR

FINDINGS

4.1 INTRODUCTION

This chapter reports on the types of mathematics education values espoused by middle school learners from different cultures. Section 4.2 reports the quantitative and qualitative results based upon the survey. Section 4.3 summarises the quantitative data, looking at overall cultural differences. Section 4.4 explores the qualitative interview results.

4.2 SURVEY RESULTS

The aim of the survey was to determine what students valued as important during their mathematics lessons. Students were instructed to rank twelve statements in order of their importance, from one to twelve, with each statement representing a different mathematics education value. Follow up interviews were used to interrogate the students' reasons for ranking specific values as most and least important. As the survey incorporated ranked ordinal data, modes were used to determine the degree of importance of each mathematics education value. The mode provides an indication of the most common or frequent ranking for each of the twelve values. For the purpose of organising the discussion of results, each of the modes were transposed (for example, mode 12 was transformed to mode 1, mode 11 transformed to mode 2 etc.), so graph length represented level of importance, with longer bars indicating mode ranking was more important than shorter bar lengths.

The following criterion was used to describe the level of importance of the value: the "most important" value category corresponded to modes 9 to 12, the "medium importance" category corresponded to modes 5 to 8, and the "least important" category to modes 1 to 4. For example, across the combined group of respondents the mode rating for *respect* was 8, or the "medium importance" category. When compared across cultural groups, the mode ranking for *respect* was 5 for the Pākehā/European representing "medium importance", 3 for Asian or "least important", 12 for Māori or "most important", and 5 for Pāsifika or "medium importance" (see Figure 4.1).

4.2.1 OVERALL VALUE MODAL RANKING

Figure 4.1 shows the overall mode ranking for each of the twelve mathematics education values listed in the survey. Across cultures, the values with the lowest (least important) and highest mode rankings (most important) are summarised in Table 4.1.

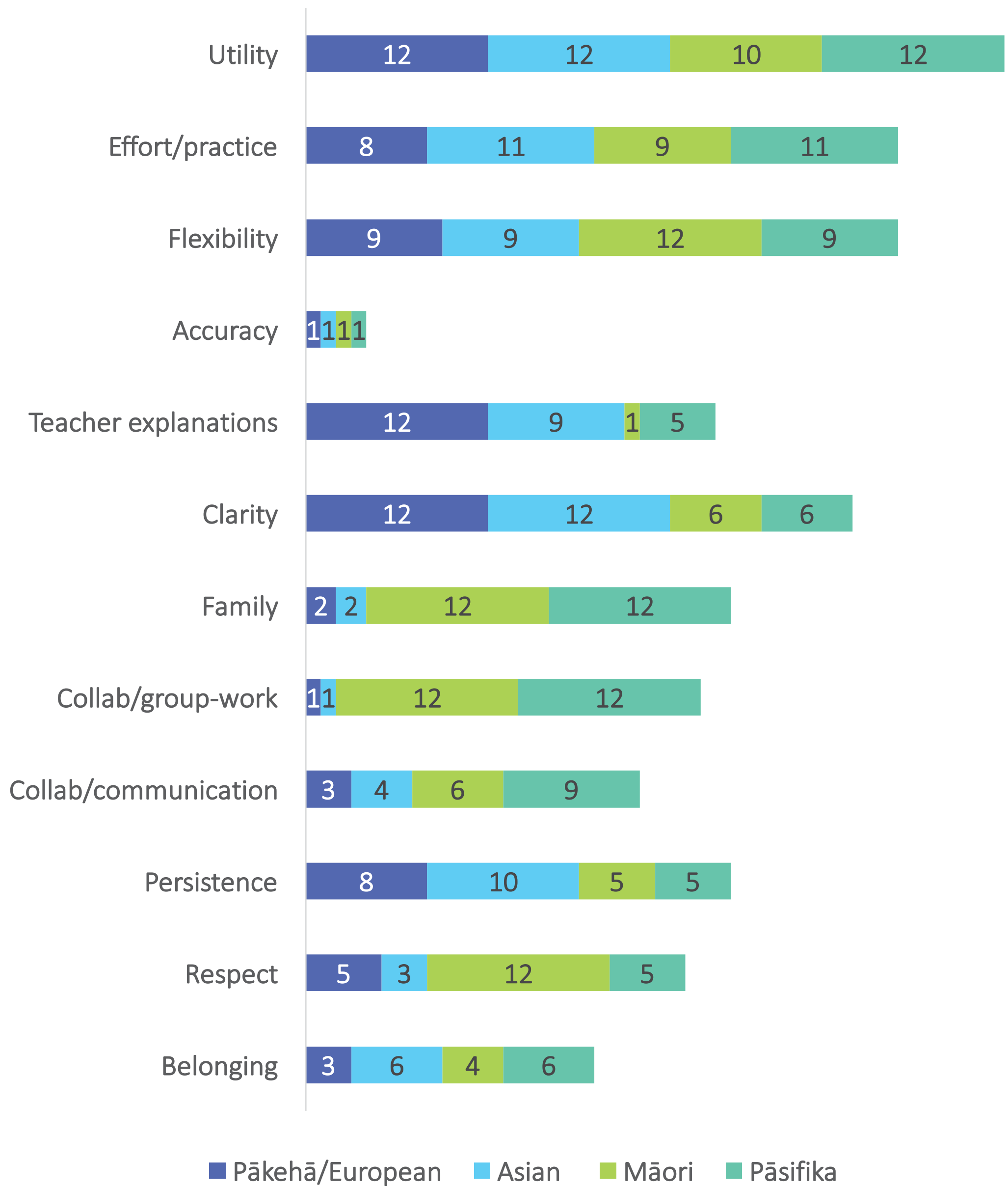

Figure 4.1. Overall modal ranking for each mathematics education value. Note, modes 1-4 = "least important" category; modes 5-8 = "medium importance" category; modes 9-12 = "most important" category

Table 4.1. Summary of the most important and least important mathematics education values across cultural group.

Cultural Group	Most Important Values by Mode Ranking (mode/s)	Least Important Values by Mode Ranking (mode)
Common to all Cultures	Utility (10-12) Flexibility (9-12) Effort/practice (8-11)	Accuracy (1)
Pākehā/ European	Utility (12) Clarity (12) Teacher explanations/clarity (12) Flexibility (9)	Accuracy (1) Collaboration/group work (1) Family (2) Collaboration/communication (3) Belonging (3)
Asian	Utility (12) Clarity (12) Effort/practice (11) Flexibility (9) Teacher explanations/clarity (9)	Accuracy (1) Collaboration/group work (1) Family (2) Respect (3) Collaboration/communication (4)
Māori	Family (12) Flexibility (12) Collaboration/group work (12) Respect (12) Utility (10) Effort/practice (9)	Accuracy (1) Teacher explanations/clarity (1) Belonging (4)
Pāsifika	Utility (12) Family (12) Collaboration/group work (12) Effort/practice (11) Flexibility (9)	Accuracy (1)

4.2.2 IMPORTANT MATHEMATICS EDUCATION VALUES ESPOUSED BY ALL MIDDLE SCHOOL STUDENTS

Table 4.1 shows students from all cultural groups most frequently ranked the values *utility, effort/practice* and *flexibility* in the "medium importance" to "most important" categories (modes 8 to 12). All students most frequently ranked the value *accuracy* in mathematics in the "least important" category (all mode 1).

UTILITY VALUE OF MATHEMATICS

The statement *"It is important for maths to be useful in real life or for my future"* was used as a value indicator for the mathematics education value of *utility.* Figure 4.2 shows students across all cultures ranked this value as "most important" (modes 10 to 12). For *utility*, a Kruskal-Wallis revealed no statistically significant difference in the value rankings of *utility*, across the four cultures. That is in practice, the assigned rankings categories confirmed agreement across cultures of the importance of *utility*.

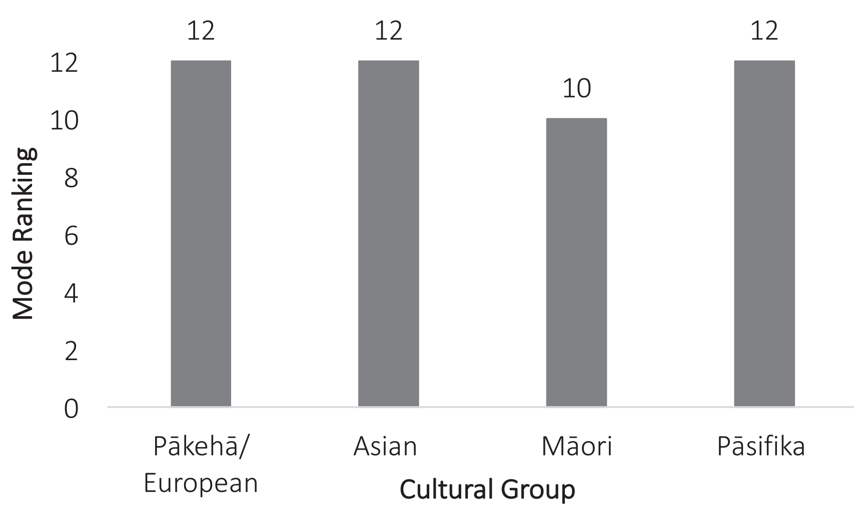

Figure 4.2. *Utility* overall modal ranking

Students in all cultures considered the *utility* of mathematics to be in the "most important" category, and for similar reasons, that is for career or future success, or utility of mathematics for everyday activities (for example., cooking or shopping) (*n*=107 students):

- Claire[3] (Pākehā/European female): *Because you always need it in everyday life, in my Dad's job he needs to use it every day and we're doing renovations at our house and using maths to calculate how big the area is.*
- Catherine (Pākehā/European female): *Because if you're learning it and you're never going to use it then what's the point of having it at all?*
- Liu (Asian male): *Because I really want to become a pilot and my father and mother told me that you need to know a lot of maths to become a pilot so I'm working hard.*

Liu's statement also suggests *utilitarian* mathematics education values can be influenced by the values held by parents.

- Evan (Māori male): *Most jobs probably involve maths so it will be important for it to be in my life.*
- Manutai (Pāsifika male)*: Because like if we go to the shopping market I can know how to use my maths*

For these students, it was important mathematics learning had a purpose. They perceived mathematics should be useful for the present or future.

[3] All names are pseudonyms

VALUING EFFORT AND PRACTICE IN MATHEMATICS

The statement *"To be good at maths it is important that I practise with lots of questions"* was used as a value indicator for the mathematics education value of *effort/practice.* Students across all cultures ranked this value within the "medium importance" or "most important" categories (Table 4.1). Figure 4.3 shows Asian, Māori and Pāsifika students most frequently ranked *effort/practice* in mathematics as "most important" (modes 9 to 11), whereas Pākehā/European ranked *effort/practice* with "medium importance" (mode 8). A Kruskal-Wallis Test revealed no statistically significant difference in the value rankings of *effort/practice*, across the four cultures. That is in practice, the assigned rankings categories were not able to distinguish levels of importance; rather the rankings confirmed agreement across cultures of the importance of *effort/practice*.

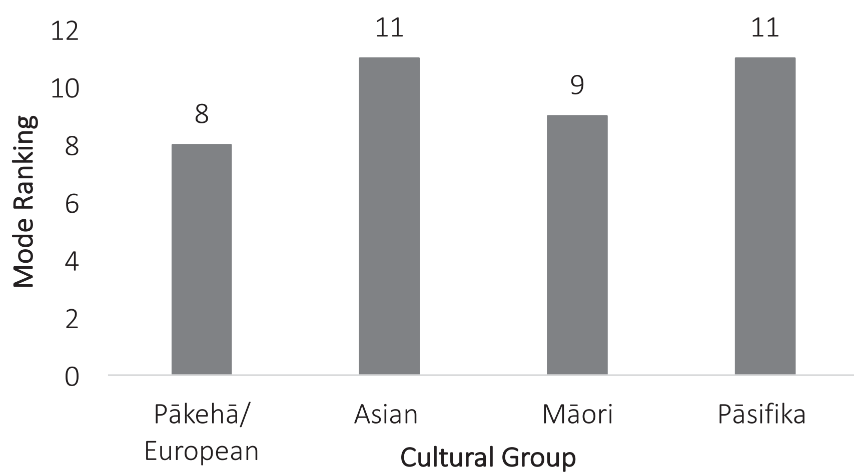

Figure 4.3. Effort/practice overall modal ranking

Students in all cultures valued *effort and practice* in mathematics as it facilitated progression/improvement (*n*=54 students) and aided memorisation (*n*= 8 students):

- Luke (Pākehā/European male): *If you practise lots at something like sport you get really good at it, it is just the same at maths. If you do maths lots then you get it more*
- Daisy (Asian female): *So it like buries deep in your brain I suppose so you can remember it more for later on.*
- Jordan (Māori male): *Because practising more questions will get you into the goals that you want to be in for maths.*
- Lloyd (Pāsifika male): *Practising your maths makes you a better maths.*

Across cultures, students perceived that success and understanding in mathematics was achieved through hard work and practice. Many of these students used the phrase "practice makes perfect" in relation to their mathematics learning.

FLEXIBILITY VALUES

The statement *"Maths involves looking for different ways to find the answer"* was used as a value indicator for the mathematics education value of *flexibility with strategies.* Figure 4.4 shows students in all cultures ranked this value as "most important" (modes 9 to 12). A Kruskal-Wallis Test revealed no statistically significant difference in the value rankings for *flexibility*, across the four cultural groups.

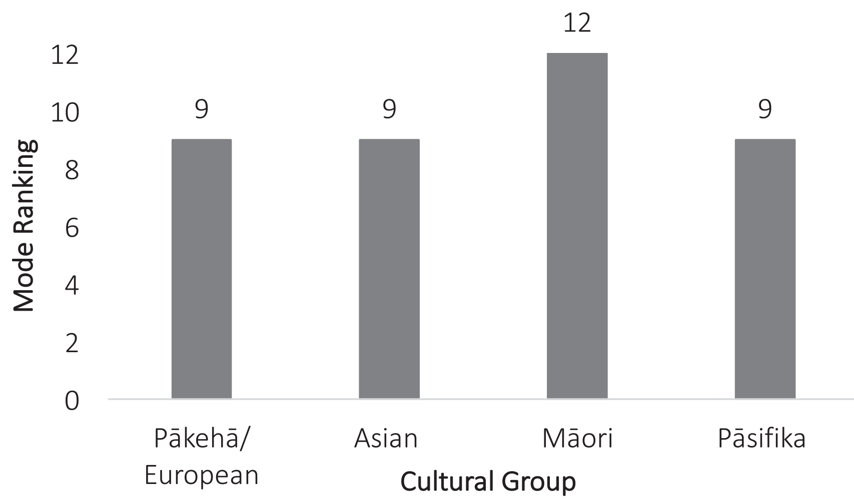

Figure 4.4 Flexibility overall modal ranking

Many students felt it was important to have *flexibility* with strategies, because knowing multiple strategies assisted with learning, mathematical clarity, and problem solving (*n*=50 students):

- Frankie (Pākehā/European female): *If you just attack it from one way it may not be able to be captured and then you have to go other ways and then you surround it and get the answer.*
- Rita (Asian female): *Because if you go with one strategy then it might get slightly confusing sometimes*
- Kaia (Māori female): *Because that way you have more than one strategy so you can do different ways and if one way doesn't work you have another strategy to back it up.*
- Carl (Pāsifika male): *Because I want to look for different answers because I have class mates who don't really understand other things so I want to help them*

understand the different ways and so that I can understand it my way and they can understand it another way and I could explain it to them.

Carl's statement alludes to multiple values, suggesting he valued *flexibility* with strategies as a means to fulfil his collectivist cultural values (MoE 2013b), that is, *reciprocity* and *relationships*. These students valued opportunities to learn different mathematical strategies. Many believed having a bank of strategies to call upon made it easier, or quicker for them to solve mathematical problems.

ACCURACY VALUES

The statement *"It is important to get the correct or right answer in maths"* was used as a value indicator for the mathematics education value *accuracy.* From Figure 4.5, across all cultures, *accuracy* was ranked as "least important" (all mode 1). A Kruskal-Wallis Test revealed no statistically significant difference in the value rankings of *accuracy*, across the four cultures.

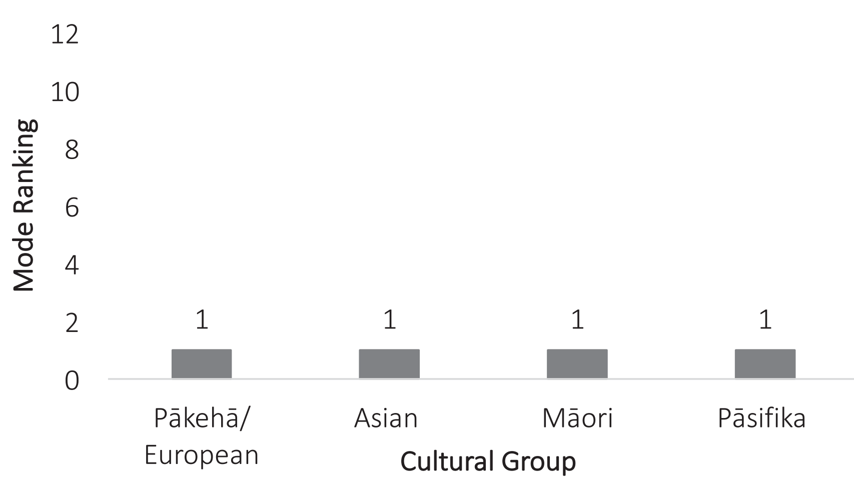

Figure 4.5. Accuracy overall modal ranking

The value *accuracy* was considered the least important by students in all four cultural groups, and for similar reasons. These students emphasised making attempts in mathematics, and learning from their mistakes rather than accuracy (*n*=77 students):

- Michael (Pākehā/European male)*: When you get the answer wrong you're just learning from your mistakes it doesn't really matter if you get it right or wrong.*
- Mei (Asian female): *You can always make mistakes in maths because the main thing is just to keep learning and progressing forward, so to get the correct or right answer is important but it's not as important as learning*
- Cody (Māori male): *I don't think it's about the answer it's about the journey to get the answer*
- Nadia (Pāsifika female)*: Everyone makes mistakes but it is not all about getting the right answer it is about how you got to the answer.*

It is evident, students in all cultures do not believe it is important to always get the answer correct in mathematics, instead they value attempting to solve mathematical problems and demonstrating their mathematical knowledge.

4.2.3 DIFFERENCES IN MATHEMATICS EDUCATION VALUES ACROSS CULTURAL GROUPS

Table 4.1 shows students from different cultures considered different values to be most and least important, and in some cases quite markedly. For example, the value *teacher explanations* were ranked as most important by Pākehā/European (mode 12), yet least important by the Māori students (mode 1). *Family* was ranked as most important by the Pāsifika and Māori (mode 12), yet least important by the Pākehā/European and Asian students (mode 2). The value c*ollaboration/group work* was ranked as most important by Pāsifika and Māori (mode 12), yet least important by Pākehā/European and Asian students (mode 1).

TEACHER EXPLANATIONS/CLARITY VALUES

The statement, *"It is important that my maths teacher explains it to me properly so I understand"* was used as a value indicator for the mathematics education value of *teacher explanations/clarity.* Figure 4.6 shows Pākehā/European and Asian students frequently ranked *teacher explanations* as "most important" (mode 12), whereas Māori and Pāsifika students most frequently ranked the value as "least important" (mode 1) and with "medium importance" (mode 5) respectively. A Kruskal-Wallis Test revealed a statistically significant difference for this value, across the four cultures (Pākehā/European: *n*= 30, Asian: *n*=25, Māori: *n*=41, Pāsifika: *n*=131), χ^2 (3, *n*=227) U= 21.56, *p*=.000. To determine which cultures significantly differed from one another, post-hoc Mann-Whitney U Tests, with Bonferroni adjusted alpha values of .025 (.05 divided by 2 groups) per test were used. Mann-Whitney U Test revealed no significant differences between Māori and Pāsifika, or Pākehā/European and Asian students for this value. A significant difference was found for *teacher clarity,* between Māori/Pāsifika (Māori: *Md*=8.08, *n*=41, Pāsifika: *Md*=6.95, *n*=131) and Pākehā/Asian students (Pākehā: *Md*=4.33, *n*=30, Asian: *Md*=5.16, *n*=25), $U > 299$, $z > -3.7$, $p < .022$, with effect sizes ranging from $.2 < r < .4$. These represent small to medium effect sizes.

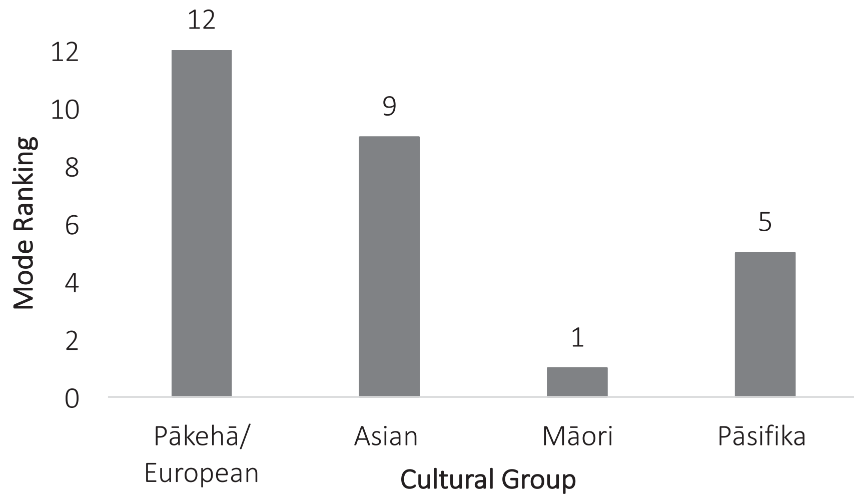

Figure 4.6. Teacher explanations/clarity overall modal ranking

The Pākehā/European and Asian students ranked *teacher explanations/clarity* as one of their “most important” mathematics education values. These students often looked to their teacher as the mathematical authority in the classroom and relied on the teacher to provide clarity and understanding (*n*=24 students):

- Anna (Pākehā/European female): *If I don’t understand it then I don’t know how to learn it because some students don’t know it either and they find it hard to explain and a teacher is supposed to teach you what you’re doing and if I don’t understand it then I probably won’t be able to figure out that question either.*

Anna felt explanations from her teacher were more helpful than explanations from her peers. One student asserted that it was important their teacher knew the mathematical content well:

- Kane (Pākehā/European male): *Because if the teacher doesn’t do it properly it will become a mistake*

Several (*n*=3) students associated teacher clarity with their own performance in tests.

- Simon (Pākehā/European male): *If my teacher doesn't explain it properly then I won't learn that and when I'm in a test I can't remember it or it hasn't been fully practised and so in the test I don't really do that well.*
- Crystal (Asian female): *If I don't understand it and my teacher just give me something random, and then they don't explain how to do it, it's like why would you put that in the test?*

These responses illustrated that students held beliefs that if their teachers' explanations lacked clarity, mathematics achievement and progression would be impacted. These students perceived their teacher to be the most valued, and important factor for their mathematics learning. Therefore, it was important that their teacher possessed relevant and expert mathematical knowledge.

The value *teacher explanations/clarity was* frequently ranked by the Māori students as one of their "least important" mathematics education values. Several Māori students described how their teachers' mathematical explanations often lacked clarity *(n*=6 students). One student expressed that she would seek assistance from her peers if her teacher's explanation lacked clarity:

- Maia: *Because when he [the teacher] explains it he explains it in a different way I don't understand*

  Researcher: *If you didn't understand, who would help you?*

  Maia: *My mate, I'd just ask them.*

Another Māori student expressed that she encountered difficulties with the pace of her teacher's explanations:

- Ari: *They talk fast, and they need to talk like slow, because it's hard when they talk fast*

These students encountered difficulties understanding their teacher, which may have impacted upon their valuing of *teacher explanations/clarity.* These students were also participating in the DMIC programme (see Section 3.6) where multiple explanations (from the teacher and peers) are valued. Therefore, for these students both teacher and peers' explanations may have been valued.

MATHEMATICAL CLARITY VALUES

The statement *"It is important that maths is clear and makes sense to me"* was used as a value indicator for the mathematics education value of *clarity.* Pākehā/European and Asian students most frequently ranked (Figure 4.7) *clarity* in mathematics as one of their "most important" values (mode 12). Māori and Pāsifika students ranked *clarity* with "medium importance" (mode 6). A Kruskal-Wallis Test revealed a statistically significant difference in the value rankings for *clarity*, across the four cultures (Pākehā/European: n= 30, Asian: n=25, Māori: n=41, Pāsifika: n=131), χ^2 (3, n=227) = 11.02, p=.012. Mann-Whitney U Tests (with Bonferroni corrections for alpha value .025) revealed no significant differences between Māori and Pāsifika, or Pākehā/European and Asian students. A significant difference was found between Māori/Pāsifika (Māori: Md=6.23, n=41, Pāsifika: Md=6.38, n=131), and Pākehā/European students (Md=4.47, n=30), U > 397, z > -2.95, p < .01. With effect sizes of r = .3 for Māori/Pākehā, and r = .2 for Pāsifika/Pākehā, representing small to medium effect sizes.

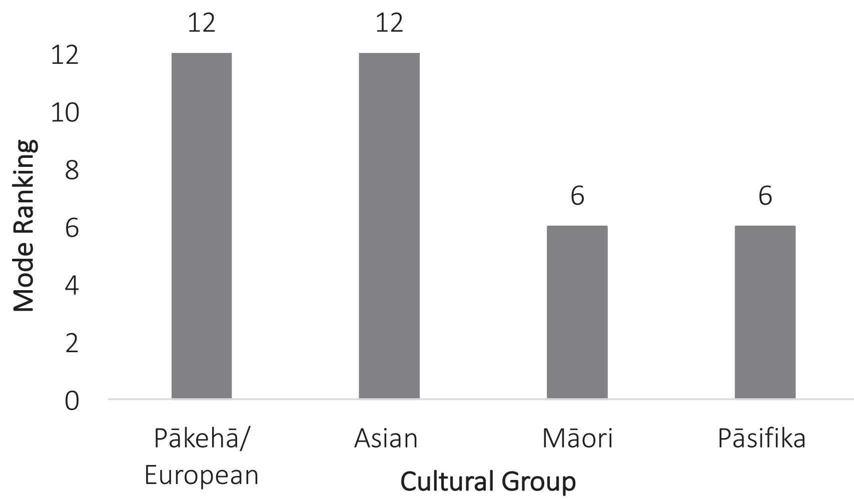

Figure 4.7. Mathematical clarity overall modal ranking

The Pākehā/European and Asian students valued mathematical *clarity,* because they felt clarity and understanding facilitated mathematical progression, and achievement (*n*=25 students):

- Chloe (Pākehā/European female): *If all the other people know what to do and you don't, then you might get in a lower grade but you're not meant to be down there.*

This statement suggests that Chloe perceived mathematical clarity enabled placement into the correct ability group/stream, and when mathematical clarity waned, she risked being placed into a lower group.

- Robert (Pākehā/European male): *Without it [clarity] you can't really do much, I know when I can't understand how to work it out, it's difficult to progress through it.*
- Daisy (Asian female): *If you don't understand it and if you get the right answer that's just luck I guess and then your teacher says, have you got it and you say*

yes but next time when you do it you don't understand it so you can't improve that's all.

- Chun (Asian male): *I need to make sure I know how to do it at the end of the day so I can know it for the next time.*

It is evident here that these students associate a lack of clarity with poor progression in mathematics learning. To construct mathematical clarity and understanding, these students often sought help from, and looked to their teacher as the expert.

FAMILY VALUES

The statement *"I cannot be good at maths without the support, love or guidance of my whānau/family"* was used as a value indicator for the mathematics education value/cultural value of *family love/support.* The mode rankings (Figure 4.8) shows Māori and Pāsifika students most frequently ranked *family* as one of their "most important" values (mode 12). Asian and Pākehā/European students ranked *family* as one of their "least important" values (mode 2). A Kruskal-Wallis Test revealed a statistically significant value difference across the four cultures (Pākehā/European: n= 30, Asian: n=25, Māori: n=41, Pāsifika: n=131), χ^2 (3, n=227) = 11.82, p=.008. Mann-Whitney U Test (with Bonferroni corrections for alpha value .025) revealed no significant differences, between Māori and Pāsifika, or Pākehā/European and Asian students. However, significant differences were found between Māori/Pāsifika (Māori: Md=5.90, n=41, Pāsifika: Md=6.07, n=131,) and Pākehā/Asian students (Pākehā: Md=8.10 n=30, Asian: Md=7.84, n=25), $U > 343$, $z > -2.61$, $p < .025$. Effect sizes ranged from $.2 < r < .3$, which are medium effect sizes.

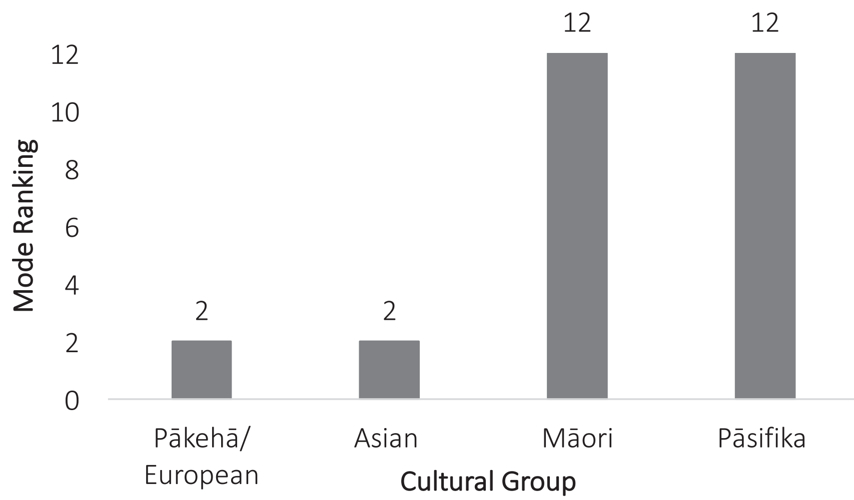

Figure 4.8. Family overall modal ranking

Māori and Pāsifika students described how their family/whānau provided encouragement and support for the mathematics learning (*n*=43 students):

- Toka (Māori male): *Because my whānau if I'm stuck with something they can just come and help me out with something*.
- Aziah (Māori female): *Because if I learn and then my mum and my brother and all that, they're supporting me and I get it done faster. Because I know that they care that I'm doing it.*
- Ophelia (Pāsifika female): *Because every time I fail in maths my Mum always encourages me to carry on and try my best*.
- Steve (Pāsifika male): *Because sometimes if you don't understand maths questions then the people in your family will be able to help you out*.
- Sela (Pāsifika female): Y*our family because you can go home and if you're struggling you can persevere yourself with your family and that*.

For these students, it was important that family was actively involved in their mathematics learning. Māori and Pāsifika cultures are situated on the collectivist end of Hofstede and colleagues (2010) collectivist-individualist values continuum. Collectivist cultures endorse strong family cultural values, and it is interesting to find the Māori and Pāsifika learners in the current study also considered family to be very important for their mathematics learning.

The value *family* was ranked as one of the least important mathematics education values by the Pākehā/European and Asian students. Responses were only recorded for the Asian students. Several (*n*=4) Asian students expressed they did not seek mathematical assistance from family members:

- Rita (Asian female): *It doesn't really matter if they (family) don't give you support in maths because you don't learn from them, well sometimes you do but mainly from the teacher.*

Rita's comment suggests a reliance on her teacher, rather than family to facilitate mathematical learning and understanding.

- Zhou (Asian female): *I don't need their* (family) *support in my maths learning*

These students felt their family played a minor role in their mathematics learning. This is interesting considering many East Asian cultures hold collectivist values and often endorse strong family values (Hofstede et al., 2010).

COLLABORATION/GROUP WORK VALUES

The statement "*I learn more in maths by working with other children"* was used as a value indicator for the mathematics education vale of *collaboration/group work.*

Figure 4.9 shows Pāsifika and Māori students most frequently rated *collaboration/group work* as one of their "most important" values (mode 12). In contrast, Pākehā/European and Asian most frequently ranked this value as one of their "least important" values (mode 1). A Kruskal-Wallis Test revealed a statistically significant difference for *collaboration/group work,* across the four cultures (Pākehā/European: *n*= 30, Asian: *n*=25, Māori: *n*=41, Pāsifika: *n*=131), χ^2 (3, *n*=227) = 30.94, *p*=.000. The Mann-Whitney U Tests revealed no significant differences between Māori and Pāsifika, or Pākehā/European and Asian students. However, a significant difference was found between Pāsifika/Māori (Pāsifika: *Md*=5.41, *n*=131, Māori: *Md*=4.92, *n*=41) and Pākehā/Asian students (Pākehā: *Md*=8.3, *n*=30, Asian: *Md*=9.12, *n*=25), *U* > 193, *z* > -4.3, *p* < .001. Effect sizes ranged from .3 < r < .5, representing a medium to large effect.

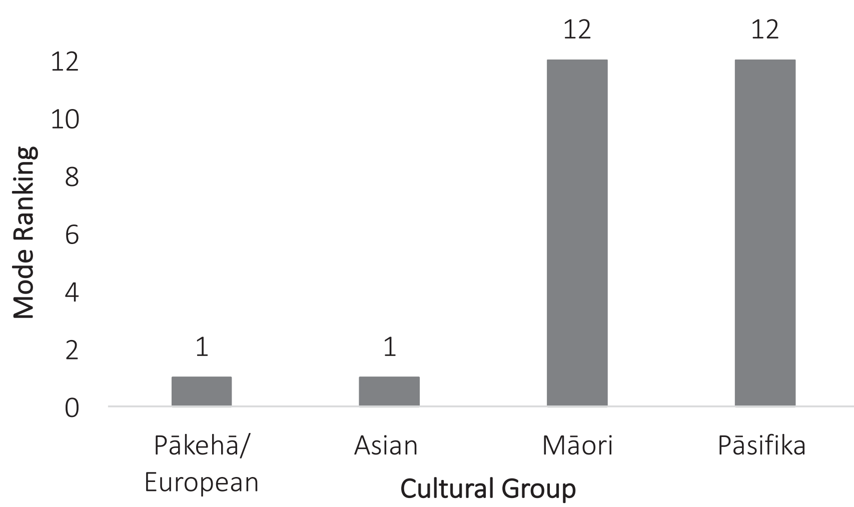

Figure 4.9. Collaboration/group work overall modal ranking

Collaboration/group work was considered one of the most important values by the Māori and Pāsifika students, as peers provided additional learning support in mathematics and enabled the sharing of ideas (*n*=60 students):

- Nadia (Māori female): *Because you can help other children and that would help you.*
- Rangi (Māori male): *I like working with other children cos they help me succeed in my maths questions and all of that and I learn different strategies in maths.*
- Junior (Pāsifika male): *They help me to concentrate and they help me when I'm stuck.*
- Paea: (Pāsifika female): M*y friends help me to understand the problem.*
- Vaisulu (Pāsifika female): *We can share ideas*.

Several Māori and Pāsifika students (*n*=4) also valued group work because their peers helped to build confidence towards mathematics:

- Rueben (Māori male): *They [peers] help me more, like get more confident*
- Maria (Pāsifika female): *They [peers] develop my confidence in maths*

One student expressed how cooperative learning with peers was valued more than teacher led instruction:

- Iafetta (Pāsifika male): *Because I learn more from each other than the teachers*

These students valued cooperative and collaborative mathematics learning, because peers provided reciprocal learning opportunities which contributed to the students' mathematical clarity and understanding. Collaborative learning improved these students' confidence towards mathematics, and contributed to their mathematical engagement. These mathematics education values reflect the collectivist cultural values of Māori and Pāsifika, which include collaboration, community and reciprocity (MoE, 2011, 2013b). It is interesting to find the links between cultural and mathematics education values by these Māori and Pāsifika learners.

C*ollaboration/group* work was ranked by the Pākehā/European and Asian students as one of their "least important" values. Many of these students *(n*=16) perceived group work as distracting which impacted on their engagement in mathematics:

- Frances (Pākehā/European female): *I find other children distracting during my maths.*
- Kate (Pākehā/European female): *When working with other children sometimes if they know the answer and they're ahead of me then I end up writing their answer down and then I don't learn anything*
- Patrick (Pākehā/European male): *I prefer speaking and working with a teacher, if you're doing individual things than it's easier to learn.*

Patrick's comment demonstrates his individualist values and preference for independent working.

- Roy (Asian male): *Because sometimes other children can distract you and they sometimes don't work with you properly.*
- Lei (Asian male): *Other people disturb me and sometimes our opinions may differ and that can get annoying sometimes*.

Several Asian students (*n*=3), felt working in mixed ability groups negatively impacted upon their own mathematics learning:

- Ying (Asian female): *If other children that you're working with are a bit lower than you, you won't improve much on your learning.*

- Shu (Asian male): *That's why I normally do maths by myself and I get more right and working with other kids, because most of the people in my class are normally below standard or below what my grade is.*

It is evident these Pākehā/European and Asian students valued independent mathematics learning, and could also see minimal value from collaborative learning in mathematics. This reflects the strong individualist values endorsed by European and New Zealand cultures (Hofstede et al., 2010), nonetheless, East Asian cultures generally possess collectivist values which often endorse the importance of collaboration.

COLLABORATION/COMMUNICATION VALUES

The statement *"It is important to talk about my ideas in a group or with my partner"* was used as a value indicator for the mathematics education value of *collaboration/communication.* The mode rankings (Figure 4.10) show Pāsifika students most frequently ranked *collaboration/communication* with "medium importance" (mode 6), Māori as "most important" (mode 9), and Pākehā/European and Asian students as "least important" (mode 3 and 4 respectively). A Kruskal-Wallis Test revealed a statistically significant difference for this value across the four cultures (Pākehā/European: *n*= 30, Asian: *n*=25, Māori: *n*=41, Pāsifika: *n*=131), χ^2 (3, *n*=227) = 19.14, *p*=.000. Mann-Whitney U Tests (with Bonferroni corrections for alpha value .025) revealed no significant differences between Māori and Pāsifika, or Pākehā/European and Asian students for *collaboration/communication*. A significant difference was found between Māori/Pāsifika (Māori: *Md*=6.03, *n*=41, Pāsifika: *Md=5.72*, *n*=131), and Pākehā/Asian students (Pākehā: *Md=7.83*, *n*=30, Asian:

Md=8.20, n=25), $U > 294$, $z > -2.95$, $p < .025$. Effect sizes ranged from $.3 < r < .4$, representing small to medium effect sizes.

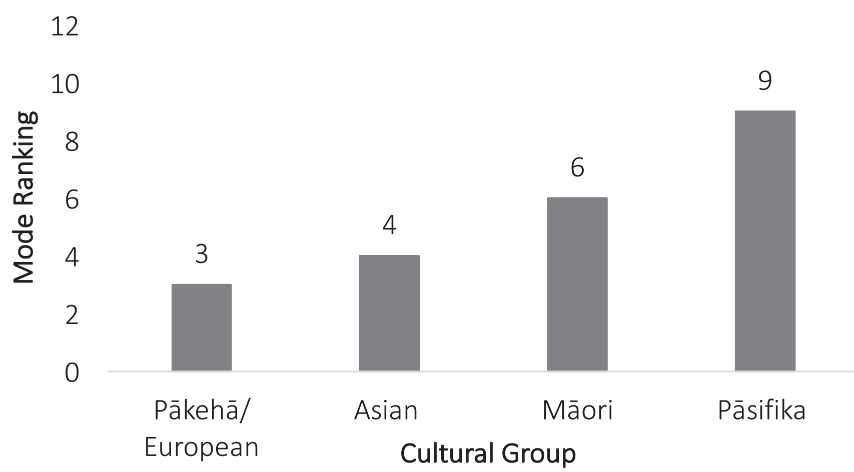

Figure 4.10. Collaboration/communication overall modal ranking

MATHEMATICAL PERSISTENCE VALUES

The statement *"It is important that if I can't solve a difficult maths problem, I need to keep working at it"* was used as a value indicator for the mathematics education value of *persistence.* Figure 4.11 shows Pākehā/European students ranked *persistence* as "most important" (mode 10), with Asian, Māori and Pāsifika students ranking the value with "medium importance" (Asian mode 8, Māori/Pāsifika mode 5). A Kruskal-Wallis Test revealed a statistically significant difference for this value, across the four cultures (Pākehā/European: n= 30, Asian: n=25, Māori: n=41, Pāsifika: n=131), χ^2 (3, n=227) = 19.14, p=.007. Mann-Whitney U Tests (with Bonferroni corrections for alpha value .025) revealed no significant differences between value rankings for Māori and Pāsifika, Māori and Pākehā/European, or Pākehā/European and Asian students. A significant difference was found between Pākehā/European and Māori (Pākehā: *Md*=5.70, *n*=30, Māori: *Md*=7.38, *n*=41), as well as Māori/Pāsifika and Asian students (Pāsifika: *Md=6.66*, *n*=131, Māori: *Md*=7.46, *n*=41, Asian: *Md*=4.64, *n*=25), $U > 290$, $z > -2.95$, $p < .025$. This had a medium effect size ranging from $.2 < r < .4$.

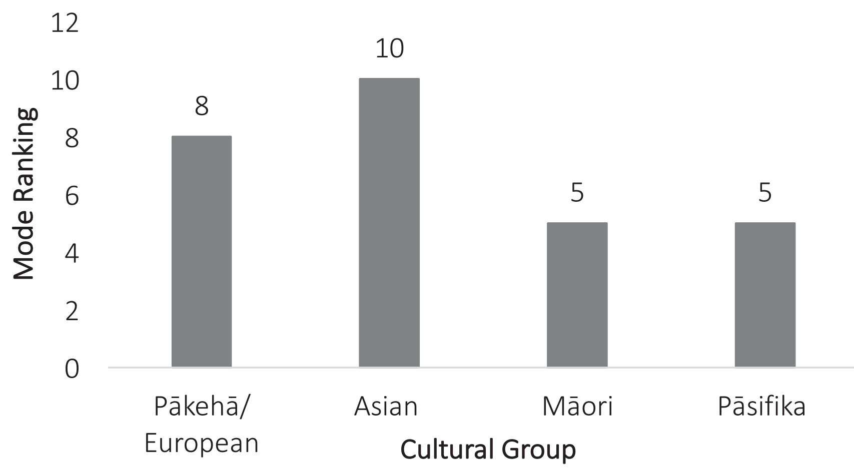

Figure 4.11. Persistence overall modal ranking

VALUING RESPECT IN THE MATHEMATICS CLASSROOM

The statement *"It is important to respect and like my maths teacher and for them to respect me"* was used as a value indicator for the mathematics education/cultural value of *respect.* A Kruskal-Wallis Test revealed no statistically significant differences for this value, across the four cultures. The mode ranking (Figure 4.12) shows Māori students most frequently ranked *respect* in the mathematics classroom as "most important" (mode 12). Pākehā/European and Pāsifika students ranked *respect* with "medium importance" (mode 5), and Asian students as "least important" (mode 3).

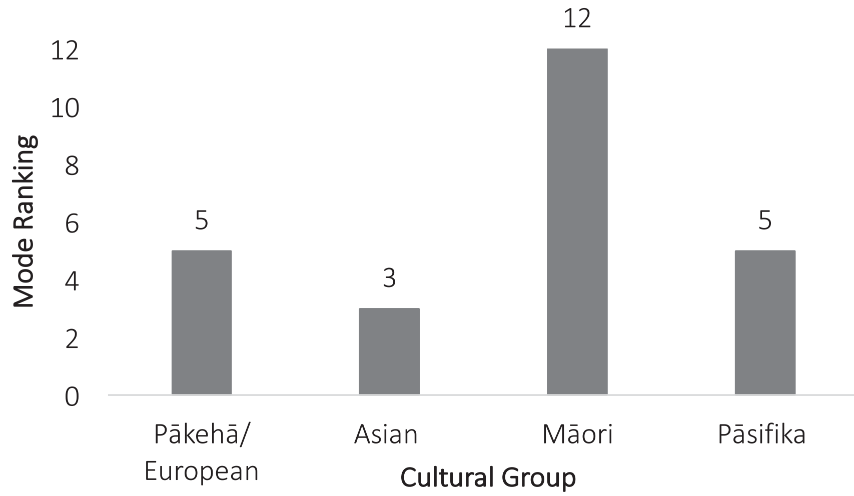

Figure 4.12. Respect overall modal ranking

For Māori students, *respect* was valued as one of their "most important" values (mode 12), because *respect* improved teacher – student relationships, which in turn facilitated an optimal learning environment:

- Cody: *Because when you respect the teacher and like, they'll respect you back and the vibe will be alright*
- Precious: *If you don't respect the teacher then you can't learn.*
- Dallas: *If I didn't have a good bond with my maths teacher I wouldn't be able to stand them. I wouldn't be able to work with them, I would just refuse and I would just close down*.
- Ruapani: *Because it's better if I respect the teacher because then I get better because she can help me out more then.*

It is again interesting to note here, the similarities between Māori collectivist cultural values, that is, respect and positive relationships (MoE, 2011), and the values the students identified as important for their mathematics learning.

VALUING BELONGING IN THE MATHEMATICS CLASSROOM

The statement *"It is important I feel like I belong in my maths class"* was used as a value indicator for the mathematics education value of *belonging.* A Kruskal-Wallis Test revealed no statistically significant difference in the value rankings for *belonging*, across the four cultures. From Figure 4.13, Pākehā/European and Māori students ranked *belonging* with "medium importance" (mode 6). Asian and Pāsifika students most frequently ranked *belonging* within the "least important" category (modes 3 and 4 respectively).

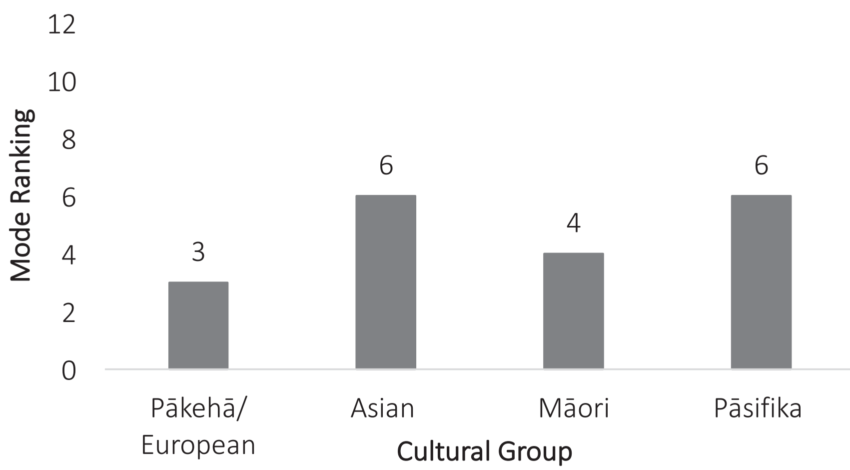

***Figure 4.13**.* Belonging overall modal ranking

4.3 UNPROMPTED VALUE INTERVIEW RESPONSES

Students' self-generated mathematics education values were explored through the open-ended interview question (asked prior to the survey): *What is important to you in your maths lessons?* The values expressed through this question were compared to the values in the survey, to determine if there were other important values not captured in the survey. Student responses to the interview question were coded either as a single or multiple values. Examples of student responses coded at each value are displayed in Table 4.2.

Table 4.2. All self-generated values and response examples

VALUE	NO. OF RESPONSES	EXAMPLE/S OF RESPONSES
Utility	**10**	• Knowing the right strategy to get the right answer. You may use the strategies in the future for jobs, money
Effort/practice	**3**	• If I get the answer wrong I go home and practise it
Flexibility with strategies	**21**	• Learning different strategies to solve the problem
Accuracy	**7**	• That I get it right
Teacher explanations/ clarity	**7**	• Having what we need to do explained and how to do it • The way they tell me (who?) the teacher
Mathematical clarity/ understanding	**50**	• Able to understand the question • Understanding it, cause sometimes it hard to understand
Collaboration/ group-work	**23**	• Working as a group
Collaboration/ communication	**18**	• Communicating, having friendly debates and making sure everyone has a say in something
Respect	**10**	• Respect, if the teacher is talking and you're talking to someone, you can't learn • Making sure everyone has a say in something
Learning new material/topics	14	• Always learning something new, no reviewing stuff you did ages ago when you were little • Learning new topics in maths
Timestables/recall	22	• Remembering all the basic stuff • Knowing your timestables
Engagement/focus	16	• Making sure I am on-task
Good marks/ improvement	10	• To do well • Improve my maths

Note, values in bold also appeared in the survey

Thirteen mathematics education values were generated by 208 middle school students, including nine existing mathematics education values which also featured in the survey (bolded in Table 4.2) and four new mathematics education values which did not appear in the survey (that is, *learning new materials/topics, timestables/recall, engagement/focus,* and *good marks/improvement*). Considering three quarters of the values overlapped in both datasets (that is, the survey and open ended question) this provides weight to the validity of the survey for measuring the values students perceived as being important in mathematics.

4.4 SUMMARY

This chapter has reported results for both quantitative and qualitative methods, to explore the mathematics education values held by middle school students from four different cultural backgrounds. The data shows diverse middle school students endorsed three common mathematic values: *utility, effort/practice* and *flexibility*, and place minimal value on *accuracy* in mathematics. However, across cultures students endorsed alternate values as most and least important for their mathematics learning. Apart from the Asian students, these mathematics education values appeared to be aligned with the students' cultural values, such that the collectivist cultures (Māori and Pāsifika) endorsed *collaborative*, *family* and *respect* mathematics education values, whereas the individualist culture (Pākehā/European) endorsed independent learning values, for example, *teacher explanations* (rather than peer explanation), mathematical *clarity* and independent (and not group) work. East Asian cultures are generally collectivist, however they endorsed similar individualist mathematics education values to their Pākehā/European peers.

The significance of these findings, and how they relate to the wider international literature on mathematics and cultural values, are discussed in the following chapter.

CHAPTER FIVE

DISCUSSION

5.1 INTRODUCTION

The preceding chapter identified the types of mathematics education values held by Pākehā/European, Asian, Pāsifika and Māori middle school students. This chapter will discuss the current study in the context of previous research where there has been a focus on values, and demonstrate how the mathematics education values reported in the previous chapter are closely aligned with the students' cultural values. Section 5.2 explores the value similarities across certain cultural groups, and acknowledges the potential impact of socioeconomic (SES) status and school decile rating on mathematics education values. Section 5.3 discusses the mathematics education values shared by students in all middle school students. Section 5.4 examines the most and least important mathematics education values espoused by students across the four cultural groups.

5.2 DECILE RANKING/SOCIOECONOMIC STATUS AND VALUES

In the present study, similarities were found between the mathematics education values held by the Pākehā/European and Asian students. Similarly, this was also found with the Māori and Pāsifika students, that is there were no statistically significant differences between these cultural pairings for any of the twelve values. It could be suggested that these similarities in mathematics education values could possibly be attributed to school/decile or socioeconomic (SES) effects, as the majority of the

Pākehā/European and Asian students in the current study attended a high decile school, and the majority of Pāsifika and Māori students attended low decile schools. This clustering of SES and culture is reflected across New Zealand, with the Ministry of Education data (2016) suggesting that Pākehā/European and Asian students are more likely to attend higher decile schools and live in privileged socioeconomic communities compared to Pāsifika and Māori students. According to the New Zealand component of the PISA study (Caygill et al., 2008) ethnicity, income, and mathematics achievement are all strongly connected. As such, in mathematics education research it can be difficult disentangling the variable effects of culture and SES, and to date no mathematics values research has acknowledged the impact of SES.

However, in the current study, despite the SES clustered cultural groups, the mathematics education values espoused by the students closely aligned with their cultural values as documented in both research studies and curriculum documents (Hofstede et al., 2010; MoE, 2011; 2013b). This indicates the mathematics education values reported in this study were more likely a reflection of the students' culture rather than differences in SES. For example, Māori and Pāsifika share common core collectivist values (Hunter et al., 2016; MoE, 2011; 2013b). Similarly, in the current study the Māori and Pāsifika students espoused mathematics education values which aligned with these collectivist values, for example, valuing *collaborative* learning, *family* support *and respect* in the mathematics classroom. Conversely, the Pākehā/European students' mathematics education values reflected New Zealand's individualist cultural values (Hofstede et al., 2010), for example, these students valued personal learning goals such as *mathematical clarity*, and valued *independent work* as opposed to *collaborative* and *family* assisted mathematics learning.

Asian cultures tend to hold collectivist cultural values (Hofstede et al., 2010), however, the Asian students in the current study espoused mathematics education values which reflected individualist learning preferences. For example, these students valued *independent work,* and ranked *collaboration* and *family* as least important for their mathematics learning. The low endorsement of collectivist mathematics education values by these Asian students may be the result of enculturation. According to Hofstede and colleagues (2010), New Zealand people hold some of the strongest individualist cultural values comparable to other nations. In the current study, the majority of the Asian students were born in, or had migrated to New Zealand several years prior. Furthermore, all the Asian students attended a school, and lived in a community which was majority Pākehā/European. Research studies show that Asian immigrant children express less cultural characteristics (including cultural values) for each subsequent generation (Phinney, Horenczyk, Liebkind, & Vedder, 2001). Furthermore, in terms of vocational values, Leong and Tata (1990) found that Chinese-American primary students held more individualist, and less collectivist cultural values, as they become more acculturated to their adoptive American culture. Considering these earlier research findings, the Asian mathematics students in the current study may have adopted New Zealand's individualist education values.

5.3 THE MATHEMATICS EDUCATION VALUES ESPOUSED BY ALL MIDDLE SCHOOL STUDENTS

According to the survey results, important mathematics education values were shared by students in all four cultures and included the *utility* of mathematics, *effort and practice,* and *flexibility.* Furthermore, students in all cultures agreed a*ccuracy* in mathematics was their least important surveyed value. The consistency of these values across cultural groups, signifies the strength of these mathematics education values amongst diverse New Zealand middle school students. Given that these four values transcend cultural differences, this result suggests that these values reflect societal and general education values and are common to students of diverse backgrounds.

The results of this study showed the *utility* of mathematics was valued by the majority of students from all cultures. Valuing *utility* means students desired mathematics that was felt to be either practical, or relevant to their own lives or the world around them. Students wanted mathematics to have a purpose, that related to their everyday activities, or which impacted upon their future success. Given the growing technological and digital economy (Ministry of Business Innovation & Employment, 2017), there is a strong message in New Zealand that mathematics is important for future employment, and economic advancement. Similar findings were reported in the study completed by Young-Loveridge and colleagues (2006). They found that an overwhelming majority of students held beliefs about the importance of mathematics for the future, suggesting *utilitarian* mathematics education values are reflective of societal values, and not distinguishable by cultural differences. The dominance of *utilitarian* values towards mathematics is a finding also reported in a range of international values research studies (e.g., Barkatsas & Seah, 2015; Österling & Andersson, 2013), reflecting the all too familiar question posed by many students in mathematics classes: "when will we ever need to use this?" (Barkatsas & Seah, 2015, p. 75). Österling & Andersson reported Swedish middle school students highly valued "connecting mathematics to real life" (p. 22). Likewise, Barkatsas and Seah found the favourite mathematical tasks reported by 3150 students, across Australia and several Chinese states involved *real life scenarios*. The strong *utility* values held by students, both in the current study and other published research (e.g., Barkatsas & Seah, 2015; Österling & Andersson, 2013) reaffirms the need for mathematics teachers to provide authentic learning experiences with opportunities for students to apply concepts and skills to real life scenarios. This may be particularly important for marginalised students, where linking school mathematics with the real world (of the students) resonates well and improves mathematical engagement (Averill, 2009; Hemara, 2000).

In the current study, students in all four cultural groups valued *effort and practice* in mathematics. These students felt it was important to work hard in mathematics, and understood that progress or improvement could be achieved through practice. In the current study, the results for the Pākehā/European and Asian students are broadly consistent with other values research from Europe and Asia (Cao & Bishop, 2001; Lee & Seah, 2015; Lim, 2015; Österling & Andersson, 2013), where students in Malaysia, mainland China, Taiwan and Sweden all valued *effort and practice* for their mathematics learning.

To date, it appears that no comparative research exists which has explicitly explored Pāsifika or Māori mathematics education values. These results describe for the first time how students in these cultures also value *effort and practice* for their mathematics learning. This is encouraging considering many teachers hold deficit views, or low expectations towards their Pāsifika or Māori students (Rubie-Davies, 2009, 2016). For example, Turner, Rubie-Davies, and Webber (2015) revealed teacher expectations were highest for Asian and Pākehā/European mathematics students, and lowest for Pāsifika and Māori, with one teacher in their study expressing that Pāsifika students were less likely to achieve in mathematics because they "are very lazy and they do not spend enough time studying and learning" (p. 62). The current findings offer a direct challenge to deficit teacher views reported in previous studies. Moreover, the results from this study demonstrating that students in all cultures valued *effort and practice,* is important, especially in light of the often reported (e.g., Cao & Bishop, 2001; Lim, 2015; Stankov, 2010) East Asian focus on internal mathematical education values (for example, *effort*, *practice* and a*chievement)*. Several researchers (e.g., Cao & Bishop, 2001; Seah, 2016) argue that the greater valuing of *effort and practice* by East Asian students is one explanation for their mathematical advantage in international assessments. However, the findings of the current study do not support this argument, as students in all cultures, not just the Asian students, valued *effort and practice* in mathematics to some degree.

Flexibility was also valued by the majority of students in all cultural groups. Students valued opportunities to learn and demonstrate multiple strategies to solve mathematical problems. Moreover, the interview data showed that students viewed learning multiple strategies as supporting their mathematical learning, for example they felt that possessing a bank of strategies made it easier to solve mathematical problems.

As it was found that students in all cultures valued *flexibility,* it may be suggested that this value is societally endorsed and less affected by differences in cultural values. The value *flexibility* may be endorsed through the New Zealand mathematics curriculum, where the New Zealand Numeracy Project emphasises students learning multiple strategies:

> The biggest difference in schools involved in the Numeracy Project is that children are encouraged to learn a range of different ways to solve problems and to choose the most appropriate one for each problem. You may be familiar with certain 'rules' for doing maths. While these will still work, your child may learn different ways to solve problems (MoE, nd, para. 5)

Mathematics values research from Asia shows similar values related to *flexibility,* held by East Asian secondary students. For example, Zhang and Seah (2015) reported students from mainland China valued good mathematics instruction to include teaching of *multiple methods.* The current study is the first to report Māori, Pāsifika, and Pākehā/European, students also hold similar *flexibility* values to their Asian classmates.

Findings from the current study showed that students from all cultures most frequently ranked *accuracy* in mathematics as their least important mathematics education value. Students felt that always getting the correct answer in mathematics was not so important because they valued learning from their mistakes, having a go, demonstrating their knowledge and/or using multiple strategies. The low endorsement of *accuracy* values by students in the current study reflects values reported in other literature. For example, Grootenboer and Marshman (2015) found that 56% of Year 5 and 8 New Zealand students in their study either disagreed or strongly disagreed that "the most important thing in maths is to get the right answer" (p. 63). The low endorsement of *accuracy* mathematics education values is encouraging as learners who hold traditional beliefs/values about mathematics, for example, mathematics is about finding the correct answer, also tend to hold more negative affective positions (dislike of mathematics or mathematics anxiety) towards mathematics (Grootenboer & Marshman, 2015).

5.4 WHAT DO STUDENTS FROM DIFFERENT CULTURES VALUE MOST, AND LEAST FOR THEIR MATHEMATICS LEARNING?

5.4.1 PĀKEHĀ/EUROPEAN AND ASIAN STUDENTS' MATHEMATICS EDUCATION VALUES

Both the Pākehā/European and Asian students valued *clarity and understanding* as one of their most important mathematics education values. These students reported feeling discontent when their mathematics lessons did not make sense, or when they failed to understand the mathematical content. The majority of these students indicated that mathematical understanding was very important, and necessary for learning progression. For some of these students, valuing *clarity and understanding* could indicate a desire for deeper mathematical reasoning, because deeper learning strategies are associated with a desire to understand the mathematical concepts, rather than simply recalling procedures, that is, surface learning strategies (Goos, 2004; Stein, Grover, & Henningsen, 1996).

It appears that no other research studies have specifically reported mathematics education values relating to *clarity and understanding*. This does not suggest these values do not exist, but instead other values research studies (Österling & Andersson, 2013; Seah & Peng, 2012) may have reported students' values relating to the source of their *clarity and understanding,* for example, *clarity and understanding* facilitated by teacher explanations, worked examples, or asking questions. Valuing *understanding* for mathematical success or achievement was reported in one New Zealand study (Darragh, 2015). Darragh interviewed middle school students to understand how they perceived someone as being "good" at mathematics. Darragh found that students reported a range of achievement related values, for example, knowing the answer, working quickly, asking questions, and confidence. In her study, a Pākehā/European student indicated she felt that mathematical understanding was important:

> I used to think it was someone who would do really well in tests and memorise the rules…now I find that the person who would be really

good at maths would be someone that actually understands all the different rules and why they're there (p. 98).

In the current study, the valuing of *clarity and understanding* by the Pākehā/European and Asian students may reflect the education culture of New Zealand classrooms. New Zealand mathematics classrooms have a mastery orientated culture (Meissel & Rubie-Davies, 2016), where lessons in most classrooms begin with informing students of what they will learn, and how they will know they have achieved the learning (S. Clarke, Timperley, & Hattie, 2003). In these classrooms, mastery orientation goals (that is improving, attaining, or understanding mathematical knowledge/skills) are valued. To illustrate, agreement with the following statement "I am striving to understand the content of this course as thoroughly as possible" (Elliot & Murayama, 2008, p. 617) constitutes a mastery orientation. In a New Zealand study, Meissel and Rubie-Davies reported that the majority of Pākehā/European and Asian middle school mathematics students in their study endorsed strong mastery orientation goals. Considering this, it is no surprise that majority of the Pākehā/European and Asian middle school students in the current study endorsed *clarity and understanding* mathematics education values.

The Pākehā/European and Asian students valued their teacher (often discounting the role of peers or family), as the primary source of their *clarity and understanding.* These students ranked *teacher explanations/clarity* to be one of their most important mathematics education values. Traditional European and Asian mathematics classrooms are typically teacher centred, emphasising individualised learning and minimising opportunities for group work (Boaler, 2015; Rao et al., 2016). Therefore, the education system in European and Asian cultures, generally value teacher led mathematics instruction. Furthermore, most Asian cultures also hold high power cultural values (Hofstede et al., 2010), meaning teachers are often perceived as experts transferring personal wisdom. These sociocultural values may, in part, explain why the Pākehā/European and Asian students valued their teacher as the main source of their mathematical clarification, and discounted the value of family learning support and social learning.

The valuing of *teacher explanations/clarity* by the Pākehā/European and Asian students in the current study, is broadly consistent with findings from other values research (e.g., Law et al., 2011; Lim, 2015; Österling et al., 2015; Seah & Peng, 2012; Zhang & Seah, 2015). For example, Seah and Peng, as well as Österling and colleagues reported that Swedish and Australian students valued *teacher explanations,* which included systemic and detailed instruction by the teacher. These Swedish and Australian students expressed the view that their peers often made mistakes which the students found confusing. Consequently, these Swedish and Australian students valued the *clarity* provided by their teachers' explanations. Similarly, in the current study, two Pākehā/European students noted that their peers often encountered difficulties explaining mathematical concepts, and therefore it was the role of their teacher to provide this mathematical clarity. Other research from New Zealand also shows that students value *teacher explanations* as a component of effective mathematics learning (Anthony, 2013). For example, when Anthony explored what students valued for "good" mathematics teaching and learning, she found students from a predominantly Pākehā/European dominated school valued a *helpful* teacher who provided effective *explanations and clarity,* as demonstrated by the statement: "she is really helpful and she teaches me new things and she explains it really well" (p. 213). In research completed with Hong Kong students, Law and colleagues also explored students' values towards effective mathematics teaching. They found students most valued their *teachers' clear and step by step explanations.* Likewise, Malaysian primary students also valued teacher explanations as an important factor in effective mathematics lessons (Lim, 2015). Taken together, the consistency of this value across both Asian and Western cultures highlights shared societal and or cultural values relating to the role of the mathematics teacher as the expert and primary source of mathematical clarification.

The Pākehā/European and Asian students ranked the values *collaboration-/group work* and *family* as two of their least important mathematics education values. This aligns with the view that many Pākehā/European and Asian students believed it was their teachers responsibly to impart mathematical clarity, rather than the responsibility of their peers or family. Furthermore, the Pākehā/European and Asian students perceived mathematics learning to be an independent enterprise, because sharing ideas with their peers was perceived as a distraction, and a hindrance to their own mathematics learning. The low endorsement of *collaborative* learning and *family* values by these students is broadly consistent with other international mathematics values research. For example, research from Asia (i.e., Law et al., 2011; Lim, 2015; Zhang et al., 2016; Zhang & Seah, 2015) demonstrates an absence of *collaborative* or *family* mathematics education values amongst East Asian students. Similarly, Swedish middle school students reported they valued *independent working*, as they perceived their peers' conflicting strategies to be confusing (Seah & Peng, 2012). In a New Zealand study (Anthony, 2013), girls from a Year 9 class in a high decile school reported limited *collaborative* mathematics education values, compared to students from lower decile schools (with a higher proportion of Māori and Pāsifika students) who valued a sense of community in their classroom and working collaboratively with peers. However in contrast to the current findings, Seah and Peng (2012) found both Swedish and Australian students also valued *sharing*, which included sharing of mathematical ideas in either a whole class or group setting. *Sharing* could, in part, be related to the value *collaboration-group work.*

Collaboration-group work and *family* are considered to be collectivist values (Hunter et al., 2016). In the current study, the low ranking of *collaboration-group work* and *family* mathematics education values, and the endorsement of independent learning values by the Pākehā/European students, reflects the strong individualist values of New Zealand European people (Hofstede et al., 2010). Interestingly, according to Hofstede and colleagues, Asian cultures are generally collectivist rather than individualist, thus, it was surprising the East Asian students in the current study, like their Pākehā/European classmates, also ranked the collectivist orientated mathematics education values as least important. As outlined previously, it is likely that the East Asian students in the current study had adopted New Zealand's strong individualist education values (Hofstede et al., 2010).

A lack opportunity for engagement with collaborative mathematical activities may also have contributed to the low endorsement of *collaboration- group work* values amongst these Pākehā/European and Asian students. As previously discussed, traditional European and Asian classrooms are typically teacher centred, often minimising opportunities for group work (Boaler, 2015; Rao et al., 2016). As a result, through a lack of exposure to, or through poorly organised collaborative learning activities, it could be conjectured that these Pākehā/European and Asian students may not have been exposed to the benefits, or value of group work in mathematics. This conjecture is supported by research from Kloosterman, Raymond, and Emenaker (1996), who reported primary students value of group versus individual work in mathematics reflected their teachers' beliefs about the appropriateness and effectiveness of group learning, as well as the variety and kinds of learning activities to which the students had been exposed. Hunter (2006) argues that if students are to value collaborative and cooperative mathematical activities, the benefits of working together should be made more explicit in the classroom. Nonetheless, if the Pākehā/European and Asians students' cultural values do not align with valuing *collaboration-group work* in mathematics, then increased exposure to group work, without explicit reorientation towards the value of collaboration in mathematics lessons may further disengage the students (Bishop & Kalogeropoulos, 2015).

5.4.2 MĀORI AND PĀSIFIKA STUDENTS' MATHEMATICS EDUCATION VALUES

In the current study, both the Māori and Pāsifika students ranked *family* as one of their most important values for their mathematics learning. Values relating to the family are central to Māori and Pāsifika peoples (MoE, 2011, 2013b) and linked to their strong collectivist cultural values (Averill, 2012b; Hofstede, 2017). The concept of *family* for Pāsifika and Māori includes extended family, neighbours and local members of the community (Hunter et al., 2016), and often incorporates related values endorsed by the family unit, for example, communalism, collectivism, collaboration and service (Civil & Hunter, 2015). These family values can also be embedded in classroom practice. For example in her thesis research, Cheung (2015) described how one mathematics teacher used collaborative responsibility (a value commonly endorsed in Pāsifika/Māori families) as a tool to encourage positive classroom interactions amongst Pāsifika students in his classroom.

In the current study, the Pāsifika and Māori students valued their *family* as important for their mathematics learning, because the family provided encouragement, and support with homework and learning. There is a paucity of mathematics education research investigating Pāsifika and Māori students' valuing of family support. Hāwera, Taylor, Young-Loveridge, and Sharma (2007) reported 39 out of the 40 Māori students they interviewed, acknowledged that support for their mathematics learning was available at home, and typically involved the family assisting with mathematical strategies, answering questions, and clarifying mathematical ideas. However, for the first time, the current findings establish the degree of importance, for the value of *family* for Pāsifika and Māori mathematics students.

Despite the importance of the *family* for Pāsifika and Māori mathematics students, New Zealand teachers often hold inaccurate stereotypes relating to parents, that is that Pāsifika/Māori parents are not interested or involved in their children's schooling (Nakhid, 2003), or that parents do not have the mathematical knowledge or skills to help with their children's homework (Nicholas & Fletcher, 2015; Turner et al., 2015). On the contrary, from the parents' perspective, MacIntyre (2008) asserted Pāsifika mothers not only valued and enjoyed being involved with their children learning, they also believed that their children's success, in any field, largely depended on *fa 'e mo 'api,* meaning "mothers and the home". Furthermore, in the current study the Pāsifika students noted that their families possessed the mathematical knowledge and skills (for example, "they teach me new strategies") required to assist with homework. Families clearly have a powerful influence on Māori and Pāsifika students' mathematics learning. Research studies (Hattie, 2008; Sheldon & Epstein, 2005) show that active involvement of family in mathematics learning is associated with student's success in mathematics. The value of *family* support for the Pāsifika and Māori learners in the current study is encouraging, and may help discount teachers' misconceptions regarding the role of Pāsifika and Māori families in mathematics education.

The mathematics value *collaboration - group work* was ranked as one of the most important values by the Pāsifika and Māori students. Collaboration is a core collectivist cultural value for Pāsifika and Māori people (MoE, 2011, 2013b). The Pāsifika and Māori students valued *group work* because sharing ideas and strategies helped the students to progress and improve their own mathematics. Several Pāsifika students reported that working with their peers helped them to concentrate and remain engaged during mathematical tasks. These comments are interesting considering many mathematics teachers fear their students will become distracted when working with their peers (Boaler, 2015).

To date, very few research studies have documented the self-reported *collaborative-group work* mathematics education values held by Māori and Pāsifika students. A research study by Anthony (2013) explored the notion of what it meant to be a "good" mathematics teacher and student. Students from a low decile school (and predominantly Pāsifika and Māori), asserted that they valued a social arrangement in the classroom, which suited their collaborative ways of learning. This is exemplified in the following statement:

> We have the coolest class ever….I like to have my friends around me…..I can't work by myself, I can't think straight…We don't have a seating plan and we can sit next to anybody we want and most of my other classes we aren't allowed to (Anthony, 2013, p. 214).

In another study, Hunter and Anthony (2011) explored the *collaborative* mathematics education values held by Pāsifika students following an inquiry-based classroom intervention, that is, the DMIC programme (see Section 3.6). A male Pāsifika student in their study recalled:

> Working in the group, I have never actually been good at it in previous years. But this year, it has been a lot better because I have people to help me and I learn different strategies from other people. Working in

a group this year has been important for my learning and that is what is helping me (p. 109).

His response mirrors the statements of Pāsifika and Māori students in the current study, that is, that *collaboration* and *group work* are valued because peer assistance and sharing ideas progresses the students' own learning. Furthermore, his response indicates that previously, he may not have valued group work as important for his learning; however, after being exposed to the DMIC programme, his valuing of group work had shifted towards a more affirmative stance. Hunter and Anthony's (2015) study is perhaps one of the first to show that values endorsed through effective pedagogy can positively influence, and possibly change, the mathematics education values endorsed by the students. This suggests that mathematics education values could be inculcated when classroom pedagogy aligns with the cultural values of the students. The Pāsifika and Māori students in the current study were also participating in the DMIC programme, yet, it is unclear whether these students' values had also changed as a result of classroom experience.

In the current study, many Pāsifika and Māori students justified that *collaboration-group work* was ranked as most important, because they valued reciprocal learning and progressing their peers understanding. Reciprocity is another core value of Pāsifika and Māori people (MoE, 2011, 2013b), confirmed by the following Samoan proverb "if you want to go fast, go alone; if you want to go far, go together" (MoE, 2008a, p. para. 1). In other research (Sharma et al., 2011), Pāsifika students recognised the importance of reciprocal mathematics learning, where the majority of

Pāsifika students (88% of those interviewed) indicated they valued explaining their ideas with their peers. According to these students, sharing ideas helped to build their own mathematical understanding (12% agreement), however, a much larger proportion (68%) valued *collaboration* as it progressed their peers' mathematical understanding. Likewise, Bills and Hunter (2015) and Hunter and Anthony (2011) established that many Pāsifika students endorsed reciprocity values during small group activities. For example, one student in Bills and Hunter's study expressed that he valued reciprocity, and took responsibility for the mathematical reasoning of his peers:

> You have to help each other figure it out. Everyone has to be included and contribute to the work. You have to encourage them to get their own answer though (p. 113).

Likewise, a Pāsifika student in Hunter and Anthony's (2011) study recalled that she valued mutual responsibility during group work, exemplified by the statement: "You can teach other people, like if they don't know, and when they ask questions you can teach them what they don't know" (p. 110). In both the current and earlier research, the importance of helping one another is clear, authenticating the value of social learning and group work for Pāsifika and Māori mathematics learners.

In the current study, the Māori students ranked *respect* as one of their most important mathematics education values. Pāsifika students ranked *respect* with medium importance. Respect is another enduring cultural value of Māori and Pāsifika peoples, and again linked to their collectivist cultural values (MoE, 2011, 2013b). *Respect* in the mathematics classroom encompasses respectful relationships, that is, valuing others' knowledge, experiences and culture, and recognising individual and cultural differences (Averill et al., 2015). Amongst the Māori students in the current study, a respectful relationship with their teacher was important because the students viewed it as promoting mathematical learning and enabling a positive learning environment. The importance of respectful relationships for Pāsifika and Māori learners was also affirmed by Hawk and colleagues (2002). In terms of effective teaching, students in Hawk and colleagues study valued teachers treating them as people/adults rather than children, and teachers who positioned themselves equally to their students. Hawk and colleagues concluded that "many comments in the interviews related to the themes of connectedness and described class climates of mutual respect between the teacher and their students" (p. 6). Likewise, in her thesis research study, Knight-de-Blois (2015) reported Pāsifika and Māori secondary mathematics learners valued respectful relationships which included a teacher who positioned themselves equally, listened to and understood their students. One student in her study noted "if I don't get along with the teacher then I don't have a good lesson" (p. 47). This statement was echoed by many students in the current study, that teacher-student respect was essential for a positive learning environment. The importance of respect during mathematics lessons was also endorsed by Pāsifika students in Bills and Hunter's (2015) study. For example, one student in their study noted how respect was valued during mathematical argumentation: "Respect is real important. When you have respect, you can have friendly arguments" (p. 113). Taken together, the current and earlier research highlights the importance of attending to students valuing of *respect* to enable effective mathematics learning for Māori and Pāsifika students.

5.5 SUMMARY

The results from this study contributes to the current body of knowledge relating to valuing in mathematics education, with additional findings for cultural groups that are highly represented in New Zealand classrooms, that is Pākehā/European, Asian, Māori and Pāsifika. Of the four cultural groups studied, all students shared three mathematics education values, that is *utility, effort/practice* and *flexibility.* The endorsement of these three values by students of all cultures suggests these are societal values, and not distinguishable by cultural differences. The commonality of these values signifies their importance for diverse New Zealand middle school classrooms. Alongside the cohort commonality, the Pākehā/European and Asian students identified more strongly with *teacher explanations* and *mathematical clarity* values. In contrast, Pāsifika and Māori students identified more strongly with *family* and *collaborative- group work* mathematics education values. It is argued the reasons for these cultural similarities (that is, Pākehā/European with Asian, and Pāsifika with Māori) may be attributed to similarities in these students' cultural values. The Pākehā/European and Asian students held greater independent learning and teacher orientated mathematics education values, reflecting New Zealand's individualist cultural values, and Asian students' high-power values (Hofstede et al., 2010). In contrast, the Pāsifika and Māori students espoused mathematics education values which were closely aligned with their collectivist cultural values (MoE, 2011, 2013b). Culturally responsive mathematics teaching attends to what students' value, or do not value in the classroom. The similarities between students' cultural values, and what they value towards their mathematics, highlights the importance that educators understand the culture of each of their students, and enact pedagogy which aligns with these values. Furthermore, from earlier research, there is evidence that appropriate values can be inculcated through positive classroom experience. The next chapter will explore the implications and limitations of the current study.

CHAPTER SIX

CONCLUSION

6.1 INTRODUCTION

This study involved an exploration of the types of mathematics education values espoused by culturally diverse middle school learners in New Zealand, focusing on a cohort of Pākehā/European, Asian, Māori and Pāsifika mathematics students. The exploration focused on students' expression of values, and sought to determine what mathematics education values were endorsed as most, and least important by students from different cultural groups. A further focus was to investigate the relationship between the students' cultural values and what they valued towards their mathematics learning.

Understanding what students' value in the mathematics classroom is important, and has implications for effective and culturally responsive mathematics instruction. However, minimal research exists exploring students' self-reported mathematics values, particularly within New Zealand, and amongst marginalised students. The findings from this study provide a useful starting point for developing an evidence base in New Zealand, as well as contributing to the international mathematics values literature.

However, the findings reported in this study in terms of students reported values may relate directly to the impact of the participants' classroom experience. In this study, the Māori and Pāsifika students, unlike the Pākehā and Asian students, were from inquiry based classrooms, where the Māori and Pāsifika students were active participants in a community of learners. Therefore, the mathematics education values (for example *collaborative* values) espoused by the Māori and Pāsifika students' may have been a reflection of their classroom norms, providing evidence that mathematics education values can be inculcated through effective mathematics pedagogy.

This chapter summarises the findings presented in earlier chapters, outlines implications for teaching and learning mathematics and suggests areas for further research.

6.2 VALUING IN THE MIDDLE SCHOOL MATHEMATICS CLASSROOM

During the middle-school phase, many students experience a negative and detrimental shift in their affect (for example, disliking mathematics) and academic engagement (Attard, 2010; Grootenboer & Marshman, 2015). As values are volitional and action based, values motivate and guide an individuals' decisions and behaviour, and facilitate their engagement towards particular mathematical tasks despite competing distractions (Bishop & Kalogeropoulos, 2015; Seah & Andersson, 2015). Therefore, understanding what is being valued (or not valued) by middle school students, may provide a tool for teachers to engage (or re-engage) these mathematics students (Bishop & Kalogeropoulos, 2015).

In this study, a cohort of diverse middle school students shared three common mathematics education values: valuing mathematics which was *useful* and/or practical for the present or future, valuing *flexibility* with strategies for mathematical problems, and valuing *effort and practice* as important for success in mathematics. The commonality of these values across cultural groups suggests they are influenced by New Zealand societal and educational values, and signifies the strength of these three mathematics education values amongst diverse middle school students. Valuing of *utility, flexibility* and/or *effort/practice* in mathematics have been reported in other international values literature from Asia and Europe (e.g. Österling & Andersson, 2013; Zhang et al., 2016), however, this study is the first to show that diverse middle school students in New Zealand also endorse these three mathematics education values.

New Zealand classrooms, like many around the world, are witnessing an increase in the cultural diversity of students, where teachers must "manage simultaneously the complexity of learning needs of diverse students" (Alton-Lee, 2003, p. 5). Moreover, International mathematics assessments such as TIMSS (Mullis et al., 2016) show New Zealand has one of the largest mathematics achievement gaps comparable to any other nation, where Māori and Pāsifika students are most likely to underachieve (Caygill & Kirkham, 2008). Yet "high attainment may be much more closely linked to cultural values than to specific mathematics teaching practices" (Askew et al., 2010, p. 12). However, minimal research exists exploring Māori and Pāsifika perspective and values in mathematics education. The findings from this study provide valuable insight into these marginalised mathematics learners.

In the current study, despite the cohort commonality, students from different cultural groups were found to endorse alternative mathematics education values. Furthermore, these mathematics education values were closely aligned with the students' cultural values as identified by Hofstede and colleagues (2010) and Ministry of Education documents (2011, 2013b). The Pākehā/European and Asian students identified most strongly with *teacher explanations* and *mathematical understanding/clarity* values, and identified least with *accuracy, collaboration-group work* and *family.* These mathematics education values reflect New Zealand's strong individualist values, as well as the high-power values endorsed in Asian cultures (Hofstede et al., 2010). In contrast, the Māori and Pāsifika students identified more strongly with the values *collaboration-group work, family* and *respect,* and least with *accuracy,* reflecting the collectivist cultural values of Māori and Pāsifika people (MoE, 2011, 2013b). The parallelism of the students' cultural and mathematics education values affirms the importance of acknowledging students' culture in the mathematics classroom. By recognising the cultural uniqueness of what the students value for their mathematics learning, teachers can customise instruction/activities to align with these values (Seah, 2016). The findings from this study are important, and align with earlier research (e.g. Averill, 2012b; Hunter et al., 2016; Hunter & Anthony, 2011; Seah et al., 2014) demonstrating a relationship between students' culture and their values within the mathematics classroom.

However, alongside cultural values, other factors such as classroom culture, pedagogy, or the classroom norms may have influenced the mathematics education values espoused by these middle school students. In the current study, the Māori and

Pāsifika students were from classrooms that were part of a whole-school professional learning intervention focused on developing mathematical inquiry classrooms. In these classrooms, students were provided with multiple opportunities to engage in collaborative group work, and mathematics lessons focused on developing conceptual understanding through questioning, inquiring, and engaging in mathematical practices (for example justifying and mathematical debates). In contrast, it is likely that the Pākehā/European and Asian students had not experienced the same opportunities for collaborative mathematics learning. In the current study, the values espoused by the middle school students may have been a reflection of their classroom pedagogy (and not just their cultural values), such that, the Māori and Pāsifika students' mathematics education values may have shifted to reflect the norms of their inquiry based pedagogy. Likewise, the absence of collaborative learning values amongst the Pākehā/European and Asian students may, in part, result from a lack of exposure to similar social learning practices.

Significant benefits (for example, positive affective states or cognitive skills) can be achieved from implicitly, or explicitly inculcating appropriate values in the mathematics classroom (Bishop et al., 2000; Seah, 2016). For example, an empowered 21st century mathematics learner requires numerous competencies involving collaboration, confidence, self-direction, citizenship and innovative problem solving (Anthony & Hunter, 2017). Therefore, inculcating appropriate values in the mathematics classroom (for example valuing collaboration) may support the empowerment of mathematics learners, and make positive differences in the students' life chances and future civic participation (Anthony & Walshaw, 2007;

Hunter & Anthony, 2011). Hunter and Anthony (2011) discovered when Pāsifika students were exposed to a successful inquiry pedagogy, students' mathematics values shifted to reflect the norms of their pedagogy. At the time of the study, the Māori and Pāsifika students within the inquiry classrooms espoused values that were aligned with Hunter and Anthony's research. This suggests that the inquiry focused pedagogy influenced the values espoused by the students. Nevertheless, further research is needed to look at shifts in mathematical values alongside transformations in pedagogies that support more collaborative and social ways of learning and being mathematical.

6.3 THE IMPLICATION OF VALUES FOR TEACHING AND LEARNING MATHEMATICS

Acknowledging and harnessing values in the mathematics classroom has important implications for culturally responsive and effective mathematics teaching and learning. As asserted by Seah (2016), "how do we go about facilitating students' appropriate valuing such that it helps them to study mathematics more effectively? The first step would be to have a good idea of what is currently being valued by students" (p. 4). By recognising what is valued (or not valued) in the mathematics classroom, teachers can firstly develop classroom culture or pedagogy which aligns with the students' values, or secondly, explicitly address inappropriate values, or values which may contradict the classroom norms and pedagogy. When values are acknowledged in the mathematics classroom relationships are strengthened, students' cultural identities are affirmed, students become more engaged, and ultimately, mathematics learning is enhanced (Bishop et al., 2009; Hunter et al., 2016; Kalogeropoulos & Bishop, 2017; Seah & Andersson, 2015).

In diverse middle school classrooms, teachers can align the three commonly endorsed mathematics education values with their pedagogy. For example, teachers can acknowledge students valuing of *useful*/practical mathematics by providing students with authentic experiences, or allowing students to engage with every-day, or real world examples. However, when attending to *utilitarian* mathematics education values, students' cultural values must also be acknowledged, because what is perceived as useful/practical in one culture, may be different from another culture (Sullivan, 2011). To harness *flexibility* values in the mathematics classroom, instead of focusing on one solution to the mathematics problems, teachers could value diversity with strategies (Seah & Andersson, 2015). For example, by providing multiple opportunities for students to engage with different strategies, either individually or with their peers (Hunter, 2008).

In concordance with earlier values research from Europe and Asia (e.g. Österling & Andersson, 2013; Zhang et al., 2016), the Pākehā/European and Asian students in the current study valued *effort and practice.* However, this study is the first to report these mathematics education values amongst Māori and Pāsifika students. This finding may challenge teachers' deficit theorising and low expectations towards marginalised students (Bishop et al., 2009; Rubie-Davies, 2016). Implications of these findings may include teachers' communicating higher mathematical expectations for Māori and Pāsifika mathematics students. Appropriate teaching practices which align with students' valuing of *effort and practice* may include setting challenging mathematical tasks, structuring lessons with adequate working time for challenging tasks, and providing hints rather than answers to encourage sustained effort and persistence (D. Clarke, Roche, Cheeseman, & Sullivan, 2014; Hunter, 2006).

The Pākehā/European and Asian students identified strongly with independent learning and teacher centred mathematics education values. These students felt a reliance on their teacher rather than peers to facilitate mathematical understanding and clarity. These findings align with Hattie's (2008) research affirming the importance of the teacher for student academic success. For the Pākehā/European and Asia students in the current study, their individualist or high power cultural values, or their lack of exposure to collaborative and peer learning, may have contributed to their valuing of teacher led instruction, and independent mathematics learning. Implications of this in the mathematics classroom may include teacher's communicating more explicitly the benefits of developing mathematical practices linked to mathematical argumentation and collaboration (Hunter, 2006).

Conversely, the Māori and Pāsifika students espoused mathematics education values that reflected their collectivist cultural values, that is *collaboration-group work, family,* and *respect*. There is a growing body of research (e.g. Averill, 2012a; Bishop et al., 2003; Hunter et al., 2016; Hunter & Anthony, 2011) demonstrating the importance of attending to Pāsifika/Māori cultural values in mathematics education. For example, Hunter and Anthony (2011) and Averill (2012a) reported that drawing upon collectivist values in the mathematics classroom improved students' cognitive thinking, engagement and attitudes towards mathematics, mathematical confidence, and decreased disruptive behaviours amongst Māori and Pāsifika students'.

Implications of the current findings may include teachers of Māori and Pāsifika reinforcing positive and respectful relationships with their students (Averill, 2012a), drawing upon family values (for example collective responsibility) in classroom practice (Cheung, 2015), or allowing multiple opportunities for students to engage with collaborative mathematics activities (Hunter & Anthony, 2011).

6.4 OPPORTUNITIES FOR FURTHER RESEARCH

This study explored the mathematics education values held by culturally diverse students using a survey format. Surveying values has its benefits, such as directing attention specifically to values of interest. This is important because even adults have difficulty articulating their values, because in our society, the term "value" often conjures feelings of right and wrong, and judgment (Clarkson et al., 2000). Nonetheless, surveying values has its downfalls, for example, the possibility of missing important mathematics education values as expressed by the students. A grounded theory approach could be used to construct a new survey, where values articulated during an initial interview are used to create the survey.

As with any survey, there are always questions about their validity in capturing the true thoughts of the individual. Were the students in the current study ranking their true values, or were they ranking values they believed they ought to be endorsing? In light of this, incorporating classroom observations may provide a more holistic approach to studying values. Clarkson and colleagues (2000) argue that "values are beliefs in action" (p. 191). If this is true, then values can be observed by our behaviour. A follow up investigation could combine a survey with classroom observations.

In this study, research by Hofstede and colleagues (2010) and Ministry of Education documents (2011, 2013b) were used to inform the cultural values endorsed by students from different ethnicities. However, the cultural values of migrant samples may not always reflect the cultural values endorsed in the students' country of origin (Phinney et al., 2001). For example, the East Asian students in the current study, despite being collectivist cultures, endorsed individualist mathematics education values. Therefore, it would be worthy to survey how strongly individual students identified with specific cultural values. For example, a survey could be used to indicate the positioning of students along Hofstede and colleagues (2010) cultural values continuum (for example, the collectivist-individualist continuum).

A possible limitation of this study was its failure to account for differences in classroom experience. Unlike the Pākehā/European and Asian students, the Pāsifika and Māori students were participating in the DMIC programme (see Section 3.6). A follow up investigation could incorporate Pāsifika and Māori students not participating in the DMIC programme to provide a better comparative research sample. Alternatively, it would be valuable to investigate how mathematics education values can change as a result of differing classroom experiences. This would have implications for effective teaching and learning, and could provide a strong indicator of the success of a mathematical intervention such as the DMIC study. Therefore, examining students' mathematics education values prior to, and following completion of the DMIC programme would be of interest.

Lastly, the sample sizes for the Pākehā/European, East Asian and Māori cohort were relatively small. Furthermore, the Pākehā/European and Asian students all attended a high decile school, and likewise the Māori and Pāsifika who attended low decile schools. These factors may limit the generalisability of the findings to other middle school students. Further research could extend the sample size, and include students from a wider range schools.

6.5 CONCLUDING THOUGHTS

The intention of this research was to examine the self-reported mathematics education values endorsed by a cohort of diverse middle school students, including Pākehā/European, East Asian, Māori, and Pāsifika. Mathematics values research is a relatively new field (Bishop, 2008). However, values in mathematics are the focus of increasing research interest (e.g., Hannula, 2012; Seah et al., 2016; Zhang et al., 2016) because of the ability of values to influence learning behaviour (for example mathematical engagement), and their stability in comparison to other affective dimensions (that is attitudes, beliefs and emotions).

The majority of values research has focused on Asian populations with minimal research exploring a New Zealand context, particularly investigating values amongst culturally diverse mathematics learners. The results from the current study demonstrated that culturally diverse middle students shared three mathematics education values, that is *utility, effort/practice* and *flexibility*. Nonetheless, students from different cultures (and from different mathematics learning environments) were found to endorse alternate values as most and least important for their mathematics learning, and these mathematics education values were reflective of the students' cultural values. Research (e.g., Averill, 2009; Hunter & Anthony, 2011; Kalogeropoulos & Bishop, 2017) shows mathematics learning outcomes are enhanced when teachers attend to the values of their students. The results from the current study highlight the alignment of students' cultural values with their mathematics education values, demonstrating the importance of attending to culture in diverse mathematics classrooms.

An unintended finding of this project was the impact of classroom norms and pedagogy on students' mathematics education values; such that inquiry focused classrooms may have influenced the Māori and Pāsifika students' collaborative mathematics education values. Likewise, an absence of collaborative classroom practices may have influenced the Pākehā/European and Asian students' independent mathematics education values. Values inculcation may have significant benefits, and help foster key competencies necessary for an empowered 21st century mathematics learner (Anthony & Hunter, 2017). Influencing appropriate values in the mathematics classroom may enhance students' mathematics learning and make positive differences in the students' life chances and future civic participation (Anthony & Walshaw, 2007; Hunter & Anthony, 2011). Further investigation is required to determine the degree of mathematics value inculcation through classroom experience.

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APPENDIX A: PRINCIPAL INFORMATION SHEET AND CONSENT FORM

What Culturally Diverse Middle School Students Value for their Mathematics Learning

Dear (Principal of school)

My name is Julia Hill and I am Masters student within the Institute of Education at Massey University. My supervisors are Dr Jodie Hunter, Prof Roberta Hunter and Prof Glenda Anthony. I am interested in what middle school students value as important for their mathematics learning.

I would like to undertake a project at (name of school) to investigate children's mathematics education values. I would like to ask your permission to interview students in your middle school classrooms (Years 7 and 8). I anticipate the interview will take approximately ten minutes. The interview will be audiotaped, and transcribed at a later date.

The participation of middle school classrooms in voluntary, and verbal consent will initially be sought from all the middle school teachers in your school. For the teachers who consent to participate, all students in their classrooms will be provided with an information sheet and consent form to be sent home to the students' parents/caregiver. Students who return a signed consent form from their parents/caregiver will be eligible to participate in the study.

All data (survey forms and audio files) will be stored in a secure location, with no public access and used only for this research. To maintain anonymity, the school name and names of all children/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.

If you are happy for this project to be undertaken at (name of school), please complete the attached consent form.

Kind regards,

Julia Hill: Massey University, School of Education. Email: J.L.Hill@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

PRINCIPAL CONSENT FORM

What Culturally Diverse Middle School Students Value for their Mathematics Learning

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

I ………………………… (Principal of school) have read the Information Sheet. My questions have been answered to my satisfaction, and I understand that …………………(name of school) can withdraw from the study at any time without prejudice.

Principal Consent

I agree / do not agree (Circle one) for Julia Hill to interview students in middle school classrooms at …………………………………… (name of school).

I agree for …………………………… (name of school) to participate in this study under the conditions set out in the Information Sheet.

Principals Signature: .... **Date:** ....

Full Name - printed ....

APPENDIX B: PARENT & STUDENT INFORMATION SHEET AND CONSENT FORM

What Culturally Diverse Middle School Students Value for their Mathematics Learning

A team from Massey University (Dr Jodie Hunter, Professor Glenda Anthony, Associate Professor Roberta Hunter and Julia Hill) will be working with a number of schools thought-out Auckland, to investigate the mathematical values held by students in middle school. To help us better understand what children think about mathematics, we would like to interview a number of students in Years 7 and 8.

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

- participate in an audio-taped interview for about 10 minutes, during a time approved by their classroom teacher.

All data 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/teachers will be assigned pseudonyms in any publications arising from this research. At the end of the study, a summary will be provided to the school and made available for you to read.

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

- decline to participate;
- decline to answer any particular question;
- in any interview have the right to ask for the audio-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 a child's name will not be used unless you give permission to the researcher;
- be given access to a summary of the project findings when it is concluded.

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

Julia Hill: Massey University, School of Education. Email: J.L.Hill@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

PARENT & STUDENT CONSENT FORM

What Culturally Diverse Middle School Students Value for their Mathematics Learning

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

We (parent and child) have read the Information Sheet and have had the details of the project explained to us. Our questions have been answered to our satisfaction, and we understand that we may ask further questions at any time.

Student Consent (with parent signature also)

I agree / do not agree (Circle one) to complete a brief in-class student interview.

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

Child Signature: .... **Date:** ....

Full Name - printed ....

Parent Signature: .... **Date:** ....

Full Name - printed ....

APPENDIX C: VALUES SURVEY

PLEASE NUMBER IN ORDER OF IMPORTANCE:
FROM 1 (THE MOST IMPORTANT) to 12 (THE LEAST IMPORTANT)

________ I learn more in maths by working with other children

________ Maths involves looking for different ways to find the answer

________ It is important to respect and like my maths teacher and for them to respect me

________ It is important for maths to be useful in real life/for my future

________ To be good at maths I need to practise with lots of questions

________ I cannot be good at maths without the support/love/guidance of my whanau/family

________ Maths needs to be clear and make sense to me

________ It is important to talk about my ideas in a group or with a partner

________ If I can't solve a difficult maths problem, I need to keep working at it

________ It is important to feel like I belong in my maths class

________ It is important to get the correct/right answer in maths

________ My maths teacher needs to explain it to me properly so I understand