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The Role of Parents in Children's Attitudes towards Mathematics

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Abstract

This study investigates the types of parental involvement in mathematics that occur in the home and how this is connected to children's attitudes towards mathematics. A mixed-method design was utilised whereby data was collected through parent and child questionnaires and a semi-structured parent interview. Fourteen families completed the questionnaire and of the 14, eight parents participated in a follow-up interview. The majority of parents and children in this study reported positive attitudes towards mathematics and parents' involvement in homework was the most commonly reported activity. This study suggests that indirect types of parental involvement, such as parents' attitudes towards mathematics, may be more important in children's attitudes towards mathematics than direct types of parental involvement, such as homework.

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Chapter One: Introduction

The Study in Context

Children's attitudes towards mathematics and parental involvement in mathematics are both important in their contribution to children's learning outcomes in mathematics, such as achievement, motivation, performance, and participation (e.g., Carmichael, MacDonald, & McFarland, 2014; Galindo & Sheldon, 2010; Georgiou & Tourva, 2007; Hemmings, Grootenboer, & Kay, 2011; LeFevre et al., 2009; Ma & Xu, 2004). Previous research has alluded to the connection, mentioning that parental involvement may be important to consider in research about children's attitudes towards mathematics, but it is not a common focus of research (e.g., Adelson, & McCoach, 2011; Galindo & Sheldon, 2010; LeFevre et al., 2009). It is important to consider the role of parents in children's attitudes towards mathematics in gaining insight into the possibility of parental involvement as providing a way to potentially improve children's attitudes towards mathematics and learning outcomes in mathematics.

Children's attitudes towards mathematics can be considered from several different aspects such as self-efficacy, self-concept, enjoyment, and anxiety, all of which have been found to have different implications for children's learning outcomes in mathematics. For example, children's perception of their ability, their self-efficacy and self-concept, can affect achievement and performance, therefore affecting their motivation in subsequent tasks (e.g., Adelson & McCoach, 2011; Ferla, Valcke, & Cai, 2009; Martino & Zan, 2011; Pinxton et al., 2012; Summers, Schallert, & Ritter, 2003; Vandecandelaere et al., 2012; Williams & Williams, 2010). Moreover, children's feelings, their enjoyment or anxiety, towards mathematics can affect attention and engagement in mathematics (Martino & Zan, 2011; Hannula, 2002). While positive attitudes towards mathematics can result in positive learning outcomes in mathematics, and negative attitudes can result in negative learning outcomes in mathematics, the type of learning outcome that occurs depends on which aspect of a child's attitude has been affected: Self-efficacy, self-concept, enjoyment, or anxiety. This depends on several external factors within a child's environment including the types of support that children

receive (Adelson & McCoach, 2011; Muzzatti & Angoli, 2007; Rice et al, 2013). Parents are one type of support that can be seen to contribute to children's attitudes towards mathematics.

Parental involvement, like children's attitudes, is important because of its complex association to children's learning outcomes in mathematics. Many types of parental involvement have been found to affect children's learning outcomes in different ways; some types of involvement have been found to improve children's learning outcomes, while some have been found to hinder it (e.g., Cao, Bishop, & Forgasz, 2006; Galindo & Sheldon, 2010; LeFevre et al., 2009; Muir, 2012). For example, if parents communicate with their child about mathematics in a positive manner, such as playing mathematics-related activities or displaying support and encouragement, then this has been found to improve children's learning outcomes in mathematics such as achievement and participation, as well as enjoyment in mathematics (Cao et al., 2006; Clinton & Hattie, 2013; Galindo & Sheldon, 2010; Kilman, 2006; LeFevre et al., 2009; Tan & Goldberg, 2009; Vukovic, Roberts, & Wright, 2013). However, if parents display negative attitudes towards mathematics, have low expectations of their child, and help their child in ways that undermine their child's ability, such as the roles that parents take on in helping in homework, then this is suggested to result in lower performance, participation, and achievement in mathematics (Cao et al., 2006; Gunderson, Ramirez, Levine, & Beilock, 2012; Muir, 2012).

Research Problem

Children's attitudes towards mathematics and parental involvement in mathematics are important because of their contributions towards children's learning outcomes in mathematics. Thus the connection between parental involvement and children's attitudes towards mathematics should also be considered as important regarding its potential contribution towards children's learning outcomes. However, research that focuses on the connection between children's attitudes towards mathematics and parental involvement in mathematics is limited (Adelson, & McCoach, 2011; Galindo & Sheldon, 2010; LeFevre et al., 2009). The connection between children's attitudes and parental

involvement has been mentioned, but it is not a common focus of research (Adelson, & McCoach, 2011; Galindo & Sheldon, 2010; LeFevre et al., 2009). The research that has alluded to this connection have found that parental involvement can affect children's self-concept, self-esteem, and general attitudes towards mathematics (e.g., Demaray et al., 2009; Summers, 2006; Vukovic et al., 2013). This can occur through parents' own beliefs and attitudes towards mathematics, and also through their behaviour and engagement in mathematics-related activities (Galindo & Sheldon, 2010; Kilman, 2006; Muir, 2011; Skwarchuk, 2009). It is evident that parental involvement has a connection to children's attitudes towards mathematics; parental involvement could provide a way to facilitate children's positive attitudes towards mathematics, subsequently improving learning outcomes. Thus it is important to further research the role of parents in children's attitudes towards mathematics.

This Study

This study explores parental involvement in the home and how this is linked to children's attitudes towards mathematics in order to gain more insight into the connection between the two. The question posed in this thesis is:

> What is the connection between parents' involvement in their child's mathematics learning and the child's attitudes towards mathematics?

Structure of the Thesis

In Chapter Two the literature review provides an analysis of current knowledge about parents' involvement in mathematics and children's attitudes towards mathematics as well as the connections that have been found between the two entities. Chapter Three examines existing knowledge about using a mixed-method design and outlines this study. The findings are then presented in Chapter Four, where the data collected is organised according to themes. Finally, Chapter Five presents a discussion and conclusion of this thesis' findings with the literature, in the attempt to consolidate its purpose and the need for similar research in the area of the role of parents in children's attitudes towards mathematics.

Chapter Two: Literature Review

2.1 Attitudes towards Mathematics

The following section critically examines the literature pertaining to children's attitudes towards mathematics. It focuses first on definitions that describe the different aspects of mathematics attitudes. This is then used to explore different ways that attitudes influence, and are influenced by, internal and external factors that encompass children's lives. Support, achievement, and perceptions are predominantly emphasised as important factors in children's attitudes towards mathematics.

2.1.1 Definitions

Attitudes, along with several different terms that are related, such as beliefs and emotions, have been coined as the affective domain (Grootenboer et al., 2008; Hannula, 2002; Martino & Zan, 2011). However, affect is also used to describe a person's response to a particular situation. This response is relative to their perceptions and previous experience of similar situations and attitude towards those types of circumstances (Martino & Zan, 2011). Other terms used within the affective domain related to attitudes are self-concept and self-efficacy. Given the cross-over between terms that are associated with attitudes, it is difficult to provide a short and succinct definition of attitudes that adequately portrays the nature of attitudes. It is important to examine the different terms used within the literature in order to understand the complexity of attitudes towards mathematics and it's many different contributions to people's learning outcomes in mathematics (e.g., Adelson & McCoach, 2011; Ocak & Yamac, 2013; Stodolsky, Salk, & Glassener, 1991; Williams & Williams, 2010). Learning outcomes in mathematics include children's achievement (successful completion of a task), performance (action of performing a task), motivation (willingness to perform a task), and participation (action of taking part in a task) (Oxford University Press, 2015). The following section explores terms that are a part of the attitudes domain and the importance of understanding these terms.

Beliefs

Beliefs are the generally ingrained opinions that a person holds in relation to a topic and are not as changeable as other parts of the affective domain, such as emotions and attitudes (Hannula, 2002; Martino & Zan, 2011). Beliefs are not directly observable, but can be investigated through people's thoughts and actions (Martino & Zan, 2011). Terms such as self-perception, self-efficacy, and self-concept have been used to investigate people's beliefs about mathematics (Williams & Williams, 2010). Each of these terms relate to different types of opinions that a person can hold about mathematics (Vandecandelaere et al., 2012).

The term self-perception is used to describe a person's views that they hold about themselves in relation to mathematics (Ferla, Valcke, & Cai, 2009; Williams & Williams, 2010). When defining self-perceptions in mathematics, the terms self-concept and self-efficacy are commonly used (Williams & Williams, 2010). Both refer to a person's perception of their ability in mathematics. However, whilst similar in definition, they refer to different types of mathematics. Self-concept refers to a person's belief in their ability in mathematics in general, while self-efficacy refers to a person's belief in their ability to complete a mathematics task (Vandecandelaere et al., 2012). These terms are equally important as they have been found to be related to different learning outcomes in mathematics for children (e.g., Adelson & McCoach, 2011; Ferla et al., 2009; Martino & Zan, 2011; Pinxton et al., 2012; Summers, Schallert, & Ritter, 2003; Williams & Williams, 2010; Vandecandelaere et al., 2012). These outcomes include achievement, motivation, performance, and participation.

Self-concept refers to children's perceptions of their ability to do well in mathematics (Vandecandelaere et al., 2012). This term includes children's self-evaluation, self-belief, and self-esteem (Adelson & McCoach, 2011; Demaray et al., 2009; Ferla et al., 2009; Williams & Williams, 2010). Essentially, it covers any perceptions that children hold about their ability in mathematics in general. It is an important term to consider because of its association with different types of learning outcomes, such as achievement, performance, and motivation (Adelson & McCoach, 2011; Ferla et al., 2009; Pinxton et al., 2012; Summers et al., 2003; Williams & Williams, 2010; Vandecandelaere et al., 2012). This is because

people's self-concept affects how they will react to mathematics, therefore affecting the aforementioned learning outcomes in mathematics (Pinxton et al., 2012).

Self-efficacy is the term used to describe a person's perception about their ability to do a specific task; this term originates from Bandura's Social Learning Theory (Anjum, 2006; Pajares & Kranzler, 1995; Williams & Williams, 2010). Feelings of self-efficacy originate from experiences in a task; this can be directly or vicariously (Williams & Williams, 2010). It can also refer to a person's self-perceived confidence (Ferla et al., 2009). However, self-efficacy does not refer to a person's perception of ability in mathematics in general (Williams & Williams, 2010). This is because self-efficacy is considered a state and not a trait, and so it is better used as a measure of competence in specific tasks rather than competence in general (Anjum, 2006). This term is important to understand as it has been found that ability in mathematics is at least somewhat influenced by a person's perception of their capabilities (Pajares & Kranzler, 1995). Furthermore it has been found to be associated with a person's achievement, performance, and participation in mathematics (Anjum, 2006; Ferla et al., 2009; Ocak, & Yamac, 2013; Pajares & Kranzler, 1995; Williams & Williams, 2010).

Children have been found to be generally overconfident in their self-efficacy in mathematics (Anjum, 2006). That is, children have been found to have higher belief in their ability to perform a task than their actual ability to perform the task. This is modified by their experiences in mathematics over time; self-efficacy lessens as children become older (Williams & Williams, 2010). Over-estimation of self-efficacy can serve to increase performance and persistence, and so may be useful to consider in fostering positive attitudes towards mathematics at younger ages (Anjum, 2006).

Emotions

Emotions are considered as the physiological reactions to particular situations (Martino & Zan, 2011). The reactions are fuelled by the existing beliefs that a person holds (Martino & Zan, 2011). Emotions are not directly in response to a situation, but are a response to a person's interpretation of the situation (Martino & Zan, 2011). Generally emotions divide into expressions of like or dislike

(Hannula, 2002). They occur in relation to objects, events, and people, and the reaction may differ according to the context of the situation (Martino & Zan, 2011). These emotions can become automatic responses (Hannula, 2002).

Emotions are important because they influence a person's attention, memory, and actions (Martino & Zan, 2011). They are also important because of their connection to beliefs and attitudes, and therefore important in their contribution to the understanding of attitudes towards mathematics (Hannula, 2002). In research about emotions and children's attitudes towards mathematics, the term affect is used. Affect describes a person's response to a particular situation. This response is relative to their perceptions and previous experiences of similar situations, which results in their attitude towards these situations (Martino & Zan, 2011). Affect is better explained as a person's feelings towards a subject: the expression of pleasure or displeasure. In research about affect that is related to mathematics, anxiety and enjoyment are commonly discussed, although anxiety has received more attention within the literature than enjoyment (Martino & Zan, 2011; Pinxton et al., 2012). This is because mathematics is met with mostly negative attitudes; it is commonly believed in society that mathematics is difficult and therefore met with feelings of disdain (Martino & Zan, 2011). However, both concepts are equally important in understanding the different influences that affect has on attitudes towards mathematics.

Anxiety in mathematics is described as feelings of tension and nervousness that can interfere with a person's ability to complete mathematics tasks (Ashcraft & Moore, 2009; Gierl & Bisanz, 1995; Sherman & Wither, 2003). Two types of anxiety arise within the attitudes literature: test anxiety and problem-solving anxiety (Gierl & Bisanz, 1995). Mathematics anxiety is important to understand because it is associated with lower learning outcomes such as achievement, performance, and participation, as well as enjoyment in mathematics; this is especially applicable in test conditions or when under pressure (Ashcraft & Moore, 2009; Gierl & Bisanz, 1995; Vukovic, Roberts, & Wright, 2013).

It has been hypothesised that anxiety could be associated with a smaller working memory and that anxiety hinders a child's ability to perform a task

competently (Sherman & Wither, 2003). Anxiety in mathematics may impair the working memory, which is needed to complete mathematics tasks. This can explain people's inability to complete tasks effectively when they are anxious (Ashcraft & Moore, 2009). The change in performance due to anxiety has been coined the "affective drop" (Ashcraft & Moore, 2009, p198). Children with mathematics anxiety have been found to report lower levels of enjoyment, self-concept, and higher avoidance rates than children without mathematics anxiety (Vukovic et al., 2013). Also, children become more anxious about mathematics as they get older (Ashcraft & Moore, 2009; Gierl & Bisanz, 1995). This awareness is important because it helps to explain why some children, especially older children, may have negative attitudes towards mathematics.

Enjoyment can be defined as the extent to which a person enjoys mathematics classes and the subject matter (Vandecandelaere et al., 2012). It is considered to be the main positive component of the emotions aspect of the attitudes domain (Frenzel et al., 2009). It has also been referred to as positive affect (Pinxton et al., 2012). Research on emotion in mathematics has widely focused on negative emotions related to mathematics, and research on positive emotions are limited (Pinxton et al., 2012). Enjoyment has been considered as a main component of a person's attitude towards mathematics and should be given more emphasis due to its implications for children's attitudes towards mathematics (Frenzel et al., 2009; Pinxton et al., 2012; Vandecandelaere et al., 2012). Implications include achievement, participation, and performance.

Children's enjoyment in mathematics is important for the quality of children's learning in mathematics (Frenzel et al., 2009). If children enjoy mathematics more, they will learn more mathematics (Frenzel et al., 2009). Enjoyment is therefore presumed to foster positive outcomes such as increased problem-solving skills, motivation, participation, and persistence (Frenzel et al., 2009; Pinxton et al., 2012). Moreover, enjoyment has been found to be related to long-term outcomes such as increased and future participation (Pinxton et al., 2012). Enjoyment has also been linked with performance, but other aspects of people's attitudes, like self-concept, is suggested to be more predictive of performance than enjoyment (Pinxton et al., 2012).

2.1.2 Factors Affecting Attitudes

External and internal factors exist that affect children's attitudes towards mathematics. Namely, this includes how a person thinks about mathematics, their predispositions as a person in society, and how the people around them think about mathematics (Adelson & McCoach, 2011; Muzzatti & Angoli, 2007; Rice et al, 2013). The literature suggests factors such as children's perceptions, achievement, gender, and support have received the most attention and have been found to influence children's attitudes towards mathematics in different ways (e.g., Adelson & McCoach, 2011; Muzzatti & Angoli, 2007; Papanastasiou, 2000; Rice et al., 2013). The ways in which these factors influence children's attitudes will be discussed in the following section.

Internal

Internal factors refer to individual aspects that can affect how a person feels and thinks about mathematics (Martino & Zan, 2011). This is the beliefs aspect of a person's attitude towards mathematics. Internal factors therefore refer to a person's perceptions about mathematics: how they think and feel about the subject (Adelson & McCoach, 2011). People's beliefs about mathematics are important because it affects how they react to mathematics, reinforcing their existing thoughts and attitudes towards mathematics (Martino & Zan, 2011).

The perceptions children hold about mathematics can influence their achievement and learning (Adelson & McCoach, 2011; Stodolsky et al., 1991). Common perceptions in mathematics include enjoyment, ability, and usefulness. Enjoyment of mathematics has been found to be associated with mathematics ability, whereas enjoyment and perceived usefulness are seen to be related to mathematical persistence and enrolment in future courses in mathematics (Adelson & McCoach, 2011). This indicates that these factors are interrelated and have a combined influence on children's learning outcomes in mathematics such as ability, persistence, participation, and achievement (Adelson & McCoach, 2011).

Perceived usefulness is a term used to define children's beliefs about the usefulness of mathematics presently and in the future (Adelson & McCoach,

2011; Bisans & Gierl, 1995; Murimo, 2013).This includes a person's thoughts about its worth, applicability, and practical use (Adelson & McCoach, 2011; Yim & Chapman, 2013). The concept is considered as a part of the affective domain and an important component in attitudes towards mathematics (Murimo, 2013; Vandecandelaere et al., 2012).

It is important for children to perceive mathematics as useful because of its implications in children's learning outcomes (Adelson & McCoach, 2011; Vandecandelaere et al., 2012). Children's perception of the usefulness of mathematics, both immediately and in their future, is a variable shown to be associated with mathematics participation, persistence, motivation, and achievement (Adelson & McCoach, 2011; Murimo, 2013). How children perceive mathematics is also linked to how they will use mathematics (Young-Loveridge, Taylor, Sharma, & Hawera, 2006).

Adults are suggested to influence children's perceived usefulness of mathematics (Adelson & McCoach, 2011; Bisans & Gierl., 1995). This can be through societal beliefs and family situations. Children whose parents have higher levels of education and more possessions are more likely to perceive mathematics as useful (Murimo, 2013; Vandecandelaere, 2012). Furthermore, families with higher levels of socio-economic status are likely to perceive mathematics as important for their children and their children's learning outcomes (Avvisati, Bebas, & Guyon, 2010; Murimo, 2013). This helps to explain why family situations influence children's perception of the usefulness of mathematics (Adelson & McCoach., 2011; Murimo, 2013).

The enjoyment of mathematics is seen as the extent to which children enjoy mathematics' classes and the subject matter (Vandecandelaere et al., 2012). It is considered to be a part of the affective dimension of the attitudes domain. Enjoyment in mathematics is an important aspect to understand as this has several implications for children's learning outcomes in mathematics, such as increased problem-solving, motivation, performance, participation, attention, and engagement, as well as their self-concept in mathematics (Adelson & McCoach, 2011; Frenzel et al., 2009; Pinxton et al., 2012; Vandecandelaere et al., 2012). A person's enjoyment in mathematics has been found to be improved by their

participation in mathematics-related games, positive learning environments, and achievement (Vandecandelaere et al., 2012).

The relationship between enjoyment and learning environment has been found to be reciprocal, where enjoyment determines the nature of the learning environment and the learning environment determines enjoyment (Vandecandelaere et al., 2012). This could be related to the classroom and teaching styles. Teacher enjoyment has been found to influence children's enjoyment in mathematics (Frenzel et al., 2009). When teachers display enthusiasm in mathematics, it is suggested that children are more likely to enjoy themselves. This can also be influenced by different teaching styles, affecting the teaching environment. For example, teachers that are motivating and supportive can contribute to children's enjoyment in mathematics (Vandecandelaere et al., 2012).

Games are suggested to increase interest in mathematics because children enjoy activities that are considered as fun (Bragg, 2007). Game-playing has been found to have a positive effect on children's attitudes towards mathematics (Bragg, 2007). Children have reported that they enjoy games that provide a positive experience (Bragg, 2007). However, it may be difficult to measure children's enjoyment of games in relation to their learning due to the ambiguity that surrounds the definition of attitude (Bragg, 2007). Regardless, games have been found to fire children's interest and motivation because children enjoy competition, challenge, and fun (Bragg, 2007).

The relationship between enjoyment and achievement has been found to be reciprocal. That is, if children enjoy mathematics, they are more likely to have high levels of achievement, and if children have high achievement in mathematics, they are more likely to enjoy mathematics (Pinxton et al., 2012). This is important in considering the implications that achievement has for children's enjoyment of mathematics, and therefore, their attitudes towards mathematics.

Perceived ability is the term used for a person's belief in their capability of completing tasks (Adelson & McCoach, 2011; Miserandino, 1996; Pajares & Kranzler, 1995). This is an umbrella term that has been used for self-concept and

self-efficacy (Adelson & McCoach, 2011; Williams & Williams, 2010). Children's perceived ability is important because it has been found to be related to performance, motivation, engagement, ability, participation, and overall attitudes towards mathematics (Jacobs et al., 2002; Miserandino, 1996; Pajares & Kranzler, 1995)

When children have doubts in their ability, the aforementioned factors, such as performance, motivation, and participation, may be hindered (Jacobs et al., 2002). Children are more likely to report low levels of confidence than children who perceive their mathematics at a high level (Young-Loveridge, 1992). It must be noted that actual ability does not reflect a person's perceived ability; actual ability and perceived ability can be different (Miserandino, 1996). However, perceived ability is important as it influences many learning outcomes in children's mathematics.

Factors that can influence children's perceived ability in mathematics include previous experiences in mathematics, and the status and beliefs of the people around them (Miserandino, 1996; Pajares & Kranzler, 1995; Vandecandelaere et al., 2012). Previous performance has been found to help to form a child's perception of ability (Pajares & Kranzler, 1995). This deems their learning experiences important. Furthermore, people in children's lives can influence their perception of ability (Miserandino, 1996). Learning environments, teaching styles, parents' beliefs, and parents' background have all been found to affect certain aspects of children's attitudes (Lindberg, Hyde, & Hirsch, 2008; Miserandino, 1996; Murimo, 2013). Parents' beliefs, such as their perception of their child's competence can affect children's beliefs about themselves (Miserandino, 1996). If parents believe that their children are capable of completing a task, their child is more likely to perceive themselves as capable, therefore affecting their behaviour. Also, families with a high socio-economic status have been found to be associated with better perceptions in ability than those with a low socio-economic status (Lindberg et al., 2008; Murimo, 2013; Vandecandelaere et al., 2012).

External

External factors are aspects of a person's mathematics experienced outside of themselves that affect how they feel and think about mathematics through experience; factors include perceptions about gender, support from teachers, peers, and parents, and achievement in mathematics (Adelson & McCoach, 2011; Muzzatti & Angoli, 2007; Rice et al., 2013). How these factors influence people's attitudes towards mathematics depends on the perceptions that exist about gender and mathematics, the level of support that they receive from their teacher, peers, and/or parents, and their level of achievement in mathematics. These factors can affect children's different perceptions about mathematics in different ways, therefore influencing their attitudes (Adelson & McCoach, 2011). These factors are important in understanding how a child's immediate surroundings can influence their attitudes, thus indicating the importance of children's environments.

Children's attitudes towards mathematics can be influenced according to gender because of the societal beliefs that exist about gender and ability in mathematics (Asante, 2012; Muzzatti & Angoli, 2007; Schwartz & Sinicrope, 2013). The main belief is that boys are better at mathematics than girls (Schwartz & Sinicrope, 2013). This belief can be passed on through teachers, parents, and peers, and ultimately affects children's perceptions of ability in mathematics. The marked difference in boys' and girls' perceptions of their mathematics ability is said to have decreased in recent years, but there is still a notable difference (Jacobs et al., 2002).

Girls have been found to demonstrate lower self-efficacy, self-concept, and self-confidence in their mathematics ability than boys (Asante, 2012; Jacobs et al., 2002; Muzzatti & Angoli, 2007; Young-Loveridge, 1992). These attitudes are said to be more notable later in schooling, rather than at the primary school age (Asante, 2012; Muzzatti & Angoli). This is found to be related to adolescents' susceptibility to social beliefs and change in gender identity around this age (Asante, 2012; Muzzatti & Angoli, 2007). However, some research reports gender differences at younger ages, where boys are more likely than girls to indicate positive attitudes towards mathematics (e.g., Jacobs et al., 2002; Muzzatti &

Angoli, 2007). This is an important issue to note because lower perceptions in ability could affect children's performance in mathematics (Muzzatti & Angoli).

Changes in children's attitudes are more often related to social context than experience (Asante, 2012; LeFevre et. al., 2009; Rice et al., 2013; Skwarchuk, 2009). Social contexts include school and home environments where different types of support in mathematics can affect children's attitudes towards mathematics (Asante, 2012; Rice et al., 2013). High levels of support from home and school have been found to influence children's self-concept, self-esteem, participation, and motivation in mathematics (Demaray et al., 2009; Summers, 2006). However, it is important to note that perceived support determines learning outcomes in mathematics more than actual support (Demaray et al., 2009). Support from more than one source is said to increase the facilitation of positive attitudes towards mathematics, especially when support is received from parents in conjunction with teachers (Ford, Follmer, & Litz, 1998). Peers are another source of support, one which can readily hinder or foster positive attitudes, depending on the overall peer group's perception of mathematics (Rice et al., 2013; Turner et al, 2002).

Social support is considered as any type of support with children's education that comes from teachers, peers, or parents (Rice et al., 2013). For teachers, this namely refers to their work inside the classroom: their teaching style, classroom environment, and overall attitude towards mathematics that they portray (Domino, 2009; Rice et al., 2013; Strayhorn, 2010; Turner et al., 2002). Peer support mainly encompasses the school environment in which a child is learning with their peers (Summers et al., 2003). The nature of the environment, whether or not it supports children's mathematics learning, depends on the attitudes and behaviours of the peer group (Rice et al., 2013). Parents' support is any support that the parent provides that is related to mathematics; this ranges from help with schoolwork at home to communication with the school (Rice et al., 2013). Despite the differences in support from teachers, peers, and parents, all have been found to influence children's learning outcomes in mathematics and their attitudes towards mathematics to some extent (Ahmed, Minnaert, van der Werf, & Kuyper, 2010; Demaray, 2005).

Teachers are seen to influence children's attitudes towards mathematics through their teaching techniques, classroom environment, and their actions and behaviour towards mathematics (Domino, 2009). This is because they largely determine the classroom environment (Rice et al., 2013; Strayhorn, 2010; Turner et al., 2002). For example, 'fun' lessons, where the teacher displays enthusiasm and mediates activities that children consider as fun, have been found to increase positive attitudes towards mathematics. This is because teacher support can affect children's perceptions about mathematics (Domino, 2009). A teacher's influence on perceptions has been found to occur indirectly, through the teacher's actions and behaviours. For example, if the teacher shows enjoyment in what they are teaching, this affects their teaching style and the environment which results in a more enjoyable lesson for children (Domino, 2009; Rice et al., 2013).

Peers influence children's mathematics achievement and attitudes through a child's desire for acceptance; this includes one's need for approval, identification with friends, the need to be correct, and the need for self-enhancement (Summers et al., 2003). Peers within the school environment provide an academic comparison group for this to happen (Rice et al., 2013). It has been found that positive support from peers can result in positive attitudes, whereas negative support can lead to negative attitudes, anxiety, and avoidance in learning (Rice et al., 2013; Turner et al., 2002). Peer support is therefore associated with enjoyment, anxiety, self-concept, and interest in mathematics (Ahmed et al, 2010; Bragg, 2007; Chen, 2005; Summers et al., 2006; Rice et al., 2013).

Parental support is complex in nature as it encompasses several roles that parents can take on in order to help their children in mathematics. Different roles can have different effects on children's attitudes towards mathematics (Fan & Chen, 2001). These roles can include helping with homework, everyday conversations about mathematics, and communication with the teacher (Cai, 2003; Georgiou & Tourva, 2007). Overall, parental involvement has been found to increase positive attitudes towards mathematics, affecting self-concept, self-efficacy, and affect (Demaray, 2005; Fan, Williams, & Watson, 2011; Ford et al., 1998; Morgan & Merttens, 2007; Sui-chu & Willms, 1996; Vukovic et al., 2013). Moreover, parents can influence children's attitudes towards mathematics through

their own attitudes, actions, and behaviours; this is similar to the effect of teachers (Lindberg et al., 2008; Murimo, 2013; Rice et al., 2013).

Teacher, peer, and parental support is important because of the multitude of ways that they can influence children's attitudes towards mathematics. This is seen in the environment that they create through their own attitudes, behaviours, and actions related to mathematics (e.g., Domino, 2009; Lindberg et al., 2008; Murimo, 2013; Rice et al., 2013). Teacher, peer, and parental contribution has been found to affect a large range of perceptions and outcomes associated with children's attitudes towards mathematics, therefore due consideration about children's attitudes should be given with such support in mind (LeFevre et al., 2009; Rice et al., 2013).

2.1.3 Factors Influenced by Attitudes

It has been found that several factors can be influenced by children's attitudes towards mathematics (e.g., Adelson & McCoach, 2011; Ocak & Yamac, 2013; Stodolsky et al., 1991; Williams & Williams, 2010). Achievement is a commonly discussed factor related to attitudes towards mathematics as both influenced by attitudes and influencing attitudes (e.g., Papanastasiou, 2000; Xin & Xu, 2004). Other factors include (but are not limited to) children's motivation, performance, and participation in mathematics (e.g., Adelson & McCoach, 2011; Ocak & Yamac, 2013; Stodolsky et al., 1991; Williams & Williams, 2010).

It is important to understand how attitudes influence, and are influenced by mathematics learning because of the implications attitudes have for children's learning outcomes in mathematics (Ocak, & Yamac, 2013). Children's perceptions about mathematics and their overall attitudes towards mathematics have been found to be related to different learning outcomes in mathematics such as motivation, participation, performance, and overall marks in mathematics (e.g., Adelson & McCoach, 2011; Carmichael, MacDonald, & McFarland, 2013; Hemming & Kay, 2010; Teoh, Koo, & Singh, 2010; Wang, 2011; Williams & Williams, 2010; Yurt, 2014). For example, higher levels of self-concept have been found to increase motivation, whereas high levels of self-efficacy have been found to increase performance and participation in mathematics. However, both are seen to boost mathematics achievement (Ocak, & Yamac, 2013; Williams & Williams,

2010). It is helpful to include different aspects of attitudes, like self-concept and self-efficacy, in order to understand learning outcomes in mathematics both individually and in general. This is to better understand the complexity of the nature of attitudes and the factors that it influences and are influenced by.

Much focus has been placed in the literature upon the relationship between children's attitudes towards mathematics and mathematics achievement (e.g., Carmichael et al., 2013; Hemmings et al., 2011; Ma & Xu, 2004). However, the direction of the influence between the two remains unclear. Several studies within the literature have attempted to investigate which factor causes the other, but results between studies still appear to be inconsistent (e.g., Carmichael et al., 2013; Hemmings et al., 2011; Ma & Xu, 2004; Papanastasiou, 2000; Teoh et al., 2010; Yurt, 2013). However, understanding this relationship between attitudes and achievement is important in improving the teaching and learning of mathematics (Hemmings et al., Yurt, 2014).

Several studies argue that children's attitudes towards mathematics influences their achievement in mathematics (e.g., Carmichael et al., 2013; Hemmings et al., 2011; Hemming & Kay, 2010). Generally speaking, research reporting how attitudes influence achievement have found that children with positive attitudes towards mathematics are more likely to score higher in mathematics than those who have negative attitudes (Carmichael et al., 2013; Hemmings et al., 2011; Hemming & Kay, 2010). Furthermore, positive attitudes are believed to encourage participation, performance, and motivation, whereas negative attitudes are found to result in avoidance, mathematics anxiety, low performance, and low achievement (Gunderson, Ramirez, Levine, & Beilock, 2012; Turner et al., 2002; Stodolsky Et Al., 1991; Leppavirta, 2011).

In contrast to this belief, other studies in the literature have argued that it is achievement that influences children's attitudes towards mathematics (e.g., Ma & Xu, 2004; Papanastasiou, 2000; Stodolsky et al., 1991; Yurt, 2014). Of those who have found that achievement influences attitudes, they maintain the notion that if children achieve well, they will have positive attitudes towards mathematics (Ma & Xu, 2004; Papanastasiou, 2000; Stodolsky et al., 1991; Yurt, 2014). These studies provide a controversial view of the relationship between attitudes and

achievement, arguing that the relationship between the two factors is not clear (Papanastasiou, 2000). This is reinforced by the findings that children who experience high levels of achievement have been found to hold positive attitudes towards mathematics, and children who do not achieve as highly are found to hold negative attitudes towards mathematics (Stodolsky et al., 1991). Furthermore, they argue that even if children have negative attitudes, they may still achieve well because achievement is not affected by children's attitudes towards mathematics (Ma & Xu, 2004; Papanastasiou, 2000; Stodolsky et al., 1991; Yurt, 2014). This would seem to essentially negate the importance of attitudes in children's learning of mathematics.

It appears, given the inconsistency of the literature, that the relationship between children's attitudes towards mathematics and their achievement in mathematics is reciprocal in nature. This has been suggested by several researchers who have investigated the causal relationship between the two (e.g., Asante, 2012; Carmichael et al., 2013; Papanastasiou, 2000; Teoh et al., 2010, Wang, 2011). In these studies, researchers have found that achievement has affected children's attitudes, and in turn attitudes have affected their achievement. For example, motivation has been found to affect children's attitudes towards mathematics, such that if a child can see the positive learning outcomes and success they will have in mathematics, it will justify their positive attitude towards mathematics, therefore increasing participation (Teoh et al., 2010). In addition, children's attitudes have been found to be related to their level of performance, which in turn affects their attitude towards mathematics. This means that if a child has negative attitudes towards mathematics, they are more likely to perform poorly, which in turn reinforces their existing negative attitude (Carmichael et al., 2013). These examples illustrate the mutual relationship that can exist between attitudes and achievement in mathematics. This is important to consider as it could affect the impact that achievement and attitudes have on the teaching and learning of mathematics (Asante, 2012; Carmichael et al., 2013; Papanastasiou, 2000; Teoh et al., 2010, Wang, 2011).

2.1.4 Summary

The three factors of achievement, perceptions, and support are a focus in this literature review because of the complexity of their roles in, and the implications that they have for children's attitudes towards mathematics (e.g., Carmicheal et al., 2013; Hemmings et al., 2011; Ma & Xu; 2004; Rice et al., 2013; Stodolsky et al., 1991). Each factor, while contributing to overall attitudes, contributes to different facets of children's attitudes (e.g., self-concept & self-efficacy) towards mathematics in different ways (e.g., performance, achievement, & motivation). This is important to understand in order to facilitate future learning of mathematics.

The relationship between attitudes and achievement is complex (Carmichael et al., 2013; Hemmings et al., 2011; Ma & Xu, 2004). The findings of the direction of the influence between the two remain inconsistent. Some researchers have argued that attitudes influence achievement, some argue that it is achievement that influences attitudes, and some researchers have suggested that the relationship may be reciprocal. Regardless, it is evident that there is a positive relationship between children's attitudes towards mathematics and their achievement; this has been found to be dependent namely on children's perception of their ability and the type of achievement in question (e.g., Adelson & McCoach, 2011; Carmichael et al., 2013; Hemming & Kay, 2010; Teoh et al., 2010; Wang, 2011; Williams & Williams, 2010; Yurt, 2014).

Perceptions are a factor in children's attitudes towards mathematics that has received attention because of its many different facets and the various implications that can exist for children's achievement and learning in mathematics (Stodolsky et al., 1991). For example, self-efficacy has been found to affect a person's performance, and self-concept can affect not only performance, but also a person's achievement and participation (e.g., Adelson & McCoach, 2011; Anjum, 2006; Ferla et al., 2009; Ocak & Yamac, 2013; Pajares & Kranzler, 1995; Pinxton et al., 2012; Summers et al., 2003; Williams & Williams, 2010; Vandecandelaere et al., 2012. Researchers have found that different aspects of children's attitudes towards mathematics can affect participation, motivation, performance, future subject choice, and overall achievement in mathematics

(Adelson & McCoach, 2011; Stodolsky et al., 1991). It is important to understand each facet in order to examine how together they affect overall attitudes towards mathematics, children's learning, and their achievement in mathematics.

The social support from others that children receive is also important because children's perceptions have been found to be influenced by their support systems (Rice et al., 2013). The support of teachers, peers, and parents can affect children's attitudes towards mathematics: their self-concept, self-efficacy, affect, and perceived usefulness of mathematics. This then affects their motivation and achievement in mathematics (Ahmed et al., 2010; Demaray, 2005). This support affects children's attitudes towards mathematics namely through the feelings and actions of teachers, peers, and parents (e.g., Domino, 2009; Lindberg et al., 2008; Murimo, 2013; Rice et al., 2013). Support is an important factor because it can influence how children think and feel about mathematics, which affects their attitudes towards mathematics, and therefore impacts on their learning outcomes in mathematics.

It is important to understand the many facets of children's attitudes towards mathematics and the factors that influence, and are influenced by attitudes, in understanding how children's attitudes influence their mathematics learning. While it is evident that children's attitudes affect children's learning, this statement does not provide insight into how these attitudes are important in children's learning. Several factors aforementioned such as children's perceptions and social support have different effects on children's achievement in different ways, and so describing and explaining those different effects is crucial in fully appreciating the importance of children's attitudes towards mathematics (Adelson & McCoach, 2011; Asante, 2012; Demaray et al., 2009; Hannula, 2002; Martino & Zan, 2011; LeFevre et. al., 2009; Rice et al., 2013; Skwarchuk, 2009; Summers, 2006).

2.2 Parental Involvement

The following section explores parental involvement in children's mathematics learning. It first describes the different types of involvement that parents can engage in, in order to understand the complexity of involvement and its influences and learning outcomes in mathematics. This section will then explain the factors

that can affect parents' level of involvement, the outcomes of parental involvement, and finally the importance of involvement in the home; its implications, and outcomes will be emphasised.

2.2.1 Definitions

Parental involvement is multi-faceted and encompasses a wide variety of parental behavioural patterns and parental practices (Fan & Chen, 2001). Researchers have previously examined parental involvement according to categories such as: providing support, motivation, monitoring, advice, communication, providing resources to learn, and teaching roles like helping with homework (e.g., Cai, 2003; Georgiou & Tourva, 2007; Hong, Yoo, You & Wu, 2010). More simply, parental involvement can be split into involvement at home and at school. Home involvement is defined as assisting one's own child at home with informal and/or school directed learning in mathematics (Cai, 2003). This can be divided further into reviewing work, monitoring progress, helping with homework, and discussing school events or course issues (Green, Walker, Hover-Dempsey, & Sandler, 2007). School involvement includes any communication or participation that the parent has at school (Cai, 2003; Kilman, 2006; Muir, 2009; Sheldon & Epstein, 2005). This can be further divided into communication with the teacher, participation in school activities, requesting for extra help, and attending workshops to further assist their children (Cai, 2003). The vast number of categories alone indicates the complex nature of parental involvement. However, exploring several types of parental involvement is necessary as it has been found that different types of involvement can have different implications for children's mathematics achievement and other learning outcomes in mathematics (Grolnick, Benjet, Kurowski, & Apostoleris, 1997; Hong, et al., 2010).

Parental Involvement at Home

The most influential contexts in which children's learning and development occurs are at home and at school (Galindo & Sheldon, 2010). Therefore, it is surprising that the literature pertaining to parental involvement at home involving children at the primary school age is scarce (e.g., Cai, 2003; Jackson & Remillard, 2005; LeFevre et al., 2009). Involvement at home is important because the extent to

which parents are involved at home in mathematics activities has been found to enhance children's general attitudes towards mathematics, cognitive development, mathematics skill, mathematics performance, and numeracy knowledge (Galindo & Sheldon, 2010; Kilman, 2006; Muir, 2011; Skwarchuk, 2009). Furthermore, parental involvement at home has been found to be associated with higher learning outcomes in mathematics for children who have previously shown low mathematics skill (Powell, Son, File, & Froiland, 2012). However, this depends on the type of involvement that occurs.

Home has been considered as the basis for supporting learning at school, meaning that early learning at home provides the foundation for learning at school (Hawighorst, 2005). This is partly because of the aforementioned implications it has for children's learning outcomes in mathematics; learning in the home can be seen to further enhance children's learning outcomes in comparison to only learning at school (Galindo & Sheldon, 2010; Hawighorst, 2005; Kilman, 2006; Muir, 2011; Skwarchuk, 2009). When children learn in the home, they integrate the education they receive at home with school education, which improves their learning outcomes (Hawighorst, 2005). Home learning has been suggested to be important because it deals with different kinds of mathematics that is suggested to foster children's interest and participation in mathematics (Hawighorst, 2005; Galindo & Sheldon, 2010). School mathematics are said to contain artificial problems, problems that do not necessarily have real life application for the present situation, where children look for abstractions and generalisations (Hawighorst, 2005). With school mathematics, children are said to be motivated by external factors such as classroom environment. At home, children are looking at practical problems and are suggested to be more motivated by internal factors, such as interest (Hawighorst, 2005). This is important because home can foster children's attitudes towards mathematics in general, thus improving their learning outcomes in mathematics, reiterating the importance of learning at home as a basis for learning at school (Galindo & Sheldon, 2010; Hawighorst, 2005; Kilman, 2006; Muir, 2011; Skwarchuk, 2009).

Involvement in mathematics at home is considered as parents assisting their child at home in informal and in school-directed mathematics-related activities (Cai, 2003). These roles can include parents as motivators, monitors,

resource providers, mathematics content advisers, homework helpers, and mathematics learning counsellors (Cai, 2003; Hoover-Dempsey & Sandler, 2007). Mathematics content adviser, homework helper, and mathematics learning counsellor are roles that parents play in directly assisting children's learning of mathematics at home. Parents as motivator, monitor, and resource provider are roles that parents play in providing emotional and resource support in children's learning and are considered as indirect types of assistance (Cai, 2003). It is more effective for parents to serve the indirect roles of motivators and monitors than to be content advisors in children's mathematics learning at home (Cai, 2003). Direct involvement roles such as content advisors and learning counsellors have been found to be less important predictors of achievement and can be associated with negative learning outcomes in mathematics for children (Cai, 2003; Cao, Bishop, & Forgasz, 2006). It is important to consider both indirect and direct involvement in understanding the type of learning outcomes that direct and indirect involvement can facilitate, such as improved numeracy skill, achievement, performance, and participation (e.g., Cao et al., 2006; Clinton & Hattie, 2013; LeFevre et al., 2009; Galindo & Sheldon, 2010; Vukovic et al., 2013).

Direct involvement at home generally pertains to parents' involvement in tasks purposefully designed to develop and improve children's mathematics skills (Cao et al., 2006; LeFevre et al., 2009). This includes parents in roles such as mathematics content adviser, homework helper, and mathematics learning counsellor (Cai, 2003). These roles usually encompass parents' involvement in mathematics-related homework and games (Cao et al., 2006; Galindo & Sheldon, 2010; LeFevre et al., 2009; Muir, 2012). These roles have been found to be less important for children's achievement than other roles that parents can take on such as motivator, monitor, and resource provider (Cai, 2003). This is because direct involvement has been found to be associated with negative learning outcomes in mathematics for children (Cai, 2003; Cao et al., 2006; Muir, 2012). However, this mostly refers to involvement with homework; some positive learning outcomes have been found for families who engage in other mathematics-related activities, such as games (LeFevre et al., 2009). This is especially applicable for younger children (Cao et al., 2006; LeFevre et al., 2009; Muir, 2012). Positive learning outcomes in mathematics for involvement in games

include increased performance and numeracy skills (LeFevre et al., 2009; Galindo & Sheldon, 2010). This shows that although direct involvement can be associated with negative outcomes, this is not always the case (Cai, 2003; Cao et al., 2006; LeFevre et al., 2009; Muir, 2012).

It has been found that parents often report their involvement in homework but it has also been found that involvement in homework can have a negative impact on children's learning performance and self-concept (Cao et al., 2006; Gunderson et al., 2012; Muir, 2012). This is believed to be because parents are more likely to become engaged in their children's homework tasks by monitoring and supervising their child, often focussing on 'drill and practice' exercises (Muir, 2012). Regardless of the negative impact that has been found to be associated with helping with homework, it is suggested that many parents are limited to this kind of involvement. This may be due to their ability and knowledge in mathematics (Clinton & Hattie, 2013; Muir, 2012).

It may be possible that some types of direct involvement, such as engagement in mathematics-related games and activities could be associated with positive outcomes (LeFevre et al., 2009; Galindo & Sheldon, 2010). Activities at home that support mathematics learning have been reported to include tasks such as cooking, board games, computer games, and shopping (LeFevre et al., 2009; Muir, 2012). Tasks like these have been found to promote positive experiences in mathematics and improve children's learning outcomes in mathematics such as performance and numeracy skills, as well as their self-concept (Galindo & Sheldon, 2010; Kilman, 2006; LeFevre et al., 2009; Tan & Goldberg, 2009).

Indirect involvement at home pertains to support that does not directly relate to helping children with mathematics. This includes encouragement, parents' expectations of their child to achieve in mathematics, communication about mathematics, and parents' attitudes towards mathematics (Cao et al., 2006; Vukovic et al., 2013). Indirect involvement differs from direct involvement such that types of indirect involvement are seen to facilitate children's mathematics learning in roundabout ways that are not necessarily obvious. These roles are important because they have been found to be associated with increased mathematics achievement, participation in mathematics, mathematics self-

efficacy, and mathematics enjoyment (Cao et al., 2006; Clinton & Hattie, 2013; Vukovic et al., 2013).

The role of support from parents is considered to include parents' display of encouragement and interest in children's mathematics learning (Rice et al., 2013). Thus support includes parents' expectations for their child's achievement and family conversations about mathematics (Kaplan, Liu, & Kaplan, 2001; LeFevre et al., 2009; Rice et al., 2013; Tan & Goldberg, 2009). This type of involvement is important because supportive parent-child relationships and interactions can have a positive influence on children's social, emotional, and educational development and can affect children's self-concept and overall attitudes towards mathematics (Kaplan et al., 2001; Rice et al., 2013). It is important to note that although parents' support can be effective, this depends on children's perception of their parents' support (Grolnick, Benjet, Kurowski, & Apostoleris, 1997; Marshall & Swan, 2010; Muir, 2011). If a child does not perceive their parents to be supportive, regardless of parents' actual level of involvement, then this can still result in negative outcomes for children (Grolnick et al., 1997; Marshall & Swan, 2010; Muir, 2011). However, it is important to look at the role of support in understanding ways that parents try to get involved in their child's learning.

Parents' expectation for their child's success is influenced by their perception of their child's ability and perceived difficulty of the task, as well as their own attitude towards mathematics (e.g., Frome & Eccles, 1998; Lindberg et al., 2008; Lopes & Donovan, 2009; Muir, 2009; Tan & Goldberg, 2009). If parents do not believe that their child is very able in mathematics, this could result in lower expectations for their child, which can then influence the child's expectations of themselves (Fan & Chen, 2001; Gunderson et al., 2012; Kaplan et al., 2001; Strayhorn, 2010). Also, if parents have a negative attitude towards mathematics, then this can be projected towards their child through their expectations, shown through parents' reinforcement of desired behaviours that are similar to their own (Kaplan et al., 2001; Strayhorn, 2010). Parents' expectation of their child's achievement is important because it has been found to be associated with children's achievement in mathematics (Fan & Chen, 2001; Kaplan et al., 2001; Strayhorn, 2010).

Communication about mathematics can provide a way in which parents' expectations are transmitted to children (Kaplan et al., 2001). Depending on parents' own feelings about mathematics, the ideas that parents portray to their child in conversing about mathematics can affect children positively or negatively (Tan & Goldberg, 2009). If parents make comments about their contentedness with low achievement in mathematics, this can portray the idea that it is not necessarily important to achieve well in mathematics; this can influence children's expectations of themselves in mathematics (Muir 2009; Tan & Goldberg, 2009). However, if parents portray their expectancy that their child should achieve well in mathematics, this can help to improve children's performance, achievement, self-efficacy, and enjoyment of mathematics (Clinton & Hattie, 2013). Positive communication about mathematics is therefore important in improving children's learning outcomes in mathematics.

Positive parent-child communication relating to mathematics can be seen to include talking about children's school mathematics and incorporating mathematics into everyday conversations (e.g., Kaplan et al., 2001; LeFevre et al., 2009; Tan & Goldberg, 2009). Talking about mathematics in school has been found to be positively associated with children's enjoyment (Cao et al., 2006; Clinton & Hattie, 2013; Tan & Goldberg, 2009). Incorporating mathematics into everyday conversations has been found to improve numeracy skills and overall attitudes towards mathematics (Cao et al., 2006; Clinton & Hattie, 2013; LeFevre et al., 2009). This is important in providing ways that parents can be involved positively at home, as not all parents can be involved in their child's school life (Tan & Goldberg, 2009).

Parental Involvement at School

Involvement at school pertains to parents' communication with the teacher, participation in school activities, and providing extra help for their child, such as requesting for extra help and attending workshops to further help their child (Cai, 2003). Parents' involvement at school is important because it has been found to lead to higher performance for children (Strayhorn, 2010). However, this can sometimes be difficult because of parents' demanding workloads, daily stress, and knowledge and ability to help with mathematics (Holloway & Pimlott-Wilson,

2013; Muir, 2011). Regardless, it is important to build bridges between educators and parents in order to provide a solid education for children and improve children's learning (Cai, 2003; Kilman, 2006; Muir, 2009; Sheldon & Epstein, 2005).

Communication between the school and parents has been found to improve children's achievement; it can provide parents with a better understanding of the difficulties that their children are experiencing in mathematics, more understanding of the mathematics curriculum, and can inform them of ways that they can help their children (Galindo & Sheldon, 2010; Zhao & Akiba, 2009). Conversely, parents who are willing to participate in their child's mathematics learning in a positive way can help teachers by providing additional insight into their child's development that could aid the teacher in providing quality mathematics learning (Muir, 2012). Thus it is important for parents to communicate with teachers to help their children both at school and at home. Communication between the school may also provide the right information in being able to improve the level of parental involvement at home (Zhao & Akiba, 2009).

Parents' involvement in school activities include parents helping in the classroom, attending school events, attending parent-teacher conferences, and participating in mathematics workshops (Tan & Goldberg, 2009). Parental involvement in activities like these is suggested to increase when schools are supportive and enthusiastic about parental involvement. School's support of parental involvement at school can be displayed through the implementation of such activities and practices that encourage these interactions (Kilman, 2006; Morgan & Merttens, 2007; Sheldon, Epstein, & Galindo, 2010). Parental involvement at school is important because it has been found to reduce children's behaviour problems and increase attendance, grades, and overall achievement (Sheldon et al., 2010). However, due to parents' busy lives, involvement can often be limited to when children are struggling or having problems in mathematics (Holloway & Pimlott-Wilson, 2013; Muir, 2011; Tan & Goldberg, 2009; Zhao & Akiba, 2009). When involvement is limited in this way, parental involvement at school can have a negative impact for children as they may associate their parents' involvement with their inability in mathematics, which can then affect children's

mathematics self-concept (Tan & Goldberg, 2009). Thus it is important that parental involvement is not only in response to negative mathematics experiences and/or learning outcomes.

Workshops designed to support parents in their knowledge and understanding about how mathematics is being taught at school is important as it can increase parental involvement (Hyde, Else-Quest, Alibali, & Romberg, 2006; Kilman, 2006; Marshall & Swan, 2010; Morgan & Merttens, 2007; Muir, 2012; Vukovic et al., 2013). Furthermore, it may help to increase parents' teaching confidence, conversations about mathematics at home, and minimise parent deficiencies in mathematics involvement (Hyde et al., 2006 Morgan & Merttens, 2007). The effects for children whose parents participate in mathematics workshops have been found to be an increase in performance, achievement, and overall positive attitudes towards mathematics (Morgan & Merttens, 2007; Vukovic et al., 2013). Furthermore, participation in mathematics workshops could help to strengthen the school-home partnership, which can help to maximise children's mathematics learning (Muir, 2012).

A common issue with parental involvement is that parents are unsure of how best to help their children with mathematics and/or do not have the knowledge and understanding to be effectively involved (e.g., Clinton & Hattie, 2013; Marshall & Swan, 2010; Muir, 2009; Sheldon & Epstein, 2005). This can compound as children move through the grades, and so involvement becomes more difficult (Sheldon & Epstein, 2005). Mathematics workshops are one way to combat parents' confusion about how best to help, but this type of involvement can be difficult to maintain because of parents' busy schedules (e.g., Hyde et al., 2006; Holloway & Pimlott-Wilson, 2013; Kilman, 2006; Marshall & Swan, 2010; Morgan & Merttens, 2007; Muir 2011; Skwarchuk, 2009; Vukovic et al., 2013). Other means of building parents' knowledge is by strengthening home-school partnerships, parent-teacher rapport, having teachers that are enthusiastic about these programmes, and providing simple after-school options and take home exercises that are easy to use and understand (Kilman, 2006; Morgan & Merttens, 2007; Muir, 2012). This provides parents with several ways to expand their mathematics knowledge, enabling them to better help their child's learning in mathematics.

2.2.2 Factors that Influence Parental Involvement

The type and level of parental involvement has been found to be influenced by several factors such as parents' background, the level of mathematics for parent and child, and the child's age (Grolnick et al., 1997; Marshall & Swan, 2010; Muir, 2011). This is because these factors contribute to parents' perception of involvement, which determines the ways in which they get involved. For example, parents with a low level of education may not have the necessary knowledge to teach their child mathematics and instead get involved by monitoring their child's homework (Clinton & Hattie, 2013; Muir, 2009, 2011). This section discusses these aspects, focussing on types of parental involvement, their impacts, and barriers to involvement.

Family background is an important determinant of success at school (e.g., Cai, 2003; Cao et al., 2006; Fan et al., 2011; Marshall & Swan, 2010; Muller, 1998). However, the effectiveness of parental involvement can depend on the type of involvement, which can be influenced by parents' ethnicity, level of education, socio-economic status, and past experiences in mathematics (Avvisati et al., 2010; Grolnick et al., 1997; Muir, 2011; Okpala, 2001; Roopnarine, Krishnakumar, Metindogan, & Evans, 2006). This is because these factors affect parents' perceptions about involvement in their child's mathematics learning, therefore affecting how they become involved (e.g., Grolnick et al., 1997; Gunderson et al., 2012; Hyde et al., 2006; Lindberg et al., 2008; Muir, 2011).

It has been found that parents with a high socio-economic status are more involved than parents with a low socio-economic status (Avvisati et al., 2010; Clinton & Hattie, 2013; Sui-Chu & Willms, 1996). Conversely families from low socio-economic backgrounds are often keen to get involved in their children's learning and may have high expectations of their child, but do not necessarily know how to best help their child (Clinton & Hattie, 2013; Muir, 2009). This has been attributed to their level of education, attitude, and/or experience in mathematics (Avvisati et al., 2010; Clinton & Hattie, 2013; Muir, 2012). It has been suggested that lower socio-economic families struggle being involved because of their previously negative experiences in mathematics (Clinton & Hattie, 2013).

Ethnicity is suggested to have an impact on parents' level of involvement because different cultures may have different ideas about learning and parental involvement in mathematics (Cao et al., 2006; Fan et al., 2011; Grolnick et al., 1997; Strayhorn, 2010). This in turn, can affect how different ethnic families become involved. In New Zealand, it has been found that Pacific and Asian families have the highest expectations of their children in mathematics achievement, in comparison to Māori families who have been found to have lower expectations of their children in their mathematics achievement (Clinton & Hattie, 2013). Regardless of ethnicity, most parents are keen to be involved in their child's mathematics learning but can be unsure of how to best help due to lack of knowledge or past experience in the education system (Clinton & Hattie, 2013; Muir 2012). Thus it appears that level of education or experience could be more important in influencing involvement, rather than cultural differences.

A lack of mathematics content knowledge can limit the ways in which parents are involved in their child's mathematics learning. This may be attributed to their level of education in mathematics (Muir, 2011). Furthermore, the difference between how children are presently taught mathematics in comparison to how parents were taught mathematics can be seen to disadvantage parents in being able to be involved (e.g., Marshalll & Swan, 2010; Muir, 2011). This causes concern for parents as their eagerness to help can be barred by their ability to help. However, a lack of mathematics knowledge helps to explain why it is common for parents to indicate 'monitor of homework' as their role in their involvement with their child's mathematics learning (Clinton & Hattie, 2013; Muir, 2009, 2011, 2012). It could be that their lack of mathematics knowledge limits their involvement to monitoring their children's learning rather than teaching or getting engaged in the mathematics that their child is learning.

Parents' level of education is important because those that have higher levels of education have been found to communicate ideas better and have higher expectations of their child in terms of their mathematics achievement (Lindberg et al., 2008). This is in contrast with parents who have lower levels of education who have reported concerns about homework set, topics learnt at school, and their inability to help. This can create tension and result in negative experiences for

both parents and children (Cai, 2003; Cao et al., 2006; Muir, 2011). It is important that parents are knowledgeable in how best to help their child in improving children's learning outcomes in mathematics. Parents with lower levels of education are unsure or unable to help more than parents with higher levels of education, and so it is important to consider this factor and its' impact on parents' level of involvement (Cai, 2003; Cao et al., 2006; Clinton & Hattie, 2013; Muir, 2009, 2011, 2012).

Parents' past experience in mathematics at school has been found to affect their level of involvement in mathematics (e.g., Clinton & Hattie, 2013; Marshall & Swan, 2010; Muir 2011; Skwarchuk, 2009). Parents who had positive past experiences in mathematics at school have been suggested to be more willing to be involved in children's mathematics learning, whereas parents with negative mathematics experiences are suggested to be uneasy about engaging in mathematics-related activities with their child (Marshall & Swan, 2010; Skwarchuk, 2009). Past experiences can contribute to a person's perceptions about, and attitudes towards mathematics; thus affecting how they engage in mathematics (Rice et al., 2013; Turner et al., 2002). Parents with negative mathematics experiences may not have knowledge necessary to help their child due to a lower level of engagement in their previous mathematics learning, which explains their uneasiness to help (Cai, 2003; Cao et al., 2006; Clinton & Hattie, 2013; Muir, 2011). Thus how a parent has experienced mathematics in the past can affect how they will get engaged in mathematics with their child in the present and future. This is important because it can then affect children's learning outcomes in mathematics.

Parental involvement can also be affected by children's age and level of mathematics (Clinton & Hattie, 2013; Gunderson et al., 2012; LeFevre et al., 2009; Muir, 2012). As children grow older and they become more independent, parents' involvement changes (Green et al., 2007). This may be because of a child's age, but can also be due to the child's level of mathematics (Hoover-Dempsey & Sandler, 2007). At younger ages, pre-school, it has been found that parental involvement in mathematics is consistent (LeFevre et al., 2009). But as children get older, and mathematics becomes more complex, it is common for the

level of parental involvement to decrease (Muir, 2009, 2012). This is found to be attributed to parents' level of understanding and knowledge in mathematics as children progress through school (Muir, 2012). It is suggested that parents may lack the teaching skills needed to help children with more complex mathematics topics, such as fractions or algebra (Muir, 2009). It is important that children perceive their parents as involved in their mathematics learning in order to improve learning outcomes (Clinton & Hattie, 2013).

2.2.3 Summary

Parental involvement is a complex topic regarding the implications that it can have for children's learning outcomes in mathematics; this is dependent on the type of involvement (Grolnick et al., 1997; Hong et al., 2010). Of specific interest are the roles that parents can take on at home to help children with their mathematics. This is because many types of mathematics-related activities at home are associated with positive learning outcomes for children and the home provides a space in which can be used to promote positive attitudes towards mathematics (Galindo & Sheldon, 2010; Kilman, 2006; Muir, 2011; Skwarchuk, 2009). The involvement factors of limited knowledge in mathematics, involvement in homework, and home involvement types associated with positive outcomes (e.g., support, encouragement, attitudes towards mathematics, and participation in mathematics-related conversations and games) are important in understanding how the level and type of involvement is vital in promoting positive learning outcomes for children.

Parents' limited knowledge of mathematics has been found to be a large barrier to parents' ability to be positively involved in children's mathematics learning (Cai, 2003; Cao et al., 2006; Muir, 2011). Lack of knowledge has been found to be attributed to factors such as level of education and past experience (e.g., Marshalll & Swan, 2010; Muir, 2011; Skwarchuk, 2009). Level of education has been found to hinder parents' ability to help as they may not have the mathematics knowledge or teaching skills to help their child. Therefore parents can become limited to only monitoring children's homework, a role associated with negative learning outcomes in mathematics for children (Cao et al., 2006; Gunderson et al., 2012; Muir, 2012). Past experience also limits parents'

knowledge of mathematics if parents have had negative experiences in mathematics which resulted in a negative attitude towards mathematics and disengagement from mathematics (Rice et al., 2013; Turner et al., 2002). This would limit their knowledge in mathematics, thus making them uneasy in their ability to help their child with mathematics.

Homework has received much attention in the literature and is an important aspect of parental involvement to consider due to the amount of parents that report their involvement in homework and because it has been found to be associated with negative learning outcomes and negative attitudes towards mathematics for children (Cao et al., 2006; Gunderson et al., 2012; Muir, 2012). Homework involvement often translates to parents' help in mathematics by monitoring work; this can often result in lower self-concept and achievement in children's mathematics (Cao et al., 2006; Gunderson et al., 2012; Muir, 2012). Given the relationship that involvement in homework has with negative learning outcomes and attitudes for children, it should be surprising that many parents continue to report their involvement in monitoring homework (Clinton & Hattie, 2013; Muir, 2012). However, due to many parents' lack of knowledge, teaching skills, and understanding in mathematics, this trend has continued (Cao et al., 2006; Clinton & Hattie, 2013; Gunderson et al., 2012; Muir, 2012). This is of large importance as it illustrates parents' willingness to be involved, but inability to be involved in ways that may be more advantageous to children's learning outcomes in mathematics (Muir, 2012).

An important consideration from this literature review is parental involvement at home with other activities that have been found to be associated with positive outcomes. These roles include support, encouragement, attitudes towards mathematics, and participation in mathematics-related conversations and games (Cao et al., 2006; Clinton & Hattie, 2013; LeFevre et al., 2009; Galindo & Sheldon, 2010; Muir, 2012; Vukovic et al., 2013). These types of involvement have been associated with positive learning outcomes for children such as achievement, increase in numeracy skills, and improvement in participation in mathematics, as well as positive self-efficacy, self-concept and enjoyment in mathematics (Cao et al., 2006; Clinton & Hattie, 2013; Galindo & Sheldon, 2010; Kilman, 2006; LeFevre et al., 2009; Tan & Goldberg, 2009; Vukovic et al., 2013).

Encouragement, support, and parents' attitude towards mathematics are important as they have been found to influence children's perceptions about themselves and mathematics, which then influences learning outcomes in mathematics (Grolnick et al., 1997; Marshall & Swan, 2010; Muir, 2011). It has been found that if a parent expresses their interest in their child's mathematics learning and engages with their child in a positive manner, then this can result in children's positive perceptions towards mathematics (e.g., Cao et al., 2006; Clinton & Hattie, 2013; LeFevre et al., 2009; Rice et al., 2013). Mathematics-related games and activities are a way in which parents can be positively engaged in and foster children's positive perceptions towards mathematics, thus improving their learning outcomes in mathematics (Kilman, 2006; LeFevre et al., 2009).

This review provides insight into the importance of exploring types of involvement that can promote positive learning outcomes for children and possible reasons as to parents' choices in their level and type of involvement. Given the potential that the home can have in facilitating positive learning outcomes for children, it is surprising that it has received less attention in the literature than involvement in schools (e.g., Cai, 2003; Jackson & Remillard, 2005; LeFevre et al., 2009). Furthermore, of the literature examined about parental involvement at home, much of the research has focused on involvement in homework, which is commonly associated with negative learning outcomes for children and negative attitudes towards mathematics (Cao et al., 2006; Gunderson et al., 2012; Muir, 2012). Parental involvement in homework is commonly attributed to parents' limitations in their abilities to be involved due to their lack of knowledge and teaching skills in mathematics (Clinton & Hattie, 2013; Muir, 2012). Considering other types of parental involvement can enable insight into potential ways that parental involvement can facilitate children's positive attitudes towards mathematics and better learning outcomes in mathematics

2.3 Justification of the Study

Research about children's attitudes towards mathematics and research about parental involvement in mathematics provide a breadth of knowledge and it is evident that children's attitudes and parental involvement are important in their contributions to children's learning outcomes, such as achievement, motivation,

performance, and participation (e.g., Carmichael et al., 2013; Galindo & Sheldon, 2010; Georgiou & Tourva, 2007; Hemmings et al., 2010; LeFevre et al., 2009; Ma & Xu, 2004). However, there is little research that focuses on the connection between children's attitudes and parental involvement, specifically parental involvement at home and with children at the primary school age (e.g., Adelson, & McCoach, 2011; Galindo & Sheldon, 2010; Grootenboer et al., 2008; LeFevre et al., 2009). This is an important area to research because parental involvement could provide a way to facilitate children's positive attitudes towards mathematics therefore enhancing children's learning outcomes in mathematics.

The role of parents in children's attitudes towards mathematics is important because of the types of parents' indirect involvement, specifically at home, that are associated to children's positive attitudes towards mathematics (e.g., Galindo & Sheldon, 2010; Kilman, 2006; Muir, 2011; Skwarchuk, 2009). It has been found that parents' involvement can influence children's perceptions and confidence in mathematics, (self-concept and self-efficacy) and their feelings towards mathematics (anxiety and enjoyment) through different types of involvement, namely parents' perceptions, expectations, support, and attitudes towards mathematics (e.g., Fan & Chen, 2001; Kaplan et al., 2001; LeFevre et al., 2009; Rice et al., 2013; Strayhorn, 2010; Tan & Goldberg, 2009). Other types of involvement at home, such as conversations about mathematics and games in mathematics, can provide ways in which these types of involvement can foster children's positive attitudes towards mathematics (Cao et al., 2006; Clinton & Hattie, 2013; Kilman, 2006; LeFevre et al., 2009; Tan & Goldberg, 2009). Although research has alluded to the connection between children's positive attitudes towards mathematics and parental involvement in mathematics, research that focuses on the connection between children's attitudes and parental involvement is not as common as a focus on teachers or peers (Grootenboer, et al., 2008; LeFevre, et al., 2009).

Furthermore, parental involvement at home has received less attention than parental involvement at school (e.g., Cai, 2003; Jackson & Remillard, 2005; LeFevre et al., 2009). Home involvement should be considered as important because children's indirect experience with number, especially in motivating contexts like games, have been found to enhance children's numeracy knowledge,

mathematics skill, and overall achievement (Kilman, 2006; LeFerve, et al., 2009). Parents' engagement with these activities can influence children's perceptions about mathematics through parents' expressions of interest, mathematics expectations, and attitudes towards mathematics (Galindo & Sheldon, 2010; Kilman, 2006; Muir, 2011; Skwarchuk, 2009). Therefore parents' roles at home are important for their implications in children's overall learning outcomes in mathematics.

Among the studies examining parental involvement in mathematics at home, only a few of them have been conducted with early childhood and primary school children. Furthermore, these studies were conducted in other countries such as America, England, and Australia (e.g., Cai, 2003; LeFevre et al., 2009; Muir 2009, 2012). At the primary school age, parental involvement has been found to have a bigger impact on children's learning than variation in school quality in countries such as America and England (Desforges & Abouchaar, 2003). Given this, it may be surprising that very few studies from the year 2000 onwards have focused on parent's roles in mathematics at home at the primary school age and in New Zealand (Cai, 2003; LeFevre et al., 2009). Furthermore, the effects of parents' expectations on children's attitudes towards mathematics is less studied in the primary school stage; a stage that is suggested to have a positive influence on children's later learning outcomes (Cai, 2003; Gunderson, et al., 2012). Thus it is important to explore parent's roles in children's mathematics education in primary school to provide more information about parent's potentially critical role at this stage of children's education.

Both parental involvement and children's attitudes towards mathematics are important because of the implications that they can have for children's learning outcomes in mathematics (e.g., Carmicheal et al., 2013; Grolnick et al., 1997; Hemmings et al., 2010; Hong et al., 2010; Ma & Xu; 2004; Rice et al., 2013; Stodolsky et al., 1991). A gap in the literature is evident in the investigation of parental involvement at home at the primary school age (Cai, 2003). Few studies have focused on this but not with a focus on children's attitudes towards mathematics, this is uncommon (Adelson, & McCoach, 2011; Galindo & Sheldon, 2010; Grootenboer et al., 2008; LeFevre et al., 2009). This thesis explored this connection to provide further research pertaining to the role of parents in

children's attitudes towards mathematics and the implications this can have for children's learning outcomes in mathematics.

This Study

This research explores the connection between parents' perceptions and involvement in mathematics and their children's attitudes towards mathematics. The question it investigated is:

> What is the connection between parents' involvement in their child's mathematics learning and the child's attitudes towards mathematics?

Chapter Three: Methods

3.1 Method in Theory

This chapter begins with an examination of the use of the mixed-method design as an appropriate methodology for this study to answer the question:

> What is the connection between parents' involvement in their child's mathematics learning and the child's attitudes towards mathematics?

Qualities of the questionnaires and interviews in relation to collecting data about attitudes towards mathematics and parental involvement in mathematics are presented. This is followed by an explanation of the types of methods used including closed and open-ended questions in a questionnaire and the use of Likert scales, the advantages and disadvantages of Likert scales in terms of cost in time and analysis. From here, the advantages and disadvantages of semi-structured interviews are considered, and the reliability and validity of questionnaires and interviews is also explored. Finally, making ethical considerations and data analysis processes are reported.

3.1.1 Mixed-Method Design

A mixed-method design is commonly adopted within educational research. This is because using a mix of qualitative and quantitative designs is useful when exploring complex or multiplex issues in education (De Lisle, 2011). De Lisle (2011) argues that multiple methods can capture different perspectives, enhancing the ability to represent complex topics. Furthermore, it is argued that combining data sets can improve transferability, practical significance, and the ability to generalise the findings. Caruth (2013) suggests that the combination of qualitative and quantitative methods presents more insight into the topic at hand than one of the methods independently. This is because both qualitative and quantitative methods offer their own advantages and disadvantages in the types of data collected. Quantitative data allows direct comparison while qualitative can provide depth and understanding (Caruth, 2013; Cohen, Manion, & Morrison, 2003; Staples, 1991).

Questionnaires

Questionnaires, or surveys, are a commonly used tool when measuring people's opinions on a topic (Clark & Watson, 1995). They have proved to be useful through their time efficiency, the ability for participants to remain anonymous to both the researcher and the public, and the ability to cover wide demographics simultaneously, whilst still maintaining quality in both response and method (De Rada & Dominguez-Alvarez, 2014; Hadre, Crowson, & Xie, 2012; Staples, 1991). Research about people's attitudes commonly uses questionnaires, often in the form of closed questions, Likert scale items, and open-ended questions (Clark & Watson, 1995). Because there are several ways to think about a topic, several questions need to be used to measure each opinion (Clark & Watson, 1995). Children's attitudes towards mathematics and parental involvement are multi-faceted and complex issues; questionnaires allow a researcher to gather a wide range of information of children's attitudes or parental involvement quickly and efficiently (De Rada & Dominguez-Alvarez, 2014; Galindo & Sheldon, 2010; Hadre et al., 2012; Philipp, 2007; Staples, 1991). This can be through the use of both closed and open-ended questions.

Closed questions provide a limited number of responses, such as yes or no (Cohen, et al., 2003). A Likert scale is a type of closed question that usually involves four or five limited responses such as strongly agree, agree, neutral, disagree, and strongly disagree (Cohen, et al., 2003). The points on the scale are ordered in terms of extent (e.g., agreement). Likert scales are useful because they provide data that can be measured and compared, which can enable reliability and validity of findings (Cohen, et al., 2003). Closed questions can be used in parental involvement research for a number of reasons, including gathering information about levels of involvement, frequency of activities that occur at home, or to measure parents' opinions about their child's education (e.g., Cai, 2003; Galindo & Sheldon, 2009; LeFevre et al., 2009; Muir, 2012).

Attitudes are also commonly measured using questionnaires and Likert scales are typically used to measure opinion (Philipp, 2007). However, there are some issues to consider in using Likert scales such as whether to include a mid-point (Garland, 1991; Philipp, 2007; Tsang, 2012). Within the literature it has

been argued as to whether or not mid-points should be omitted from Likert scale questions, because including a mid-point means that participants are given a middle ground that could have one of several meanings (e.g., Adelson & McCoach, 2010; Garland, 1991; Tsang, 2012). The respondent could interpret the mid-point as neither agree nor disagree, that they have no opinion, that the question is not applicable, or that they are unsure. This makes it difficult to determine the importance of an issue to a respondent (Philipp, 2007; Tsang, 2012). Those who support the omission of the mid-point argue that mid-points distort the results of a study, as it is believed that participants are more likely to choose the mid-point, rather than taking a stance (Garland, 1991; Tsang, 2012). They argue that by omitting the mid-point, participants are forced to take a stance which is suggested to cause participants to be more thoughtful in their choices. This can result in more accurate ratings (Adelson & McCoach, 2010; Cai, 2003; Tsang, 2012).

Open-ended questions are questions in a survey where a free space is left for participants to record their comments; there is less of a limit to the content of response in open-ended questions than in closed questions (Cohen et al., 2003). They are useful in qualitative research, specifically exploratory topics or to indicate an expected range of responses (Staples, 1991). They also have the potential to capture unexpected findings or qualitative information, whilst still being cost effective and covering wide demographics; this means that a large sample could be investigated with less cost and time than other methods, such as interviews (Cohen, et al., 2003; De Rada & Dominguez-Alvarez, 2014; Hadre et al., 2012; Staples, 1991). Several studies have used open-ended questions to collect parents' perspectives on parental involvement (eg., Galindo & Sheldon, 2009; Muir, 2012). However, unlike closed questions, open-ended questions are more difficult to convert into numbers and measure, which means direct comparisons are hard to make (Cohen et al., 2003). They could also provide difficulty where there is strict time constraints placed on the questionnaire as open-ended questions often take longer to answer than closed-ended questions (Cohen et al., 2003).

The type of question used may be influenced by the intended sample. Smaller populations, for example, involve less data to analyse and make

inferences about, and so provide opportunity for more open-ended responses. This is because time is not as much of an issue as it would be with a larger population, as larger populations would take a large amount of time to analyse such data (Cohen, et al., 2003). Integrating both open-ended and closed questions into a questionnaire allows both qualitative and quantitative inferences to be made about the data (Cohen, et al., 2003). This allows more insight into the perspective of the participant in a way that is still cost effective and covers a wide demographic (Cohen, et al., 2003; De Rada & Dominguez-Alvarez, 2014; Hadre et al., 2012; Staples, 1991). If a smaller population is used within an investigation, adopting both closed and open-ended questions may prove useful in the types of data that can be collected.

Interviews

Interviews are a qualitative approach to data gathering and are used to explore participants' personal interpretations of a topic (Cohen, et al., 2003). Where questionnaires can be time efficient and faster to analyse, they also provide fixed and limited ranges of responses that make it difficult to make inferences about participants' thinking. Interviews, though more time consuming, are useful in their ability to supply responses that are rich and more extensive in nature (Cohen et al., 2003). This means that they can be utilised in research where further exploration of a topic is desired.

Structured interviews, where all questions are predetermined, can be too rigid and may limit the free-flow of participants' ideas and responses. However, unstructured interviews can result in a situation where participants stray too far off topic. This would lead to less usable information for the research at hand (Borg, 2008). Semi-structured interviews provide a middle ground with structured questions for comparable responses, whilst still allowing participants to express their personal opinions and ideas (Borg, 2008).

Semi-structured interviews enable participants to demonstrate their unique way of looking at the topic in question. Open-ended questions enable important but unanticipated issues to be raised, but semi-structured interviews can allow the interviewer to explore normally unobservable aspects of a participant's life that questionnaires do not necessarily capture (Borg, 2008; Cohen et al., 2003). This

also means that the researcher can interpret participants' experiences from their point of view, providing qualitatively richer data than closed questions (Borg, 2008). Furthermore, due to the open structure of the interview, it may result in the interviewer making unexpected discoveries about the topic that they had not considered, providing the interview with the opportunity to come up with new questions and explore new information as a result of the unanticipated findings (Borg, 2008). Research regarding parental involvement has used semi-structured interviews to gather information about feelings and attitudes of interviewees towards involvement and education (e.g., Muir, 2012).

It is difficult to ensure validity and reliability in the use of interviews. This is in comparison to quantitative designs where validity and reliability can be measured using various tests (Presser et al., 2004). In interviews, comparing and replicating measures can be more difficult as these types of designs are not as rigid and pre-determined (Kuzmanic, 2009). In cases like this, Cohen and colleagues (2003) argue that reliability in the interviewing process can be regarded as a fit between what researchers' record as data and what actually occurs in the natural setting that is being researched. Validity within qualitative research, and thus interviews, can then be considered as accurately portraying and representing the participants' perspectives of their social world that is in question (Kuzmanic, 2009). In qualitative designs like semi-structured interviews, it appears that for research to be valid and reliable, the researcher must be as explicit and honest with the data as possible.

One way of ensuring the reliability and validity of interviews is though providing rich and thick descriptions in the reporting process of the research (Creswell & Miller, 2000). This can occur through detailed descriptions of the setting, participants, and themes within the study. Rich and thick descriptions can involve describing interactions, situations, relationships, or feelings (Creswell & Miller, 2000). It is said that these kinds of descriptive accounts can allow the reader to feel as if they have experienced or could experience the context that is being researched. Furthermore rich and thick descriptions are said to provide enough detail to enable the reader to make decisions about the applicability of the findings to other contexts (Creswell & Miller, 2000). Overall, providing rich and

thick descriptions establishes credibility of the data because the statements create transparency, ensuring that the reporting of the data is explicit and honest.

To further ensure validity and reliability in an interview, a researcher needs to be knowledgeable about their topic, clear in language, sensitive, critical, open, steering, remembering, and interpretive (Cohen et al., 2003). In summary, the researcher must be conscious about their actions and how this can affect the participant, as well as ensuring that the participant is comfortable and on topic. This should essentially enable the data collected to be honest, non-biased, and representative of the social world in question (Kuzmanic, 2009).

3.1.2 Data Analysis Processes

One method of presenting data once it has been collected is through thematic analysis. Thematic analysis is a method for identifying patterns within the data, organising and analysing the data according to theme (Braun & Clarke, 2006). Essentially thematic analysis involves the researcher exploring and organising the data in a way that describes commonalities between participant responses according to the topics that emerge. It is suggested that there are six steps in the method of thematic analysis, these are: Becoming familiarized with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report (Braun & Clarke, 2006). Analysing data thematically is an important method in research because it enables the researcher to organise data in a way that still provides rich detail.

Two methods of identifying themes within the data are through the deductive approach and the inductive approach; both are important because they provide different types of analysis (Braun & Clarke, 2006). The deductive approach to data analysis is driven by the researchers' theoretical interests and can be described as a top-down process (Braun & Clarke, 2006). This means that the theoretical framework chosen will help to determine the data collection and analysis, whereby data will be organised into themes that fit within framework. The inductive approach to data analysis is driven by the data that the researcher collects and is known as a bottom-up process (Braun & Clarke, 2006). This means that the data helps to determine and organise the themes and the theoretical framework is chosen to fit the data. The deductive approach is useful in providing

detail within a few themes, whereas the inductive approach is useful in providing description of all of the themes that arise (Braun & Clarke, 2006). Both the deductive approach and inductive approach are important to consider in thematic analysis in deciding which type of approach is best for the research being conducted.

3.1.3 Ethical Considerations

Within any research, qualitative or quantitative, ethical considerations should be made to ensure that a participant's wellbeing is protected (Ahbed, 2013; Hossain, 2011). Steps need to be taken to ensure that data collection is conducted in a way that is appropriate for the research and the people within the research: taking into consideration the individual, their culture, and society (Hossain, 2011). Ethical considerations that should be acknowledged include informed consent, right of withdrawal, confidentiality, anonymity, and protection from harm (Ahbed, 2013; Hossain, 2011). To ensure that ethical issues are fully considered, research should take care to ensure that participants are appropriately informed about the study that they are participating in and their rights as a participant (Hossain, 2011). This means that they are suitably informed about their role as a participant, their right to withdraw from the study, that they will remain anonymous within the confines of the research, that their details will also remain confidential, and that they are aware that they will come to no harm during their participation in the research (Ahbed, 2013; Hossain, 2011). By considering these issues, researchers are still able to attain desired information, but in a manner that protects their participants' wellbeing.

3.1.4 Conclusion

Using mixed-methods is useful as this can enable the researcher to gather qualitative and quantitative data. Questionnaires can provide measures of attitudes that are comparable between participants, whereas the qualitative data provides depth and understanding of the multi-dimensional nature of parental involvement (Cohen et al., 2003; Galindo & Sheldon, 2010; Staples, 1991). However, in order to use a mixed-method design, the researcher needs to be knowledgeable about both types of design to effectively utilise each method and ensure validity and reliability of the study (Caruth, 2013).

3.2 Method in Action

In this section, the justification of the chosen method will be discussed. This study explored children's attitudes towards mathematics and its link to parental involvement in the home. Data was attained through the use of a mixed-method design consisting of two questionnaires (one parent questionnaire and one child questionnaire) and a parent interview. One of Adelson and McCoach's (2011) *Math and Me* surveys was utilised to measure children's and parents' attitudes towards mathematics and a semi-structured interview was used to investigate parental involvement. The following section provides an in-depth explanation of the subjects, procedures, data-gathering instruments, and data analysis applied in this research.

3.2.1 Setting and Participants

The participants in this study were parents with children in a primary school. There were no selection preferences in ethnicity, economic status, or family status. However, children in year 5, aged approximately 9, were preferred. This age was chosen based on the appropriate age group for the *Math and Me* survey (Adelson & McCoach, 2011), accounting for variation in parental involvement based on age and keeping the study within primary school education. Both parents and children were necessary for this study in order to answer the research question and provide direct comparison in their attitudes towards mathematics and, to some degree, parents' involvement in mathematics in the home.

This study used convenience and purposive sampling to obtain participants. One school (decile 9) in a small provincial town in the Waikato region was approached for a willing classroom of Year 5 children, age approximately nine, and their parents as volunteers to complete a questionnaire. The school has approximately 250 students, the ethnic composition being: NZ European/Pākehā (70%), NZ Maori (17%), Asian (8%), Other European (3%), Cook Island Maori (1%), and Other (1%). With principal and teacher agreement, the chosen class was informed about the study. The explanation provided to the children included the purpose of the study, what was required of them if they and their parents participated, and where to return the forms. The visit to the school took place on a Tuesday and children were asked to return the forms by that Friday. At the time of the visit there were approximately 20 children in the class.

During the visit a handout was given to each child. This handout included an information sheet, two consent forms for the child and their parent, and two questionnaires; one questionnaire for the child, and one questionnaire for the parent. The information sheet (Appendix A) contained details of the project aims and requirements of the participants. The parent consent form asked for consent for both the questionnaire and interview (See Appendix B). The child consent form (Appendix C) was initially intended for the child to sign so that they could personally consent to participating. However, the majority of parents/caregivers in the study opted to sign the child consent form on behalf of their child, as well as their own.

In total, 14 sets of questionnaires were completed. Of the 14 Parent Questionnaires, 13 were completed by a female parent/caregiver and one was completed by both of the child's parents/caregivers. Of the 14 child participants, five children were male and nine were female. The average age of children was 9 and the average age of parents/caregivers were 42. Parents' ages ranged from 29-60. Participants' reported ethnicities were namely NZ European/Pākehā (n=15), and New Zealander (n=6). Two participants reported themselves as more than one ethnicity, being New Zealand Maori and Dutch, and the other New Zealand European and Maori. One other indicated their ethnicity as Dutch and one indicated their ethnicity as Australian European. Three did not indicate an ethnicity.

Children were asked to complete a one-page questionnaire (Appendix D) containing 21 four-point Likert scale attitude questions and eight open-ended questions. Questions pertained to children's attitudes towards mathematics, their view on their parents' involvement in their mathematics learning at home and how they perceived their parents' feelings about mathematics.

Parents were asked to complete a two-page questionnaire (Appendix E) comprising 21 four-point Likert scale attitude questions about their attitudes towards mathematics. Six open-ended questions were also included asking in more depth about parental involvement and attitudes towards mathematics. They were also invited to participate (as indicated in the consent form) in an interview

to gain further insight about their perceived level of involvement, types of involvement, and the importance of involvement.

Data used for analysis were all questionnaires that had been completed and returned by both the parent and their child. This was so responses between a child and their parent could be directly analysed. Parents/caregivers were chosen for a follow-up interview based on their consent. The criterion for selection of participants for the interview was any parent who showed their willingness to participate in a follow-up interview as indicated on their consent form. Eight of the nine participants who indicated their interest in participating in a follow-up interview took part. The ninth participant who indicated their interest was unable to be contacted.

Fourteen parents/caregivers responded and of the 14, eight indicated their interest in a follow-up conversation and participated in the interview. Seven interviews were conducted with the female parent/caregiver and one was conducted with both of the child's parents/caregivers.

The questionnaire completed by both of the child's caregivers turned out to be the child's grandparents. The grandparents considered themselves the child's main caregivers and so will be referred to as the child's parents for the remainder of the report.

Parents who indicated their interest were contacted through the contact details they provided. Upon consent, dates and times were agreed upon for both face-to-face and phone interviews. The interviews took place approximately two weeks after the questionnaires were completed and handed in.

3.2.2 The Data-Gathering Tool and its Justification

Justification

One of Adelson and McCoach's (2011) *Math and Me* surveys (M&MS) was used and semi-structured interview was utilised in order to measure both attitudes towards mathematics and parental involvement in mathematics. The following paragraphs explain the decision to adopt the mixed-method design.

Likert scale questions were used to investigate parents' and children's attitudes towards mathematics. This was to allow direct comparison between parents and their children. However, because parental involvement is multi-dimensional and extensive in nature (Galindo & Sheldon, 2010), qualitative data was also obtained through the use of open-ended questions. This was to capture a more accurate portrayal of involvement in mathematics in the home. Open-ended questions in a questionnaire, as mentioned, are useful in qualitative, exploratory topics (Cohen et al., 2003; Staples, 1991).

Open-ended questions were utilised to explore participants' opinions about involvement in mathematics in the home. The purpose of the open-ended questions in this study was to provide comparable answers for parents and children and to explore a range of responses. The development of open-ended questions in this study was inspired by the research of Skwarchuk (2009) in regards to children's participation research about parental involvement in mathematics. However further investigation of parental involvement was to be completed through the use of interviews.

Interviews were chosen in order to gain access to parent participants' views of involvement in children's mathematics learning because parental involvement in learning is multi-dimensional and extensive in nature (Galindo & Sheldon, 2010). Although comparable responses between children and parents could be achieved using open-ended questions in the questionnaire, interviews allowed a wider range of response, which could capture a more accurate portrayal of the nature of mathematics involvement in the home (Cohen, Manion, & Morrison, 2003).

Data-Gathering Tools

Parents' roles in children's attitudes towards mathematics were examined through the use of parent and child questionnaires and a parent interview. Children's questionnaires asked about children's attitudes towards mathematics and their view on their parents' involvement in mathematics. This was to gain measurable comparisons between parents and children. Parents' questionnaires included questions pertaining to their attitudes towards and involvement in mathematics as well as their perceptions of involvement. This was to gain insight into the types of

involvement that could then be explored in the follow-up interview. Semi-structured interviews were conducted, where parents were asked to discuss their views of parental involvement in children's mathematics learning. A semi-structured interview was chosen so that the conversation would not go off topic, but so that participants could still adequately explain their perceptions without being limited by the set questions.

Child Questionnaire

Children's questionnaires were one page in length and contained 21 four-point Likert scale questions, three 'yes' or 'no' questions, and five open-ended questions (Appendix D). The questionnaire asked about children's attitudes towards mathematics and their view on their parents' involvement in mathematics. The four-point Likert scale attitude questions were taken from Adelson and McCoach's (2011) *Math and Me* survey. It is tailored to ages 8 to 12 years using appropriate language in order to gain more valid answers from participants. Adelson and McCoach (2011) argue that this survey is more valid than other measures of attitudes towards mathematics as it is catered specifically for children, rather than for adolescents or adults. The items shown in the child questionnaire are the exact questions used, in the same order as they appear in the *Math and Me* survey, with the exception of questions 5, 11, and 20. The word 'good' was removed from Question 5 in both questionnaires to avoid confusion or bias in what participants may perceive as a 'good' job. Questions 11 and 20 were revised and changed in both questionnaires to 'I enjoy doing puzzles that involve maths' and 'I enjoy playing games that involve maths' so to broaden the scope of 'maths games' and 'maths puzzles' to any game or puzzle that involves mathematics. This was in place of games and puzzles that are developed for the sole purpose of teaching mathematics. The other difference was that a four-point Likert scale was chosen in place of a five-point Likert scale, to avoid a fence-sitting position. This survey looks at three aspects that contribute toward attitudes, they are: enjoyment, self-perceptions, and perceived usefulness (Adelson & McCoach, 2011). Finally, of the revised surveys that Adelson and McCoach (2011) provide, the three-factor model that explored perceived enjoyment, ability, and usefulness was used instead of the final two-factor model that omitted perceived usefulness. Although Adelson and McCoach (2011) suggested that

perceived usefulness may not be appropriate for children in providing insight into their attitudes towards mathematics, for the purpose of the study it could provide comparison between parents and children.

The open-ended questions 22, 23, and 24 were based on Skwarchuk's (2009) research about parental support in numeracy learning at the preschool age and its inclusion of children in the study. Many of the questions pertaining to parental involvement are posed to the parent participants and not the child participants. Including questions pertaining to parental involvement in the child questionnaire means that children's view about parental involvement were also taken into consideration, which Skwarchuk's (2009) research suggests is useful into gaining a different perspective on parental involvement. Open-ended questions 26, 27, 28, and 29 were developed based on Adelson and McCoach's (2011) research and the importance that enjoyment was shown to have in attitudes towards mathematics. Questions involving children's perceptions of their parents' enjoyment of mathematics were included to provide comparable responses for parents and children. The purpose of these questions was to gather children's perceptions of their parents' involvement in their mathematics learning.

Parent Questionnaire

Parents' questionnaires were two pages long and included 21 four-point Likert scale questions and six open-ended questions which pertained to their attitudes and involvement in mathematics as well as their perceptions of involvement (Appendix E). The 21 four-point Likert scale attitude questions were the same items included in the child questionnaire, taken from the *Math and Me* survey (Adelson & McCoach, 2011). These items were chosen for parents to allow direct comparisons between children's attitudes towards mathematics and their parents' attitudes towards mathematics. However, some questions were revised to relate better to parents. Questions 3, 4, 5, and 12 were changed to the past tense in the parent questionnaire so that the items were relatable to the parent participants.

Open-ended questions A and B were the same as the questions asked in the child questionnaire for direct comparison. Question D asks about activities that are considered as numeracy activities that can potentially be completed at home (LeFevre et al., 2009). The other questions C, E and F were based on

Galindo and Sheldon's (2010) research where they acknowledged that parents may hold existing perceptions about mathematics and their responsibility in involvement in numeracy learning. These questions were formulated to gain knowledge about how parents feel about mathematics and being involved in their children's learning of mathematics.

Interviews

Questions were formulated to obtain a variety of answers regarding perceptions of parents' involvement in children's mathematics learning (Appendix F). As Galindo and Sheldon (2010) explain, family involvement is multi-dimensional and no one type of involvement can be used to understand how family shapes children's environment. Although the study focuses on types of involvement in the home, questions are purposefully broad with the attempt to capture similarities and differences between *all* types of parental involvement. This was to understand the types of involvement and the connection it may have with children's attitudes toward mathematics. It should be noted that some questions were purposefully similar to those asked in the questionnaire; the intent was to gain more elaborate answers in those areas.

Eight semi-structured interviews were conducted where parents were asked to discuss their view of their involvement in their child's mathematics learning, mathematics learning at home, the types of activities they considered to be mathematics oriented, and their opinion of their child's learning and enjoyment in mathematics. For each interview one hour was allocated in order to allow for a difference in length of answers from participants. However, each interview took between 10 to 25 minutes.

Interviews were held at a time and place that was convenient to the participants. Face-to-face interviews were not practical for all participants due to time constraints of employment, and so participants had the option of conducting their interviews over the phone. Of the eight interviews, four were conducted over the phone and four were conducted face to face. Two of the face-to-face interviews were conducted in the home and two conducted at a convenient location. I wanted to provide several options of contact to ensure that participants were comfortable and the least inconvenienced. This was in the effort to gain

longer, more honest and open answers. Ethical procedures were followed for each interview and so the participants consent was sought in regards to recording the interview. A verbal explanation in regards to the purpose of the study and their rights as a participant was also provided.

3.2.3 Data Analysis

This research explored the connection between parents' involvement in mathematics and children's attitudes towards mathematics. Parents' and children's responses to the questionnaire and parents' responses to the interview were examined. Using thematic analysis interviews were recorded and transcribed, then inductively analysed according to common themes that arose from the participants' data. The responses of the open-ended questions in the questionnaire were also grouped and analysed in terms of these themes. The purpose of using thematic analysis was to explore similarities among and differences between parents' perceptions of involvement. Likert scale questions within the parent and child questionnaires were analysed by determining the frequencies. The frequency of responses were analysed deductively, according to Adelson and McCoach's (2011) three aspects of attitudes towards mathematics that were measured: perceived ability, perceived enjoyment, and perceived usefulness. This was to directly compare children's and parents' attitudes towards mathematics. The extent of similarity between parent's involvement and children's attitudes towards mathematics was analysed by examining parent's perceptions and types of involvement as discussed in the interviews and their children's response to the attitude questions in the questionnaire.

Chapter Four: Results

The study utilised thematic analysis whereby data was analysed using both deductive and inductive approaches. The questionnaire data was analysed deductively whereby Likert Scale questions were grouped under three main headings used previously by Adelson & McCoach (2011). They were: perceived ability, perceived enjoyment, and perceived usefulness. The data collected from the follow-up interviews were analysed inductively whereby data was organised and analysed according to prevailing themes that emerged. These were: mathematics in school, parental involvement, usefulness of mathematics, communication with the child and school, perceived ability in mathematics, attitude to mathematics, and mathematics in the home. Next the data from the questionnaires and follow-up interviews were synthesised according to similar findings. This chapter presents the findings of the study according to the order of data-collection. Firstly, the questionnaire data and follow-up interview data sets are reported, and finally, the synthesised data is examined according to the four key findings that emerged: shared perceptions, mathematics as useful, parents' perspectives of ability in mathematics, and perspectives of parental involvement.

4.1 Questionnaire Results

Perceived Ability

The majority of participants had generally positive attitudes in their perceptions of their abilities in mathematics (Table 1). The children appeared more confident in their ability than their parents, shown by higher rates of the response 'strongly agree' and 'strongly disagree'. For example, more children than parents indicated a response that suggests positive self-perception for Item 3 'I am unable to solve most maths problems' (Parents that strongly disagree=5, Children that strongly disagree=8) and Item 4 'I can solve difficult maths problems' (Parents that strongly agree=1, Children that strongly agree=3). Equal numbers of positive and negative responses were evident for parent participants in regards to Item 7 'mathematics comes easily to me', and in their ability to solve difficult and long problems.

Table 1: Participants' responses to perceived ability

Item	Self-Perceptions Items	SA	A	D	SD	Participant
1	Maths is very hard for me	1	1	8	4	Parent (14)
		0	5	5	4	Child (14)
2	I can solve difficult maths problems	1	6	6	1	Parent
		3	9	2	0	Child
6	I can tell if my answers in maths make sense	4	9	0	1	Parent
		2	10	1	1	Child
8	I understand maths	3	9	1	1	Parent
		5	9	0	0	Child
10	Maths comes easily to me	2	6	5	1	Parent
		3	8	2	1	Child
14	Maths is confusing to me	1	4	6	3	Parent
		0	3	6	5	Child
16	I can solve maths problems that take a long time to finish	1	6	6	1	Parent
		3	8	3	0	Child
19	I am unable to solve most maths problems	1	2	6	5	Parent
		0	1	5	8	Child

Comparison of Parent and Child's Perception of Ability

In the perception of ability items, it is clear that the majority of parents and children shared similar perspectives regarding their ability in mathematics. This is shown by the number of parents and children that chose similar ratings in the items pertaining to perceptions of ability (Table 2).

Table 2: Comparison of parent and child responses to perceived ability

Item	Self-Perceptions Items	SA/A	D/SD	Participant
1	Maths is very hard for me	2	12	Parent (14)
		5	9	Child (14)
2	I can solve difficult maths problems	7	7	Parent
		12	2	Child
6	I can tell if my answers in maths make sense	13	1	Parent
		12	2	Child
8	I understand maths	12	2	Parent
		14	0	Child
10	Maths comes easily to me	8	6	Parent
		11	3	Child
14	Maths is confusing to me	5	9	Parent
		3	11	Child
16	I can solve maths problems that take a long time to finish	7	7	Parent
		11	3	Child
19	I am unable to solve most maths problems	3	11	Parent
		1	13	Child

Parents' and children's responses were similar in Items 1, 14, and 19 where the majority of parents and children indicated either a 'disagree' or a 'strongly disagree' response. Their responses were also similar in the Items 6, 8, and 10

where the majority of parents and children indicated an 'agree' or a 'strongly agree' response. Items 2 and 16 were the only items where parents and children did not share a majority in similar responses, as parents indicated split responses for these items (Item 2 = 7 Parents Strongly Agree/Agree and 7 parents Strongly Disagree/Disagree, Item 16 = 7 Parents Strongly Agree/Agree and 7 parents Strongly Disagree/Disagree). Regardless, this shows that parents and children have similar perceptions regarding their ability in mathematics

Perceived Enjoyment

The majority of participants held positive attitudes in terms of their enjoyment of mathematics (Table 3). It was evident from the child participant responses, that the majority enjoyed mathematics, most indicating a 'strongly agree' response in regards to items that inquired about their enjoyment of mathematics. Again, child participants were more likely to be drawn towards the extreme responses available in the questionnaire. Parents' responses towards their enjoyment of studying mathematics appeared equally split. However, the majority of participants disagreed that mathematics is boring. There was a general consensus that fun activities that involve mathematics are enjoyable shown by Items 4 'I enjoy doing puzzles that involve maths' and 7 'I enjoy playing games that involve maths'. One participant did not answer Items 4 and 5.

Table 3: Participants' responses to perceived enjoyment

Item	Enjoyment Items	SA	A	D	SD	Participant
3	I enjoy(ed) studying maths	2	5	6	1	Parent (14)
		7	5	2	0	Child (14)
7	I hate maths	1	2	7	4	Parent
		2	1	1	10	Child
11	I enjoy doing puzzles that involve maths	0	9	2	2	Parent
		5	5	3	1	Child
15	Solving maths problems is fun	0	8	4	1	Parent
		7	5	1	1	Child
17	I do maths problems on my own just for fun	0	3	9	2	Parent
		1	7	2	4	Child
20	I enjoy playing games that involve maths	1	8	3	2	Parent
		5	7	0	2	Child
21	Maths is boring	1	2	7	4	Parent
		2	1	1	10	Child

Comparison of Parent and Child's Perception of Enjoyment

When comparing the responses of children and parents in the items pertaining to their perception of enjoyment, some similarities in response are evident. It can be seen that in five of the items pertaining to participants' perception of enjoyment, parents and children share similar responses (Table 4).

Table 4: Comparison of parent and child responses to perceived enjoyment

Item	Enjoyment Items	SA/A	SD/D	Participant
3	I enjoy(ed) studying maths	7	7	Parent (14)
		12	2	Child (14)
7	I hate maths	3	11	Parent
		3	11	Child
11	I enjoy doing puzzles that involve maths	9	4	Parent
		10	4	Child
15	Solving maths problems is fun	8	5	Parent
		12	2	Child
17	I do maths problems on my own just for fun	3	11	Parent
		8	6	Child
20	I enjoy playing games that involve maths	9	5	Parent
		12	2	Child
21	Maths is boring	3	11	Parent
		3	11	Child

In Items 21 and 7 the majority of both parents and children chose the response 'strongly disagree' or 'disagree'. A similar response for both parents and children is also evident in the Items 3, 11, 15, and 20, where the majority of parents and children indicated 'strongly agree' or 'disagree'. Differences existed for Item 3, where parents' responses were split, and Item 11, where the majority of parents 'strongly disagreed' or 'disagreed' with the Item 'I do maths on my own just for fun' (n=11) and the majority of children 'strongly agreed' or 'agreed' (n=8). These results suggest that, for the most part, children and parents share similar perceptions regarding their enjoyment of mathematics.

Perceived Usefulness

The majority of participants held a positive attitude towards the usefulness of mathematics (Table 5). Participants 'strongly disagreed' with the Item 'people do not need to know maths' (10 Parents, 11 Children). Parents responded more positively regarding the use of mathematics outside of school in comparison to child participants (9 Parents 'Strongly Agree', 5 Children 'Strongly Agree'). However, children were more likely to 'strongly agree' that knowing mathematics

would help in employment (4 Parents Strongly Agree, 10 Children Strongly Agree). This suggests that the perceived types of mathematics that are useful out of school may be different for parents and children.

Table 5: Participants' responses to perceived usefulness

Item	Perceived Usefulness Items	SA	A	D	SD	Participant
4	I use(d) maths in other subjects in school	2	11	0	1	Parent (14)
		5	7	2	0	Child (14)
5	Knowing maths will help(ed) me get a job	4	8	1	1	Parent
		10	4	0	0	Child
9	Many jobs use maths	8	4	1	1	Parent
		8	6	0	0	Child
12	I (have) use(d) maths outside of school	9	4	0	1	Parent
		5	7	1	1	Child
13	People do not need to know maths	1	1	2	10	Parent
		2	0	1	11	Child
18	Maths is all around us in our everyday lives	9	4	1	0	Parent
		9	5	0	0	Child

Comparison of Parent and Child's Perception of the Usefulness of Mathematics

A similarity in parent and child responses can be seen in the items pertaining to their perceptions of the usefulness of mathematics. Similarity in response was found in all six items which clearly demonstrates parents' and children's shared perceptions in mathematics (Table 6)

Table 6: Comparison of parent and child responses to perceived usefulness

Item	Perceived Usefulness Items	SA/A	SD/D	Participant
4	I use(d) maths in other subjects in school	13	1	Parent (14)
		13	2	Child (14)
5	Knowing maths will help(ed) me get a job	12	2	Parent
		14	0	Child
9	Many jobs use maths	12	2	Parent
		14	0	Child
12	I (have) use(d) maths outside of school	13	1	Parent
		13	2	Child
13	People do not need to know maths	2	12	Parent
		2	12	Child
18	Maths is all around us in our everyday lives	13	1	Parent
		14	0	Child

The majority of parents and children indicated a 'strongly agree' or 'agree' response in the Items 4, 5, 9, 12, and 18. Also, the majority of both parents and children indicated the response of 'strongly disagree' or 'agree' in Item 13. These responses illustrate the similarity in children's and parents' perceptions of the usefulness of mathematics.

Open-Ended questions

Both parent and child participants had similar answers in the open-ended questions pertaining to their enjoyment of mathematics. Enjoyment in mathematics was reported to be when participants were working with others (mentioned six times), had an understanding of the questions (mentioned five times), or the activity was fun (mentioned eight times). Also, both children and parents reported that they did not enjoy mathematics when it was difficult or hard to understand (mentioned 10 times). Specific difficulties with fractions were mentioned by both parents and children. Parents and children indicated that parents' use of mathematics was related to work or everyday life; although parents also reported that they used mathematics with their children.

Parent and child responses differed in regards to how parents helped their children with mathematics. Twelve parents mentioned their involvement in homework and school-related mathematics work. Three parents were involved in general games related to mathematics, such as monopoly and Sudoku, and one parent was involved in mathematics-related computer games. Three parents reported having conversations with their child about mathematics. However, homework was the activity that was least emphasised by children, as only one child mentioned homework, whereas 10 children mentioned that their parents helped to explain mathematics to them, practised, and worked alongside them. No child mentioned parents being involved in everyday activities that involved mathematics. This suggests that children's and parents' ideas about involvement may be different or that children may notice different things.

Summary

Overall, the questionnaires showed generally positive attitudes towards mathematics in regards to perceived ability, enjoyment, and usefulness. Most evident was participants' indication of the usefulness of mathematics, with these items showing the highest positive response rates for both parents and children. Also evident was children's responses of 'strongly agree' or 'strongly disagree' in regards to their attitudes towards mathematics, meaning that children were more likely to choose the extreme ratings in the Likert scale questions. Negative attitudes towards mathematics were relatively low for both parent and child

participants within all three aspects measured, particularly in regards to the usefulness of mathematics. Parent and child differences appeared to be in agreement on the types of mathematics that are useful, the enjoyment of mathematics in school, and the perception of mathematics as easy. This suggests that parent and child participants' attitudes towards mathematics could differ between different types of mathematics. Also, the open-ended questions showed that children perceive their parents' involvement in their learning differently to how their parents perceived their involvement. Parents' response rates were high for being involved in homework, whereas children's response rates were low in this category. Children more often indicated that their parents helped explain mathematics to them. The findings from the questionnaire data suggest that parents' and children's attitudes towards mathematics may be similar, but that their perceptions of involvement may be different.

4.2 Follow-Up Interview Results

Eight of the fourteen parents that participated in the questionnaire also took part in a follow-up interview. Regardless of parents' attitudes towards mathematics, all parents saw some importance in their children learning mathematics. This was mostly for the purpose of their children doing well in the future. Parents' involvement therefore was to ensure future success, although there was variation in the type of involvement. Involvement was seen to include mostly homework, but involvement in games and conversations about mathematics was also mentioned. Other themes of conversation included mathematics at school and at home, ability in mathematics, and attitudes towards mathematics. The common themes that arose from the interviews are discussed below in order of most discussed.

Mathematics in School

Mathematics in school was a commonly discussed topic in all interviews. Comments focused on parents' views of the current practices of mathematics in school, including types of learning strategies, topics in mathematics, the importance of learning the basics in mathematics, teaching style, and the current curriculum. Most evident were parents' comparisons of how they learnt mathematics in school in relation to how their children were learning

mathematics. Some parents had negative views about how mathematics was being taught to their child, emphasising the use of multiple strategies for solving number problems. The majority of parents had learnt mathematics using algorithms and the adoption of the partitioning strategy, for example, appeared foreign to them. Many parents commented on their lack of ability to help their child because of this focus on number strategies.

Parents talked about the current curriculum, comparing it to their experience at school. While some agreed with the new problem-solving strategies used in schools, others had doubts about this approach.

> It's [mathematics in school] teaching the children different strategies as opposed to rote learning like when I was a child (Participant from Interview 4)

The "times tables" were commonly brought up in regards to parents' doubts about the current emphasis on problem-solving strategies, as well as the teaching of fractions and algebra. In regards to negative comments, five of the parents questioned the necessity of such an emphasis on so many problem-solving strategies and difficult topics such as fractions and algebra. It appeared that these parents saw the new problem-solving strategies and such topics as unnecessary for their children to learn. Two of the parents recognised that these new strategies could help their children better understand mathematics and be beneficial in everyday life and in the future.

> I'm also concerned they don't do drills and although they have quite good strategies, to be able to get to a point, if they had those basic drills, they'd know those numbers straight away and wouldn't have to tax their brains to get to the point of getting the number before they can do any work with it (Participant from Interview 1)

> Like it's all well and good having a piece of paper that says 'what is one plus one', but you need to relate that to life things, you know what I mean (Participant from Interview 6)

> They need to concentrate on the basics (Participant from Interview 6)

Parents who questioned the necessity of an emphasis on such strategies also commented on their lack of knowledge or ability of that particular topic. This may

have been because parents relate this back to being able to help their child with mathematics now that the problem-solving strategies are perceived to be different. Overall, it seemed that parents who were lacking confidence in their mathematics ability had doubts about the curriculum and the effectiveness of their involvement, whereas those who were confident in their ability appeared to mostly praise the curriculum.

> But the difficulty with that is sometimes you don't know if you're teaching them the right way (Participant from Interview 3)

> It was a struggle early on, because I think, in those first few years he was getting so many ways to do things. I think that's where he struggled. But now he understands why he's got different ways to do it. I mean, I'm still learning new stuff, when he's doing things I'm like 'oh that's a good way to do it!' We didn't have that 20 years ago (Participant from Interview 4)

> I understand the logic of it but get annoyed as a parent from the 1970's that they don't just do drills, and so the general knowledge, so it's become a little bit airy fairy. (Participant from Interview 1)

> My husband is always complaining about things that aren't necessary, we don't think is necessary as far as maths goes at that age (Participant from Interview 6)

Parental Involvement in Mathematics

Parents' comments about their involvement mainly pertained to the need for them to be involved because of its importance. Some parents also talked about involvement as a requirement of being a parent, feeling strongly about their role in their children's learning. All parents said that they want to be involved but not all could clearly explain why. It seemed that involvement was related to either the feeling of obligation as a parent, the desire to further their child's future, or both. The types of involvement discussed were largely homework and specific activities, but support, motivation, and encouragement were also reported. Interestingly, some parents discussed the necessity to make mathematics fun in order to get children interested. This suggests that they considered enjoyment important in their child learning mathematics. Again the gap between how parents learnt and how their children were learning was a barrier to their level of involvement. Some parents commented that they had been trying to develop their

mathematics knowledge in order to aid their children. Overall most parents were eager to be involved and differed mostly in their type of involvement.

> It's an obligatory role of being a child's parent (Participant from Interview 1)

Support and encouragement were referred to as ways that parents got involved with their child, but helping with homework, sitting, and doing mathematics with their children were more commonly discussed.

> [Our role as parents are] to be supportive and to be motivated and to make it fun, and to source ways of learning for ourselves as parents and finding ways to support them and to look out there if we can't do it (Participant from Interview 2)

> We sit with her and help, well, one of us will. If she's struggling with it yeah (Participant from Interview 2)

Being involved was not about doing homework for all parents. Some parents wanted to be involved in their children's mathematics learning regardless of their own ability, as they saw it as important for their child's future and their relationship with their child.

> I think it's mainly the school's responsibility because they're educated, but I'd just like to be involved so I know what she's doing? (Participant from Interview 5)

As many of the parents consistently reported helping mostly with homework, the change in mathematics' problem-solving strategies was a barrier to their level of involvement. Parents appeared focused on their inability to help with their child's homework.

> He comes home with it and we've done it a different way than we learnt years ago (Participant B from Interview 7)

Parents' involvement was hindered by their understanding and ability in mathematics. Five of the parents reported improving their own skills in mathematics so that they could help their child; one reported using the internet to find answers and resources to help her child. This reiterates participants' willingness and interest to be involved.

> So we want to help where he is at this stage, and we're interested in learning for his sake as well as our own, to keep up with everything (Participant B from Interview 7)

> But you know I don't…fractions, division, multiplication and those types of things and above that, I find it hard to help her. So she can try and help us, and then we can help her back. We google it (Laughs) (Participant from interview 2)

Usefulness of Mathematics

All parents discussed the importance of their children knowing mathematics in relation to their children attaining good employment, completing everyday life tasks, and/or generally functioning in society. Parents explained the need for their child to learn mathematics as they perceived it to be important for their child's future. Some parents felt very strongly about mathematics, discussing the necessity of mathematics knowledge in order to be able to function in society.

> You can't survive without maths in modern society (Participant from Interview 1)

> You name me one thing in life that doesn't require maths (Participant from Interview 1)

Parents who believed that mathematics was important also talked about what could happen if people did not know mathematics, resulting in the risk of being 'ripped off'. This was stated by two parents.

> I think if you haven't good basic maths skills you know, you can easily get taken for a ride, you know, things like that. (Participant from Interview 3)

The importance of learning mathematics appeared to relate to parents' desire for their children to do well in life, which related to their reasons for involvement. Parents appeared to want to be involved to ensure their child's success in later life.

> We just feel it's important for her future…in anything (Participant from Interview 2)

Parents' desire for their child to succeed included their children obtaining good jobs in the future. All parents commented that mathematics would be needed in order to achieve this.

> Every job has got some form of maths. Whether you're a farmer, a builder; you've got to be able to measure things, you've got to be able to add things together, you've got to be able to put up a fence and split a paddock in half, so maths is everyday life. So it's important that they know the basics (Participant A from Interview 7)

> Because I think if you want to succeed in life, it doesn't matter what you do, there's going to be maths involved in some point, and if you're comfortable with it you're going to adapt a lot easier (Participant from Interview 4)

It is important to note that many parents talked about learning 'the basics'. Although not fully explained in the interviews, basic mathematics appeared to pertain to basic addition, subtraction, multiplication, and division. This also appeared to include any mathematics the individual participants saw as important to their child's future such as fractions and working with money. Being able to adequately accomplish everyday tasks that involved mathematics (such as cooking, measuring, money, and shopping) appeared to be important to parents.

Communication with the Child and School

Communication was not as commonly discussed as other topics, but those who did talk about it discussed the need to be in contact with their child and the school so that they were aware of their child's progress. Parents talked mostly with their child about their education rather than talking with the teacher. However, a few parents did consistently contact the school if their child was struggling. Many parents talked about a workshop that the teacher had held for the parents so that they could understand what the children were learning. This was mostly met with positive responses. Other than the workshop, school communication was only talked about by two parents. This was in regards to their children struggling with mathematics in school.

> They (the school) recently did a fractions unit, so at the school (session) for parents and I went along to that and it was really good. I had always thought I was pretty good at that until I found a few things I hadn't known before (Participant from Interview 8)

> He's going into a different category for maths that what he was doing and he does just not fully understand it, and we're doing our very best, working with the teachers, to get him there you know (Participant B from Interview 7)

Few parents discussed bringing mathematics into everyday discussions, and those who did appeared to be very eager and enthusiastic about being involved in their child's mathematics learning. These discussions encompassed discussing school and doing mathematics at school.

> Asking questions; how are you doing with maths? Are you struggling? (In response to: 'what do you consider involvement to be?' Participant from Interview 3)

> Probably my conversation with his is 'don't stress, it's not that bad' (Participant from Interview 4)

A few parents reported that they tried to incorporate mathematics into everyday life and conversations with their children; for example, bringing mathematics into cooking, shopping, and working on the farm. Parents stated that they would ask their child to help with these activities and get them to calculate, for example, quantities of ingredients and the prices of products.

> We pretty much bring it into whatever we can. Whether we're eating dinner, whether we're trying to work something out or whether we're going to go out, we try (to) fit it in wherever we can (Participant from Interview 2)

> We do lots of cooking and baking and following instructions with recipes, so there's lots of adding, diving and lots of calculating (Participant from Interview 1)

> Well I was just making anzac biscuits when you rang, and I asked the children how much is three quarters of a cup plus three quarters of a cup? What is, how much do I need? And he said 'one and a half cups', 'one cup and two quarters'. So I said 'yup one cup and two quarters, how can I simplify that a bit further?' And he said 'one and a half' so yup, we apply stuff like that (Participant from Interview 3)

> On the farm we get them to calculate, you know, how much milk you need for how many calves and stuff like that (Participant from Interview 6)

Parents commented that, because they knew their children well, they could tell when their child was coping or struggling with mathematics. This indicated that although there may not be frequent conversation about mathematics, it is talked about when deemed necessary by parents.

> He's articulate enough to tell me that he's not doing well (Participant from Interview 1)

Perceived Ability in Mathematics

Parents' discussions about ability in mathematics were in regards to low ability or high ability; parents' ability did not seem to match children's ability. In the interviews either the parent reported being low in ability and believed that they were unable to help the child, or the parent reported being high in ability and reported that their child as low in ability. When children were struggling or had low ability, parents were more likely to be involved. Three parents specifically stated that they contacted the school for help because their child appeared to have low ability in mathematics.

Parents' lack of confidence or perceived low mathematics ability appeared to be related to the change in problem-solving strategies used in schools since they learned mathematics. Two of the parents commented that because it was different, it was more difficult to help their children. For other parents, because of the change in problem-solving strategies, they had started learning again alongside their children. Being able to do mathematics was important for all parents, mostly because they saw mathematics as useful for their child's future.

> She wants me to help her, I can't help her if I don't know how to do it (Participant from Interview 5)

> I wouldn't be able to help her at home with her homework if I didn't understand it (Participant from Interview 8)

Two parents who rated themselves of high ability had children that were low in mathematics ability. The parent from Interview 4 explained that her child struggled in mathematics in the earlier years, but once he saw the practicality in mathematics and developed his skills further, he was more interested. This parent would get involved by trying to incorporate mathematics into everyday

conversations. The parent from Interview 8 reported their child's lack of enjoyment in mathematics, the child saying that it was too difficult. This parent got involved by sitting down and doing homework with the child. In these cases, both parent participants enjoyed mathematics whereas their child did not.

> It did worry me that he was struggling when both his father and I are very involved in maths in our jobs, so yeah (Participant from Interview 4)

> It just doesn't seem to sink in [Tables], and then that impacts pretty much every other part of maths (Participant from Interview 8)

Attitudes towards Mathematics

Parents held the view that if their child had an interest in mathematics and wanted to learn, they would be more likely to learn. An interest in mathematics, according to two parents, would result in a willingness to do mathematics. This interest appeared to derive from learning experiences in mathematics.

Two parents indicated that children who were interested in mathematics would persevere in the subject, learn more, and inevitably do better. This related to parents' views about the usefulness of mathematics and the necessity of learning mathematics.

> If you're interested, you can find numbers everywhere (Participant from Interview 1)

> How he feels about maths is important, it's certainly going to happen further down the track, in life (Participant B from Interview 7)

> The basics. If a person has an interest in it, they'll build on the basics, there's something to build on. If they've got no basics, no knowledge, then they'll go no further than that (Participant B from Interview 7)

An interest in mathematics was thought to derive from children's experiences as discussed by two of the parents who believed that good experiences would result in positive attitudes and bad experiences would result in negative attitudes. Four parents stated that mathematics can appear intimidating or boring to children, and so that was also a contributing factor to children's attitudes. Two parents stated

that a part of being involved in their child's mathematics was to make it fun and less intimidating.

> It's up to the attitude, you know of looking at what you're doing and taking the scare factor out of it. (Participant from Interview 1)

> They have a bad experience and they think, like myself, that's it I don't want to learn anymore. And we want to have fun, and you know they do say, once you understand it, it is fun (Participant from Interview 2)

One parent held the view that mathematics is difficult for most children, stating that children need to have an interest in order to learn mathematics and do well in the future.

> See, well, a lot of average children, maths is a problem for them, it always has been and if they haven't got the interest it's always going to be a problem for them. And if they can be helped or we can get help for him to do it for him, I feel that he will achieve quite a bit (Participant A from Interview 7)

Mathematics in the Home

Three parents supported the view that mathematics in the home environment provided the opportunity for children to consolidate their learning from school. They discussed the advantage of parents' involvement as providing one-on-one learning that children did not necessarily receive at school. Types of direct mathematics involvement in the home included: homework, mathematics games, and out of school tutoring.

All parents reported doing mathematics-related activities at home, such as homework and mathematics games. Parents reported playing mathematics-related games with their children, such as monopoly, and downloading mathematics-related games for them also, such as Sumdog. Homework usually involved the parents sitting down with the children.

> Well I, we, do maths games, you know. We play monopoly and stuff like that and that's adding, that's money, and basic facts, and yeah. That's how I become involved, and sometimes if she's stuck with her homework I'll explain how to do it (Participant from Interview 5)

> It's just the set homework. Sometimes it gets a bit busy for us and it's hard to fit the homework in. The kids do 'sumdog' in the morning; they're at school quite early, about eight, they do 'sumdog' on the computer in the morning sometimes (Participant from Interview 3)

> I tend to be the one where if there's homework I would sit down with him and work through a strategy (Participant from Interview 4)

Some parents talked about the advantages and importance of doing mathematics at home. The main theme that arose was that mathematics at home provided another opportunity for children to consolidate the learning that occurred at school. Parents believed that learning mathematics at home would improve skills, confidence, motivation, and overall positive attitudes.

> So if you're working one-on-one in the family, you're getting better teaching from a one-on-one perspective. But you're also, you're adapting the knowledge that they're picking up from school into a real time, a real environment (Participant from Interview 1)

> … If you give them the time and effort to shine in their own time at home, then they can grow their confidence from there (Participant from Interview 1)

The advantages of mathematics at home seemed to relate to parent participants' perceived roles as parents. Parents appeared to see the importance of mathematics, and because of this, saw the need or advantage of being involved in their children's learning. Although their own knowledge could be a barrier, all parents still maintained the desire to be a part of their child's mathematics learning.

> It's one of the greatest roles a parent can have is, is getting a child enthused about learning and then giving the opportunities to learn away from the school (Participant from Interview 1)

> Well I guess in a busy classroom if they don't get something finished they put it away, and that's the end of it. The next day they go on to something else, whereas at home, I can make sure she finishes it, actually understands it and doesn't just give the answer they want to hear, that she understands it, can explain it and that she does know what she's doing (Participant from Interview 8)

A part of parents' desire to bring mathematics learning into the home appeared to be in order to provide different learning opportunities in mathematics that could possibly alter how children felt about and perceived mathematics.

> They have to learn themselves and be motivated to learn, we have to provide the tools at home, and provide the environment at home, but we have to work with them out of state education as well (Participant from Interview 1)

> Just incorporating it into everyday, so he doesn't feel like he's sitting down and doing maths" (Participant from Interview 4)

Summary

All parents held strong views about the importance of being involved in their child's learning in mathematics. This mostly derived from the desire for their child to be successful in later life. Mathematics was seen as an important tool that would enable their child to be successful. Many parents appeared to believe that being involved would ensure that their child received the help necessary to do well. Parents were directly involved in different ways, doing homework, providing games and activities, and trying to incorporate mathematics into everyday life. The barrier to involvement seemed to exist where parents perceived that they did not have the necessary mathematics knowledge to aid their child's learning. Some parents seemed unsure as to how they could best help their child. What was evident, however, was that all parents were more than willing to help their child in any way that was possible. If parents could not directly help their child, involvement translated into support, communication, and providing the means to get help, such as contacting the school, referring to the internet, and paying for out of school tutoring.

4.3 Thematic Synthesis: Parents and Children

Four key findings emerged from the data in the questionnaires and interviews collected: 1) that parents and children had similar perceptions regarding their attitudes towards mathematics, 2) that participants placed particular importance in the usefulness of mathematics, 3) that parents' perspectives of ability changed over context, and 4) that parents' and their children had different ideas about the types of parental involvement that occurred in their family, as seen the open-

ended questions in the questionnaire. The results showed that parents and their children shared the same views in their attitudes towards mathematics, as seen in the similar responses in the questionnaires. Moreover, the view that mathematics is useful resounded throughout the questionnaires and interviews. This illustrates the similarity in children and their parents' perspectives about mathematics, and ultimately, their attitudes towards mathematics. However, there are also conflicting views, particularly the perspectives regarding the types of involvement that occurred in each family, and parent's and their child's perspective of the child's ability.

This section synthesises the data collected from the questionnaires and interviews, specifically making use of the data from participants that took part in both. The data is organised into the four key findings. The findings are described in accordance to the related data collected, with examples to clearly illustrate each idea. The aim is provide a fuller picture of the participants' thoughts regarding attitudes towards mathematics and parental involvement.

4.3.1 Shared perceptions

The results suggest that parents and children share the same perceptions in relation to their attitudes towards mathematics. This is seen in all three aspects of attitudes towards mathematics that were measured in the questionnaires: perceived ability, perceived enjoyment, and perceived usefulness. It was found that the majority of parents and children's responses were similar regarding all of the items used in the questionnaire to measure participants' attitudes towards mathematics, with the exception of Items 2, 3, 11, and 16. While not all parents and children had similar responses for all of the items, it is apparent that, for the most part, parents and their children share similar perceptions in their attitudes towards mathematics.

4.3.2 Mathematics as Useful

It was evident that participants viewed mathematics as useful, as indicated in the closed-question items pertaining to perceptions of usefulness and within the follow-up interviews. Two common ideas arose in relation to the usefulness of mathematics; its association to attitudes towards mathematics and its role in

parents' reasoning for their involvement in their child's mathematics learning. Firstly, it is apparent that many parents related their feelings about mathematics to the usefulness of mathematics. Within the interviews, when asked 'how do you feel about mathematics' four of the parents referred to the necessity and usefulness of mathematics in everyday life, when it had been anticipated that participants would respond by mentioning their like or dislike of mathematics. For example, the parent from Interview 1 answered by saying

> You have to have maths. If you don't have maths you're disabled in your society. You need maths for so many things, so many basic things, and so many things you don't even realise you're using them for. You can't survive without maths in modern society. Not in the western world anyway (Participant from Interview 1)

This illustrates parents' association of their feelings towards mathematics with the necessity of mathematics in everyday life. Parents from the Interviews 2, 3, 6, and 7 also responded similarly, mentioning how important it is to know mathematics.

Secondly, the importance that parents placed on their involvement in their child's mathematics seemed tied to their belief in the usefulness of mathematics in everyday life. When parents were asked about mathematics involvement in the home, many talked about the necessity to be involved to help their children succeed in later life. Mathematics was believed to play a role in their child's success in later life because of its usefulness. Parents from Interviews 2 and 5 illustrated this when asked 'why do you think it is important for children to do maths at home?'

> To prepare them for later life. And just to have a go at it, even if they can do it. It helps them with that self research – you know if they can't do it, to learn to google it (Participant from Interview 2)

> Well we use it every day, throughout the day. Time, money, what else? Just all the time! It's very important! (Participant from Interview 5)

This shows the importance that parents place on doing mathematics at home, because they believe that it helps children to gain the necessary skills to succeed in later life.

4.3.3 Parents' Perspectives of Ability in Mathematics

An interesting finding is the different perspectives that parents held regarding ability in mathematics. This particularly refers to their ability, and their child's ability. Four of the parents who participated in the follow-up interviews showed a slight difference in response between their questionnaire and interview answers regarding their perspective of their own ability in mathematics. This particularly pertained to parents of Interviews 2, 5, 6, and 7. These participants all indicated a positive attitude towards mathematics in the questionnaire, particularly in their perception of ability in mathematics. However, when asked again in the interview, all participants expressed some form of inability and lack of confidence in some areas of mathematics. For example, parents from Interviews 5 and 6 expressed concerns about their ability to help their child with mathematics, specifically their homework. The parent from Interview 6 commented that they were competent with everyday mathematics but struggled to help their child with mathematics from school. This suggests that parents may have different perceptions of ability in different types of mathematics, especially learning mathematics versus teaching mathematics.

Interestingly, two of the parents held a different perspective of their child's ability in mathematics than what their child had indicated in the items in the questionnaire pertaining to their perspective of ability in mathematics. Parents from Interviews 1 and 8 both commented on their child's lack of ability in mathematics; the parent from Interview 1 indicated that her child found mathematics difficult and the parent from Interview 8 commented on her child's struggle learning the times tables. Conversely, both children indicated positive perceptions in their ability in mathematics within the questionnaire. This shows a difference in child and parent perspectives of ability.

4.3.4 Perspectives of Parental Involvement

It was interesting to find that parents and children had different views of parental involvement. That is, parents' statements about how they got involved in their children's mathematics learning did not match their child's statements about how they thought their parents got involved in their mathematics learning. Twelve of the parent questionnaires reported involvement in homework in comparison to one

of the child questionnaires that reported their parents' involvement in homework. This was reiterated in the interview with all eight participants mentioning their involvement in homework. Children's statements about their parents' involvement mainly pertained to their parents' help to explain mathematics, practise mathematics, and work alongside them in mathematics tasks. This shows that parents' and their child's perspectives about parental involvement that occurs in their home may differ.

4.4 Results Summary

In summary, these results show that participants indicated generally positive attitudes towards mathematics, as illustrated by the questionnaires. The results also suggest that parents and their children share similar perceptions in their attitudes towards mathematics regarding their perceptions of ability, the usefulness of mathematics, and their enjoyment in mathematics. This is particularly true for participants' perspectives of mathematics as useful, an idea that resonated throughout the questionnaires and interviews.

In the data regarding parental involvement, it is evident that parents and children have different ideas about what types of involvement occur in their home. While the majority of parents considered helping with homework as their main type of involvement (as mentioned by 12/14 parent questionnaires and 8/8 parent interviews), children indicated that they believed their parents were involved in their mathematics learning by explaining and discussing mathematics with them (as mentioned by 13/14 children). All parents, regardless of their attitude towards mathematics, were involved in their child's mathematics learning in some way.

An important finding to consider is parents' concerns in their ability to help their child with mathematics. Six of the eight parents in the interviews reported concern for their ability to help their child with mathematics. Even parents that indicated a positive perception in their ability in mathematics reported concerns in their ability to help. This suggests that perceptions in ability differ depending on what type of mathematics is involved (teaching mathematics or learning mathematics). Concerns were namely associated with the difference in problem-solving strategies that children use now in comparison to the problem-

solving strategies that parents used when they were at school. This appeared to affect how parents get involved in their child's learning, either restricting them to monitoring homework or helping mainly with everyday mathematics by incorporating mathematics into everyday life.

Chapter 5: Discussion and Conclusion

This study explored parental involvement in mathematics in the home and how this connected to children's attitudes towards mathematics. The question posed in this thesis was:

> What is the connection between parents' involvement in their child's mathematics learning and the child's attitudes towards mathematics?

The main findings that were apparent from the data analysed from questionnaires and interviews were: parents and children have similar attitudes towards mathematics, parents' perceptions change depending on the situation, and parents' and their children have different views of the types of parental involvement that occur in the home. This chapter first presents the main findings of the study and these are discussed in relation to the literature. This is followed by a critical examination of the similarities and differences in accordance with the main themes found in the data. This chapter then examines the strengths, limitations, and implications of the study, its practical uses, and future research. Lastly, this chapter concludes the thesis with a brief summary of the study.

5.1 Main Findings

The main findings of this study were found in children's and parents' perceptions about mathematics. Findings show that parents and their children shared similar perceptions in their ability in mathematics, their enjoyment of mathematics, and the usefulness of mathematics. The findings also show that parents' perception of their own mathematics abilities changed dependent on the situation. Finally, parents' and children's perceptions differed in their view of parental involvement. The similarities and differences in perceptions suggest that parents' perceptions about mathematics are important in the connection between parents' involvement in their child's mathematics learning and the child's attitudes towards mathematics; this finding had been reiterated within the literature (e.g., Fan & Chen, 2001; Gunderson et al., 2012; Kaplan et al., 2001; Strayhorn, 2010). It also suggests that parents' perceptions are more important than specific types of activities that parents engage in related to learning mathematics, such as homework.

5.1.1 Shared Perceptions

This study found that parents and children shared similar perceptions regarding the three aspects used to measure attitudes in this study. These three aspects were: perceived usefulness, perceived ability, and perceived enjoyment. The finding that parents and children share similar perceptions in mathematics suggests that parents' perceptions about mathematics are linked to children's perceptions about mathematics, and therefore their attitudes towards mathematics.

The questionnaire responses pertaining to parents' and children's attitudes towards mathematics were substantially similar. The majority of parents and their children responded similarly to the three aspects measured in the Likert scale items: perceived usefulness, ability, and enjoyment. The literature suggests that parents influence their child through their beliefs, values, and perceptions, which affects children's own perceptions, achievements, and self-concept in mathematics (Fan & Chen, 2001; Gunderson et al., 2012; Kaplan et al., 2001; Strayhorn, 2010). The connection between parents' perceptions and children's attitudes towards mathematics is evident in this study from the similarities that exist between parents' responses and children's responses in regards to the three aspects used to measure participants' attitudes towards mathematics. These similarities reinforce the idea that parents' perceptions are linked to children's perceptions.

Usefulness

Almost all participants indicated a positive attitude towards the usefulness of mathematics. The items regarding perception of usefulness asked about participants' perception of the usefulness of mathematics in school, in employment, and in everyday life (Adelson & McCoach, 2011). The majority of parents' and children's responses were the same for all items pertaining to their perception of the usefulness of mathematics. Because everyone perceived mathematics to be useful, this indicates that the usefulness of mathematics did not affect participants' attitudes towards their ability or enjoyment of mathematics. This is supported in other research, which suggests that children's perception of the usefulness of mathematics does not affect children's general attitudes towards mathematics (Adelson & McCoach, 2011).

In the items pertaining to parents' and children's perception of the usefulness of mathematics a similarity in perceptions was evident. This was illustrated in Items 4, 5, 9, 12, and 18, where most parents and children indicated a 'strongly agree' or 'agree' response. This was also illustrated in item 13, where most parents and children responded with a 'strongly disagree' or 'disagree' response. The similarity in perceptions again suggests that parents' perception are connected to children's perceptions.

Ability

An interesting point to note was the differences of child and parent responses in the items pertaining to their perceived ability. Children tended to regard their ability quite highly, more likely choosing the extreme responses available in the questionnaire. It has been found within the literature, that young children are generally over-confident about their abilities (Anjum, 2006; Williams & Williams, 2010). It was therefore presumed that younger children will have more positive attitudes towards mathematics. This explains the large amount of children reporting positive attitudes in their ability in mathematics in this study.

Regardless, when looking at the number of parents and children that responded with 'strongly agree' and 'agree' or 'strongly disagree' and 'disagree' the majority of parents and children indicated similar responses. This was seen in Items 1, 14, and 19, where most parents and children indicated either a 'strongly disagree' or 'disagree' response. A similarity was also evident for the Items 6, 8, and 10, where the majority of parents and children indicated a 'strongly agree' or 'agree' response. Again, this reiterates the connection between parents' perceptions and children's perceptions.

Enjoyment

Similarities were also evident in the items pertaining to participants' enjoyment of mathematics. It was found that the majority of participants held positive attitudes in terms of their enjoyment in mathematics and that parents and children held similar responses. This was evident where parents and children indicated a 'strongly disagree' or 'disagree' response for Items 7 and 21, and indicated a 'strongly agree' or 'agree' response in Items 3, 11, 15, and 20. This again

demonstrates parents' and children's shared attitudes towards mathematics and further suggests that parent's perceptions are linked to children's perceptions, thus indicating a connection between parents' attitudes towards mathematics and children's attitudes towards mathematics.

Implications of Similar Perceptions

The similarities in parents' and their child's responses in the questionnaire suggests that parents have some connection to children's attitudes through their perceptions. This can occur through interaction and experience (LeFevre et. al., 2009; Osante, 2012; Skwarchuk, 2009). Children's attitudes are affected by social context and experience, which reinforces the idea that parents' perceptions could influence children's attitudes. The high response rate of positive attitudes towards mathematics from both parents and children therefore indicates that parents must be involved in children's mathematics learning in a positive way.

One way in which parents' perceptions and expectations are transferred to children is through communication (e.g., Kaplan et al., 2001; LeFevre et al., 2009; Tan & Goldberg, 2009). Communication about mathematics was a commonly reported type of involvement, where parents would talk about their child's mathematics at school and try to incorporate mathematics into everyday life. Because parents and children in the study shared similar perceptions towards mathematics, and communication was a commonly reported type of involvement, this suggests that parental involvement is connected to children's attitudes towards mathematics through their discussions about mathematics.

Overall, the finding that parents and children share similar perceptions of mathematics suggests that an important role of parents in children's attitudes towards mathematics is the connection that they have to children's perceptions of mathematics. Research suggests that this could occur through interaction and communication (e.g., Kaplan et al., 2001; LeFevre et al., 2009; Tan & Goldberg, 2009).

5.1.2 Parents' Perception of Ability in Mathematics

The findings showed that parents' perceptions, specifically their perception in ability, changed depending on the situation. Although most parents reported

positive attitudes towards mathematics in the questionnaire, some parents in the interview reported different perceptions in ability when asked about their role in their child's mathematics learning. This change in perception was attributed to parents' feelings of a lack of knowledge in the mathematics that their children were learning, and changes in the curriculum. Parents presented their lack of knowledge as a concern in their ability to be involved in their child's mathematics learning. However, all parents reported their involvement in their child's mathematics, regardless of their perceived lack of ability. Involvement in these cases most often translated to parental involvement in homework.

All parents who participated in the follow-up interview indicated a positive attitude towards mathematics in their questionnaire. This included positive perceptions regarding their ability in mathematics. However, when asked about their role in their child's mathematics learning, some reported a concern in their ability to help their child in mathematics. This was reported by four of the parents in the follow-up interview who expressed some form of inability and lack of confidence in some areas of mathematics. In these cases, their concern was related to their previous experiences in mathematics and a change in the curriculum.

Some parents expressed their concern and hesitancy in being involved in their child's mathematics learning due to their lack of knowledge. It is suggested that parents' personal experiences and memories of mathematics, feelings of anxiety and helplessness, perceived inability, and lack of confidence in their ability to help their child can be a barrier to parental involvement in mathematics (Marshall & Swan, 2010; Muir, 2011). This appeared to be true in this study, where some parents reported past negative attitudes when they were at school and some reported their lack of knowledge in mathematics. This was seen to affect their ability to be involved in their child's mathematics learning and restricted their involvement.

Another concern mentioned in regards to parents' inability to be involved in their child's mathematics learning was the change in curriculum. Within the literature, the change in problem-solving strategies, from algorithms to part-whole thinking, has reportedly left some parents confused and less able to help their

children learn mathematics (Muir, 2009). This is because the new strategies are foreign to them. This was evident in the study from the parents' comments about the change in curriculum, where parents discussed a lack of understanding of the new additions to the curriculum and, therefore, their inability to help.

Regardless of parents' concerns in their ability to be involved in their child's mathematics learning due to their lack of skill or knowledge, all parents wanted to be involved. This was because parents' saw mathematics as important for their child's future success. Therefore, all parents still reported some type of involvement. Some parents, who perceived their mathematics abilities as low, would seek alternate options in ensuring that their child received additional support. This included contacting the teacher, paying for tutors, downloading mathematics-related games for their children to play, and using the internet to find answers and resources. But in most cases parents' involvement in children's mathematics learning translated into parents helping with homework.

Implications

The importance of this finding lies in the types of involvement that occur in the home as a result of parents' lack of knowledge in mathematics. It has been found that a lack of mathematics knowledge can limit parents' roles to monitoring and assisting with activities like homework (Cai, 2003; Cao et al., 2006; Muir, 2012). This was evident where all parents, who reported an inability to help their children with mathematics due to their low knowledge, reported their involvement in homework. This is important because parents' involvement in homework has been found to be associated with children's negative attitudes towards mathematics (Cai, 2003; Cao et al., 2006; Muir, 2012).

The findings showed that many parents emphasised the necessity for their children to learn the basics (addition, subtraction, multiplication, and division) and questioned the necessity of learning more complex topics in mathematics, such as algebra and geometry. When parents are limited in their knowledge, it is often reported that they will monitor their child's progress in homework, focus on 'drill and practice' exercises, and learn 'tables' by rote; this was seen in this study, by parents emphasis on 'the basics' and reports of involvement in homework (Muir, 2012). This is a concern because it has been found that involvement in

homework, especially homework that focuses on 'drill and practice' exercises, can leave children feeling incompetent and has been found to lower children's self-concept in mathematics, therefore fostering negative attitudes towards mathematics (Cao et al., 2006; Gunderson et al., 2012; Muir, 2012). Thus parents' knowledge is important for the inadvertent contribution it could have to children's negative attitudes towards mathematics.

Given this, an important finding is that the majority of children who participated in the questionnaire, including all of the children whose parents' participated in the follow-up interview, reported positive attitudes towards mathematics. This then suggests that parents in the study who got involved in homework less commonly took on the role of monitors, and may not have focussed on 'drill and practices' exercises in a way that compromised children's feelings of competence and their self-concept (Cai, 2003; Cao et al., 2006; Muir, 2012). Instead, parents must take on some other type of role, most likely a type of indirect involvement, such as providing support or encouragement. This is important because it negates the idea that parents' limited knowledge and their subsequent involvement in homework will foster children's negative attitudes towards mathematics.

In summary, what became evident during this research, as a barrier for parents, was their lack of understanding of the current mathematics curriculum and problem-solving strategies. This was reflective of their mathematics learning. This research supports the existing literature whereby limited parental involvement could be attributed to the parents' lack of understanding or knowledge in mathematics and could result in parents' involvement in homework (Muir, 2012). Clearly highlighted in this study was that barriers to parental involvement were seemingly independent of their perception of their own ability in mathematics and their general attitudes towards mathematics. Furthermore, their desire for their children to succeed superseded any negative attitudes parents may have had towards mathematics; this was particularly in relation to types of mathematics they deemed as necessary for their child to learn. A concern, in these cases, was that parents' involvement would translate to helping with homework (Muir, 2012). This was originally considered as problematic given the negative learning outcomes and attitudes associated with this type of involvement (Cai,

2003; Cao et al., 2006; Muir, 2012). However, given children's reports of positive attitudes towards mathematics, it is hypothesised that parents must become involved in homework in a manner that does not compromise children's positive attitudes towards mathematics (Cai, 2003; Cao et al., 2006; Muir, 2012). These findings are important because they suggest that parents' knowledge of mathematics and their involvement in homework is not indicative of children's attitudes towards mathematics.

5.1.3 Perspectives of Parental Involvement

It was interesting to find that parents and children had different views of parental involvement. That is, parents' statements about how they got involved in their child's mathematics learning did not match their child's statements about how they thought their parents got involved in their mathematics learning. Although parents' support can be effective, this depends on children's perception of their parents' support (Grolnick, Benjet, Kurowski, & Apostoleris, 1997; Marshall & Swan, 2010; Muir, 2011). Parents reported several types of involvement including homework, mathematics-related games, conversations about mathematics, incorporating mathematics into everyday life, and providing support, such as finding resources to help with mathematics learning or communicating with the teacher to express concerns. However, the majority of children reported that their parents got involved in their mathematics learning by helping and explaining. The majority of child participants reported positive attitudes towards mathematics and so it is difficult to determine exactly what types of parental involvement are linked to positive attitudes towards mathematics and negative attitudes towards mathematics. However, it does suggest that other factors are at play that may be contributing towards children's attitudes towards mathematics, such as parents' behaviour during these interactions and children's perception of the interaction.

Direct Involvement

All parents reported some form of direct involvement in mathematics, particularly involvement in homework. Direct assistance often involves homework of some kind, but could also extend to games involving mathematics (Cao et al., 2006). Some parents discussed fun activities that were mathematics-related such as Monopoly and Sum Dog, but homework remained the main form of involvement.

This is an important consideration as this appears to be the main activity that parents perceive as their role of participation in their child's mathematics learning within this study. This was originally considered as problematic, given the negative learning outcomes and attitudes that are associated with parents' involvement in homework (Cai, 2003; Cao et al., 2006; Muir, 2012).

The literature suggests that it is more effective for parents to be indirectly involved through their communication and support rather than direct roles such as monitoring children's mathematics learning at home (Cai, 2003). However, this was somewhat contradicted in this study as children whose parents reported to be involved mainly in homework, also reported positive attitudes. This suggested that homework may not have an adverse effect on children's attitudes towards mathematics, dependant on how parents become engaged in their child's mathematics homework. The majority of parents whose children reported positive attitudes indicated both direct and indirect types of involvement, which implies that there is a different underlying factor to consider other than specific activities that parents' are involved in.

Indirect Involvement

Children, whose parents reported involvement in indirect activities such as talking about mathematics and being supportive and encouraging, all indicated positive attitudes towards mathematics. Indirect assistance, defined as encouragement, expectations, and parental attitudes toward mathematics, has a substantial impact on children's attitudes towards mathematics (Cao et al., 2006; Ing, 2014). This is supported by findings from this study where the children whose parents reported indirect involvement held positive attitudes towards mathematics. The majority of parents who discussed indirect involvement reported talking about mathematics or incorporating mathematics into everyday life. Encouragement and support were mentioned, but considered as normal parts of parenting rather than types of involvement in children's mathematics learning. What is interesting about this finding is that the parents' attitudes and behaviours supportive of mathematics were mirrored by their children and provides further support for the inference that parents' indirect involvement is connected to children's attitudes towards mathematics.

Most parents in the interviews reported talking to their children about mathematics. When asked, the topics of conversation that parents discussed were talking about school and incorporating mathematics into everyday life. Incorporating mathematics into everyday life was also mentioned in some of the parents' questionnaires, though not as often as it was talked about in the interview. With prompting, types of mathematics involvement outside of school reported were: knowing what their children were doing within school and helping to improve their skills in that area or areas they deem necessary, such as basic facts, money, and time. Additionally, involvement included having conversations or discussions about mathematics in everyday life and ensuring that homework is completed. However, more often than not, homework remained the main type of involvement reported.

Parents interviewed appeared somewhat confused when asked about talking to their children about mathematics. It seemed that they did not consider talking about mathematics to be a type of involvement, but just a normal part of being a parent. Conversations about mathematics are considered to be a form of indirect involvement, and considered a part of parenting (Cao et al., 2006). Parents, therefore, may not see the benefits that talking about mathematics can have on their child's learning outcomes in mathematics and attitudes towards mathematics. Indirect involvement is suggested to have a positive effect on children's learning outcomes and attitudes, particularly interacting and talking with children (Tan & Goldberg 2009). Although parents may not have considered this a part of their involvement, it still appeared to be linked to children's positive attitudes towards mathematics; conversations were often reported by parents whose children indicated positive attitudes towards mathematics.

Implications

An interesting point to consider here is the nature of parent and child interactions themselves, and the behaviours that occur during the interaction. It could be that indirect involvement types, such as support and encouragement, are the factors that affect children's attitudes, which is suggested to be the case (Tan & Goldberg, 2009). This is feasible, and it is possible that parents' normally take on different behaviours when engaging in homework, which would explain the

research that found homework has a negative influence. However, the findings of this study in regards to direct involvement provides a contradicting thought that perhaps it is not what type of involvement occurs, but how that involvement occurs. This would reinforce the notion of the positive effects that indirect involvement has on children's attitudes towards mathematics.

It could be that other factors, such as parents' communication with their child, influences children's attitudes towards mathematics. In each of these types of involvement, communication has to occur in order for interaction to take place; communication between parents and their child provide a way in which perceptions and expectations are transmitted from parent to child (Kaplan et al., 2001). It could be that the discussions that take place during these interactions create a way in which parents' perceptions and expectations are transmitted from parent to child, and so it is the communication and not the interaction, that is important.

The majority of children reported that their parents became involved in their mathematics learning by helping and explaining, rather than through actual activities as reported by parents. How children perceive their parent to be involved is most important (Grolnick, Benjet, Kurowski, & Apostoleris, 1997; Marshall & Swan, 2010; Muir, 2011). This helps to reinforce the idea that it is communication that could be the key to the connection between parental involvement in mathematics and children's attitudes towards mathematics.

In summary, considering that the majority of children within the study reported positive attitudes towards mathematics, it is suggested that it is not direct types of involvement that are important. Instead, the findings suggest that parents' communication and engagement is important in how they will influence children's attitudes towards mathematics. This is reinforced by children's reports of parental involvement, that their parents got involved by helping and explaining, rather than mentioning specific activities. Indirect involvement, specifically, communication, support, and encouragement, provides a space in which parents' perceptions and expectations are transferred to their children (LeFevre et. al., 2009; Osante, 2012; Skwarchuk, 2009). This implies that parents' communication and engagement is important in the ways that it is linked to children's attitudes towards mathematics.

5.1.4 Summary

The most important findings from this study were the similarities and differences in parents' and their child's perceptions regarding mathematics. Firstly, parents' and children's shared attitudes towards mathematics suggest that parents' perceptions are linked to children's perceptions about mathematics, thus linked to children's attitudes towards mathematics. Secondly, the finding of parents' change in perception of their ability was important in the subsequent choices of types of involvement, as parents who reported concern in their ability to help their children would more often report involvement in homework. Involvement in homework is suggested to have negative learning outcomes and attitudes for children, and so this was originally a concern (Cai, 2003; Cao et al., 2006; Muir, 2012). However, given that the majority of children reported positive attitudes towards mathematics, it appeared that parents must not get involved in homework in the manner reported in the literature (Cai, 2003; Cao et al., 2006; Muir, 2012). Instead they must provide some sort of encouragement or support, as these types of involvement have been found to foster positive attitudes towards mathematics (LeFevre et. al., 2009; Osante, 2012; Skwarchuk, 2009). Lastly, the difference in parents' and children's perceptions in parental involvement suggest that parental involvement is not linked to children's attitudes towards mathematics through specific mathematics-related activities, but appear to be connected through the way that they engage in mathematics-related activities, through their communication, support, encouragement, and expectations.

Overall, the findings from this research suggest that parents' involvement in children's mathematics learning has the potential to foster children's positive attitudes towards mathematics, but this is dependent on the type of parental involvement. These types are suggested to be indirect types of involvement, such as support, communication, encouragement, and expectations. This study supports the research that shows that indirect involvement is a positive contributor towards children's attitudes towards mathematics (Cao et al., 2006; Clinton & Hattie, 2013; LeFevre et al., 2009; Galindo & Sheldon, 2010; Muir, 2012; Vukovic et al., 2013). However, this study did not find evidence to support the findings that direct involvement, specifically homework, has a negative connection to children's learning outcomes and attitudes towards mathematics (Cai, 2003; Cao

et al., 2006; Muir, 2012). This is a finding that is worthy of further investigation. Regardless, the findings from this study support the connection between parents' involvement in mathematics and children's attitudes towards mathematics.

5.2 Strengths, Limitations, and Implications

The mixed-method design in this study proved useful in its ability to collect the qualitative and quantitative data needed to measure parents' and children's attitudes towards mathematics and explore the complex nature of parental involvement. Mixed-methods and the combination of qualitative and quantitative methods present more insight into the topic at hand than one of the methods independently (Caruth, 2013). Although research about children's attitudes and parental involvement commonly use questionnaires (e.g., Adelson & McCoach, 2011; Tan & Goldberg, 2009), combining the two methods allowed more insight and interpretations of findings to be made, which enriched the results of this study.

5.2.1 Strengths

The strength of this study was in its design choices, such as the inclusion of perceived usefulness items in the questionnaire, similar questionnaires for parents and children, open-ended questions about involvement, and semi-structured interviews. These were considered strengths in this study because they provided useful data that contributed to the study's main findings.

The questionnaire used in this study was based on Adelson and McCoach's (2011) Math and Me Survey (M&MS), but was refined for this study to account for parents. Items were changed to make them more suitable for parents, replacing words that may have changed participants' interpretation of the item, such as a 'good' job, and including the items pertaining to the usefulness of mathematics. The inclusion of the perceived usefulness items made transparent the similarities in parents' and children's perceptions in their attitudes towards mathematics. It helped to identify the extent to which parents' and children's ideas related, a connection which would have been more difficult to make if the study had used the final two-factor model that the M&MS finally became,

omitting usefulness whilst maintaining perceived ability and enjoyment (Adelson & McCoach, 2011).

The other factors in the M&MS, ability and enjoyment, provided necessary information as to the similarities and differences in responses, but more so they provided insight into parents' and children's overall attitudes towards mathematics. It was especially important to include them because the perceived usefulness items did not contribute to overall attitudes towards mathematics. This was because all participants indicated in the questionnaire the perception that mathematics was useful, regardless of their perceived enjoyment or perceived ability in mathematics. Attitudes towards mathematics are complex in nature and so more than one measure was necessary in order to attain more accurate results (Adelson & McCoach, 2011).

An important decision was the choice to use the same questionnaire for children and parents, with the exception of some word changes. This made it easy to compare parent and child responses. Some open-ended questions were also identical in the parent and child questionnaire, such as questions pertaining to participants' enjoyment and lack of enjoyment in mathematics. This enabled the study to further reinforce the notion that parent and child perceptions are similar, given the substantially similar responses in these open-ended questions. It also allowed this study to examine any difference in responses that occurred. This was especially helpful in the question pertaining to parents' and children's ideas about parental involvement; it was found that parents and children had different ideas about the ways that parents got involved in the home. If not for the question being included in both the parent and child questionnaire, it would not have shown that children had different ideas about parental involvement, thus reinforcing the idea that it is not parents' involvement in mathematics activities that is important, instead it is the manner in which they become engaged in activities that appears to contribute to children's attitudes towards mathematics.

The open-ended questions used in the parent questionnaire were especially useful in gaining responses of types of involvement. This was important because the parents whose children reported negative attitudes towards mathematics did not participate in the follow-up interviews. The inclusion of open-ended questions

meant that the data showed that conversations have an association to children's positives attitudes towards mathematics, given that the parents of the children with negative attitudes did not report having conversations in mathematics. Furthermore, the open-ended questions meant that the interviews could be quick, yet insightful, as more qualitative questions could be asked over a short amount of time. This enabled the study to collect information in a way that did not greatly inconvenience the parents.

The open-ended questions meant that more insightful, qualitative questions could be asked in the interview, without taking too much of the parents' time. This enabled parents to talk about their perceptions of children's mathematics learning in more depth, without the necessity to explain aspects of their involvement that could just as easily be written down. As a result, parents appeared to have thought about mathematics in the time leading up to the interview and seemingly provided honest and insightful views. This was reiterated in the literature, where mixed-methods tend to provide more insightful information than what would be attained using only questionnaires (Cohen et al., 2003; De Rada & Dominguez-Alvarez, 2014; Hadre et al., 2012; Staples, 1991).

Gaining parents' perceptions through the adoption of semi-structured interviews allowed the study to gain insight into unobservable aspects of parent and child interactions. This was important because of the suggested influence that social context can have on children, parents being one of these contexts (Asante, 2012; LeFevre et. al., 2009; Rice et al., 2013; Skwarchuk, 2009). Parents were seen to be encouraging and supportive of their children for the most part, which shows in children's reported attitudes towards mathematics. Although exactly how and why this is influential is not necessarily clear from this study. Also, it would have been useful to gain more insight into children's perceptions because of the difference in parents' and children's perceptions of parental involvement. Regardless, the inclusion of parent interviews allowed this study to attain much more data about types of involvement that parents do not consider to be 'involvement in mathematics' such as communication, support, and encouragement.

Overall, the mixed-method design meant that this study could attain more data regarding the nature of parental involvement in mathematics in the home and its connection to children's attitudes towards mathematics. The ability to combine data collected from the questionnaires and the follow-up interviews meant that this study attained deeper insights into how parental involvement can have an effect on children's attitudes towards mathematics. If not for this combination of data, it would have been more difficult to suggest that parents' indirect involvement is more important than the types of mathematics activities that occur at home in regards to children's attitudes towards mathematics.

5.2.2 Limitations

The limitation of this study was in the ability to generalise the findings because of the small sample. The findings suggested that parent's indirect involvement in mathematics have some connection to children's attitudes towards mathematics. However, the small sample size makes it difficult to generalize these findings to the general population, reasons for this being the lack of negative attitudes found, the wide variation of types of involvement reported, the complex nature of involvement, and the limited collection of data about parent and child perceptions in mathematics.

One limitation was the range of reported attitudes towards mathematics in the child participants. Only two of the children in the study indicated negative attitudes towards mathematics, and because their parents were not involved in the follow-up interviews, it was difficult to gain understanding into the connection between their parents' involvement and their attitudes towards mathematics. All other children reported positive attitudes towards mathematics and the majority of parents reported positive attitudes towards mathematics. This meant that the data analysed only included participants with positive attitudes towards mathematics and so was not representative of the general population. This means that the study's findings cannot necessarily be generalised to the wider population.

A wide range of parental involvement types were reported in the study: homework, games that involve mathematics, downloading computer games that are mathematics-related, talking to the teacher, finding help when the child is struggling, talking about mathematics, incorporating mathematics into everyday

life, perceptions about mathematics, support, and encouragement. Although these can be grouped into categories like direct and indirect involvement, it is difficult to determine the contribution of specific types of parental involvement in children's attitudes towards mathematics. It is evident that some form of indirect involvement appears to have an impact on children's attitudes towards mathematics, but the specific type of involvement is not evident. A larger sample may help to determine the specifics of this involvement.

5.2.3 Implications

This study is indicative of the positive contribution that parents can have in children's attitudes towards mathematics. This is seen explicitly through types of indirect involvement that are linked to children's perceptions, therefore contributing to their attitudes. Types of indirect involvement such as parents' perceptions, support, encouragement, and communication were seen in this study to be linked to children's positive attitudes towards mathematics in some way. This would suggest that to increase involvement types like these, would help to improve children's attitudes towards mathematics. These findings are supported by the research whereby parental involvement, particularly indirect types of involvement, is linked to children's reports of positive attitudes towards mathematics (Cao et al., 2006; Ing, 2014). This implies that encouraging indirect types of parent involvement would improve children's positive attitudes towards mathematics.

Children's perceptions in mathematics were namely similar to their parents, shown by the similarities in responses in the questionnaire. This reiterates the body of literature showing that parents' perceptions influence children's perceptions, therefore impacting children's attitudes towards mathematics (Cao et al., 2006; Ing, 2014). This implies that parents' perceptions about mathematics are important in their connection to children's attitudes towards mathematics. Children's perceptions change through interactions and experiences and so not only are parents' perceptions important, but so too are the ways that they get involved that may impact their children's perceptions.

Support and encouragement, seen as everyday parts of being a parent (Cao et al., 2006), are one aspect of involvement that is connected to children's

attitudes. This was reported by the children with positive attitudes whose parents reported their active support and encouragement in their child's mathematics learning. This was shown through involvement in other types of mathematics such as homework and communication. This type of involvement was reported explicitly by parents who had positive attitudes towards mathematics, which suggests that parents' attitudes are important in determining the types of involvement they are engaged in, how they get engaged, and how this contributes to children's attitudes towards mathematics.

There was a clear indication in the results that having conversations about mathematics or incorporating mathematics in everyday life was connected with children's positive attitudes towards mathematics. This implication suggests that encouraging parents to talk with their children about mathematics can help to improve their attitudes towards mathematics. This could be in everyday life while doing everyday things, as indicated by some parents who commonly did this. Having conversations about mathematics could therefore provide a simple means of fostering children's positive attitudes towards mathematics. However, parents who commonly reported this type of involvement also reported positive attitudes towards mathematics. This again suggests that parents' perceptions matter in their likeliness to engage in this type of involvement with their child.

Parents' perceptions may have an effect on how they become involved in mathematics. This was seen by parents' reports of the types of involvement that occurred and their concerns surrounding the efficacy of their involvement. What may provide reassurance is the fact that parents' desire for their children to succeed far outweighed any negative perceptions that they had towards mathematics. This suggests that, if aware of the implications indirect involvement can have on children's attitudes, parents would more likely be involved in this way.

Encouraging parents' involvement in children's mathematics learning in the home is important because of the connection that parental involvement can have with children's attitudes. These early attitudes may affect later mathematics opportunities and learning, potentially influencing achievement, motivation, and self-esteem (Adelson & McCoach, 2011; Jacobs et al., 2002). Children are clear

about how they feel towards mathematics by their actions and intentions in participating, but this can be changed by experience and society (Galindo & Sheldon, 2010; Kilman, 2006; Muir, 2011; Skwarchuk, 2009). Because of this, it is important that children are exposed to positive attitudes towards mathematics and experiences in order to continue developing positive attitudes, especially as they grow older. Parents are a highly influential factor on children's attitudes, as seen in the literature and in this study (Grolnick et al., 1997; Hong et al., 2010). Therefore, it is important that parents are a part of children's mathematics learning, so to facilitate positive attitudes towards mathematics.

5.4 Future Research

An important finding of this study was the difference in parents' and their child's perception of the type of parental involvement that takes place in their home. This was found from a question asked of both parents and children in the questionnaire. This question showed that children saw their parents as helpers and explainers, which differed to parents' reports of their involvement as namely helping with homework. This was an important finding as it suggested that children's perception of their parents' involvement and the interactions that takes place with their parents while engaged in mathematics affects their attitudes towards mathematics. This seemingly negated the notion that involvement in homework has a negative impact on children's attitudes, because how children perceive the interaction also needs to be accounted for (Grolnick et al., 1997; Marshall & Swan, 2010; Muir, 2011). This finding supported the conclusion that parents' indirect involvement is more important that direct involvement.

It may be important to consider children's perceptions of parental involvement and how this is connected to their attitudes towards mathematics. This is an interesting finding that could be examined with a large sample size and the incorporation of children's perceptions. Children's perceptions could be investigated through the use of Likert scale items in order to find associations between types of attitudes and perceived involvement. Using interviews similar to those conducted with parents may not be necessary for children if adequate questionnaires were formulated; questionnaires would be quicker and more efficient. However, a mixed-method design was useful in this study and so child

interviews pertaining to parental involvement could be conducted in order to find further information on the influence of parental involvement. This would enable the study to attain comparable qualitative data from the child's perspective. However, a parent involvement questionnaire would save time, and enable involvement and attitudes to be compared statistically.

Parents' perceptions would still be of use in such a study to provide consistency in answers and gain a view of how involvement is associated to children's attitudes towards mathematics. The combination of both perceptions would mean that more insight is gained, which would hopefully result in more understanding as to the underlying factors that are influencing the interactions that occur, therefore influencing children's attitudes towards mathematics.

Further triangulation of data could occur with observational data, examining parent and child interactions in mathematics to facilitate understanding of the underlying factors behind the interactions that contribute to children's attitudes. This could be conducted by observing behaviour and discourse analysis, to determine patterns of interaction that result in positive attitudes. This would provide additional data of parental involvement which could possibly provide more information than using questionnaires and interviews only.

5.5 Conclusion

The purpose of this thesis was to explore the role of parents in children's attitudes towards mathematics. The research question was:

> What is the connection between parents' involvement in their child's mathematics learning and the child's attitudes towards mathematics?

Both parental involvement in mathematics and children's attitudes towards mathematics are important in their contribution to children's achievement, motivation, performance, and participation (e.g., Carmichael, MacDonald, & McFarland, 2014; Galindo & Sheldon, 2010; Georgiou & Tourva, 2007; Hemmings, Grootenboer, & Kay, 2011; LeFevre et al., 2009; Ma & Xu, 2004). However, the role of parents in children's attitudes towards mathematics is not a common focus; research in this area is scarce (e.g., Adelson, & McCoach, 2011;

Galindo & Sheldon, 2010; LeFevre et al., 2009). This thesis therefore aimed to critically examine parental involvement and children's attitudes towards mathematics. Data was attained through the utilization of a mixed-method that contained interviews and questionnaires. It was found that parents namely got involved through homework, a type of involvement associated with negative attitudes towards mathematics (e.g., Cao et al., 2006; Gunderson, Ramirez, Levine, & Beilock, 2012; Muir, 2012). However, 12 of the 14 children reported positive attitudes towards mathematics. It was also found that parents' and their child's perspectives about mathematics were strikingly similar, but that their perspectives about parental involvement differed. These results suggested that what is important is not the specific activities that parents get involved in (such as homework) but how they get engaged (through support, communication, and encouragement); this was supported by the literature (e.g., Cao et al., 2006; Clinton & Hattie, 2013; LeFevre et al., 2009; Galindo & Sheldon, 2010; Muir, 2012; Vukovic et al., 2013). These findings reiterate the importance of this topic as parents can potentially help to foster positive attitudes towards mathematics, thus increasing children's mathematics achievement and other learning outcomes in mathematics.

Parental involvement and children's attitudes are important in their contribution to children's learning outcomes in mathematics, such as achievement, motivation, performance, and participation (e.g., Carmichael, MacDonald, & McFarland, 2014; Galindo & Sheldon, 2010; Georgiou & Tourva, 2007; Hemmings, Grootenboer, & Kay, 2011; LeFevre et al., 2009; Ma & Xu, 2004). However, the connection between parental involvement in children's learning and children's attitudes towards mathematics is not a common focus in research (e.g., Adelson, & McCoach, 2011; Galindo & Sheldon, 2010; LeFevre et al., 2009). Parental involvement, specifically in the home, has been found to promote positive attitudes towards mathematics, develop numeracy skills, and improve overall achievement (Galindo & Sheldon, 2010; Kilman, 2006; Muir, 2011; Skwarchuk, 2009). Children's attitudes towards mathematics are also important for children's learning outcomes in mathematics (e.g., Adelson & McCoach, 2011; Ocak & Yamac, 2013; Stodolsky et al., 1991; Williams & Williams, 2010). Whilst both are important in improving children's learning

outcomes, literature that focuses on the connection between parental involvement in children's mathematics learning and children's attitudes towards mathematics is scarce (e.g., Adelson, & McCoach, 2011; Galindo & Sheldon, 2010; LeFevre et al., 2009). Previous research has alluded to the connection, outlining the effect that parental involvement can have on children's attitudes to some extent, but it is not a common focus (e.g., Adelson, & McCoach, 2011; Galindo & Sheldon, 2010; LeFevre et al., 2009). The connection between the two is important because parents could provide a way of fostering positive attitudes towards mathematics, therefore improving children's learning outcomes in mathematics.

Children's attitudes towards mathematics are important because they have been found to be associated with children's learning outcomes in mathematics. Learning outcomes such as achievement, motivation, performance, and participation have been found to be affected by different aspects of children's attitudes towards mathematics (e.g., Adelson & McCoach, 2011; Ocak & Yamac, 2013; Stodolsky et al., 1991; Williams & Williams, 2010). For example, children's perception of their ability (self-efficacy and self-concept) can affect achievement and performance, therefore affecting their motivation in subsequent tasks (e.g., Adelson & McCoach, 2011; Ferla, Valcke, & Cai, 2009; Martino & Zan, 2011; Pinxton et al., 2012; Summers, Schallert, & Ritter, 2003; Vandecandelaere et al., 2012; Williams & Williams, 2010). Children's feelings (enjoyment or anxiety) towards mathematics can affect attention and engagement in mathematics, which influences their willingness to get engaged (Martino & Zan, 2011; Hannula, 2002). This illustrates the important role of children's attitudes towards mathematics in children's learning outcomes in mathematics.

Parental involvement can help to foster positive attitudes towards mathematics, depending on the type of involvement. Types of parental involvement that has been found to foster positive attitudes towards mathematics are indirect involvement types, such as support, encouragement, and communication (Cao et al., 2006; Clinton & Hattie, 2013; Galindo & Sheldon, 2010; Kilman, 2006; LeFevre et al., 2009; Tan & Goldberg, 2009; Vukovic et al., 2013). These types of parental involvement have been found to improve self-efficacy, self-concept, and enjoyment. However, other types of parental involvement, such as involvement in homework, has been found to be associated

with negative attitudes towards mathematics (Cao et al., 2006; Gunderson et al., 2012; Muir, 2012). Involvement in homework has been found to lower children's self-concept and their general attitudes towards mathematics. This is because parental involvement in this case usually translates to monitoring progress, which can make children feel undermined (Cao et al., 2006; Gunderson et al., 2012; Muir, 2012). Thus how parents become involved in children's mathematics learning is important.

A mixed-method design was utilised to attain data about parents' and their child's attitudes toward mathematics, and perceptions about parental involvement in mathematics. This was achieved using two data collection methods: questionnaires and interviews. A parent and child questionnaire was used to attain measures of parents' and their child's attitudes towards mathematics and to gather data pertaining to perceptions about parental involvement. In the questionnaires, Likert scale questions were used to attain participants' attitudes towards mathematics in regards to their perception of their ability, perception of the usefulness of mathematics, and their perception of their enjoyment of mathematics. The open-ended questions in the questionnaire enabled some data about participants' perceptions of parental involvement to be attained from parents and children. The parent follow-up interview was used to gain more insight into parents' perceptions about parental involvement in mathematics in the home. Using more than one method allowed this research to attain more insightful qualitative data that provided a richer view of parental involvement in the home, whilst still attaining data about participants' attitudes towards mathematics that was easy to compare.

It was found that parents were involved namely in children's mathematics homework, a type of involvement normally associated with negative attitudes towards mathematics (Cao et al., 2006; Gunderson et al., 2012; Muir, 2012). However, given that 12 of the 14 children reported positive attitudes towards mathematics, this concept was negated. In the literature, parental involvement in homework has been found to be associated with negative attitudes towards mathematics (Cao et al., 2006; Gunderson et al., 2012; Muir, 2012). This is because parents namely get involved by monitoring their child's progress, which can undermine children's ability, thus lowering their self-concept and general

attitudes towards mathematics (Cao et al., 2006; Gunderson et al., 2012; Muir, 2012). However, within this study, it was found that 12 of the 14 children who participated reported positive attitudes towards mathematics and the majority of parents reported involvement in namely homework. This negated the literatures findings and suggested that the parents in this study did not get involved by monitoring progress. Instead it was suggested that they must be involved in some other way.

Parents' and their child's attitudes towards mathematics were strikingly similar, but their perspectives about parental involvement differed. It was found that parents and children had similar responses in the questions pertaining to their attitudes towards mathematics. However, parents' and their child's perceptions about parental involvement differed, whereby parents reported involvement in homework and children reported parental involvement as helping and explaining. The similarity of parent and child responses pertaining to their attitudes towards mathematics suggests that parents' perceptions have some connection to children's perceptions about mathematics, therefore their attitudes towards mathematics. This was supported by the literature whereby parents' perceptions have been found to influence children's attitudes towards mathematics (e.g., Frome & Eccles, 1998; Lindberg et al., 2008; Lopes & Donovan, 2009; Muir, 2009; Tan & Goldberg, 2009). Parents' and their child's different reports about parental involvement also support this idea. This finding suggests that specific types of involvement, like homework, are not as important as parents' perceptions about mathematics; this is given that children reported parental involvement as helping and explaining, not as parents' involvement in specific activities like homework.

The findings suggested that indirect involvement in mathematics is more important that direct involvement in mathematics. Parents' reports of involvement in homework, children's reports of positive attitudes towards mathematics, and the differences between parents' and children's ideas about parental involvement suggested that it is not specific types of parental involvement that is important. What is important is how parents become involved. Parental involvement in activities like homework is related to negative attitudes because parents normally get involved by monitoring and supervising children (Cao et al., 2006; Gunderson

et al., 2012; Muir, 2012). Children's reports of positive attitudes towards mathematics and their view of parental involvement as helping and explaining suggest that this is not the case. It suggests that indirect types of involvement as seen in this study (such as support, communication, and parents' perceptions of mathematics) have some connection to children's attitudes towards mathematics; an idea supported by the literature (Cao et al., 2006; Clinton & Hattie, 2013; LeFevre et al., 2009; Galindo & Sheldon, 2010; Muir, 2012; Vukovic et al., 2013). This suggests that how parents engage with children in their mathematics learning is more important than the specific activities that they get involved in.

In conclusion, this thesis aimed to critically examine the connection between parents' involvement in mathematics and children's attitudes towards mathematics. This was achieved through a mixed-method design whereby child and parent questionnaires, as well as parent interviews, were utilised in attaining data about parental involvement and attitudes towards mathematics. The findings were that although parents were involved mostly in homework, children still reported positive attitudes towards mathematics. It was also found that while parents and children reported similar attitudes towards mathematics, their perspective of parental involvement differed substantially. These results suggested that indirect involvement types (such as support, communication, and encouragement) are more important in children's attitudes towards mathematics than direct types of involvement (such as homework). This was supported by the literature (e.g., Cao et al., 2006; Clinton & Hattie, 2013; LeFevre et al., 2009; Galindo & Sheldon, 2010; Muir, 2012; Vukovic et al., 2013) and suggests that it is not what parents get involved in, but how they get involved that is important. These findings reinforced the importance of the role of parents in children's attitudes towards mathematics, and their contribution to children's positive learning outcomes in mathematics.

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Appendix A: Information Sheet

The Influence of Parents on Students' Attitudes towards Mathematics

Information:

My name is Shaunnie Farr; I am a Masters student at the University of Waikato under the supervision of Associate Professor Jenny Young-Loveridge and Dr Brenda Bicknell.

You and your child are being invited to take part in a research project exploring mathematics-related activities at home and the link this may have to children's attitudes towards mathematics.

This research aims to explore parent's involvement in their child's mathematics learning and the association it has to children's attitudes towards mathematics.

WHAT WILL HAPPEN:

In this study, you and your child will be asked to complete a questionnaire. Your child's questionnaire asks about their feelings towards mathematics. Your questionnaire also asks about this, as well as types of involvement in your child's learning and your view on parental involvement in mathematics learning in the home.

You may be asked to attend a follow-up conversation, if you are willing. This conversation asks for your personal opinion about children's learning of mathematics in the home and the importance of parental involvement. The follow-up conversation will be held at a time and location convenient to you.

Please note that in no part of the study will participants be asked to make judgements about the school or the teacher's performance in mathematics.

TIME COMMITMENT:

Each questionnaire should take no more than **15 minutes** and can be done at yours and your child's leisure.

The follow-up conversation will take no longer than **1 hour** and will be conducted in a place of mutual agreement.

PARTICIPANTS' RIGHTS:

You and your child do not have to answer any questions that you do not want to. Participants may withdraw at anytime and data may be withdrawn up until the commencement of data analysis. You and your child's permission are sought through the consent forms included in this handout. I will know the identity of the participants by the information that is provided in the questionnaires. However, all measures will be taken to ensure that individual's names and identifying factors remain anonymous and

confidential beyond me. The information will be used as a part of my Masters thesis in a report and may also be used in other scholarly publications and/or presentations.

Records and consent forms will be will be kept for five years and then destroyed. This is in accordance with university regulations. An electronic copy of the final copy of the thesis will become available, as the University of Waikato requires that a digital copy of the Masters thesis be lodged permanently in the University's digital repository: Research Commons.

FOR FURTHER INFORMATION:

Feel free to ask questions at any point. If you have any questions as a result of reading this information sheet, feel free to ask me at any time. I can inform you about the results of the study once the report is complete if you wish.

MY SUPERVISORS:

Associate Professor Jenny Young-Loveridge *Ph:* (07 838 4353) *Email:* educ2233@waikato.ac.nz

DISPUTES:

Should a dispute arise, please contact me in the first instance. If further action needs to made feel free to contact my supervisor, Associate Professor Jenny Young-Loveridge, or for further action, Dr Anne Hume.

Dr Anne Hume *(Chairperson of Mathematics Science and Technology Education Department)* *Ph: (07 838 4466 x7880) Email:* annehume@waikato.ac.nz

MY CONTACT DETAILS:

Shaunnie Farr *Ph:* (027 667 6697) *Email:* shaunnie.farr@windowslive.com

THANK YOU FOR YOUR TIME AND CONSIDERATION

Appendix B: Parent Consent Form

Department of Mathematics, Science & Technology Education
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THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

May 2014,

This form seeks your permission for you and your child to take part in a research project exploring mathematics-related activities at home and the link this may have to children's attitudes towards mathematics. Participation involves you and your child completing a questionnaire. You are also invited to have a follow-up conversation. The conversation will be at a time that suits you. Further details are in the information sheet provided.

If you and your child are willing to participate, please can you both fill in the consent forms, fill in the questionnaires, and return them to _____ by __/__/2014. If you have any difficulties, concerns, questions or require more information, please contact me **(*Phone:* 027 667 6697 *Email:* shaunnie.farr@windowslive.com)** or my lead supervisor Jenny Young-Loveridge **(*Phone:* 07 838 4353 *Email:* educ2233@waikato.ac.nz).**

Yours sincerely,

Shaunnie Farr (Masters Student)

Jenny Young-Loveridge (Associate Professor in Mathematics Education & Human Development)

****

Informed Consent: Parent/Caregiver

I consent to completing the survey. I understand that all information gathered, including my name, will be kept confidential. I may withdraw myself or my child at anytime and data may be withdrawn up until the commencement of data analysis.

I am also willing to take part in a follow up conversation **Y/N** *(Please circle)*

Signed: _____

Name: _____ Contact Number _____

I consent to my child completing the survey. I understand that all information gathered, including his/her name, will be kept confidential.

Signed: _____ Date: ___/___/2014

Your Name: _____ Child's Name: _____

Please return consent forms and questionnaires to _____by __/__/2014

Appendix C: Child Consent Form

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THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

May 2014

Researcher's Name: Shaunnie Farr

Consent Form

Shaunnie has explained to me what the research is about. I am happy to complete the paper-and-pencil survey. I know I can skip any question I don't want to answer. I know that what I write will be kept private. In the written report, I would like to be referred to as _____.

****

Signed: _____

Name: _____ Date: _____

Please return consent forms and questionnaires to _____ by __/__/2014

Appendix D: Child Questionnaire

The Influence of Parents on Students' Attitudes towards Mathematics

Name: _____ Age: _____ Ethnicity:_____

Please Tick One:	Strongly Agree	Agree	Disagree	Strongly Disagree
1. Maths is very hard for me				
2. I can solve difficult maths problems				
3. I enjoy studying maths				
4. I use maths in other subjects in school				
5. Knowing maths will help me get a job when I grow up				
6. I can tell if my answers in maths make sense				
7. I hate maths				
8. I understand maths				
9. Many jobs use maths				
10.Maths comes easily to me				
11.I enjoy doing puzzles that involve maths				
12.I use maths outside of school				
13.People do not need to know maths				
14.Maths is confusing to me				
15.Solving maths problems is fun				
16.I can solve maths problems that take a long time to finish				
17.I do maths problems on my own "just for fun"				
18.Maths is all around us in our everyday lives				
19.I am unable to solve most maths problems				
20.I enjoy playing games that involve maths				
21.Maths is boring				

22) What kind of maths do you do at home?	23) Who helps you with maths at home?
24) How do they help you with your maths? **Y/N**	25) Do you think your parents use maths? If yes, what do you think your parents use maths for?
26) Do you think your parents enjoy maths? **Y/N**	27) Do you enjoy maths? **Y/N**
28) I enjoy maths when:	29) I don't enjoy maths when:

Appendix E: Parent Questionnaire

The Influence of Parents on Students' Attitudes towards Mathematics

Name: _____Age: _____ Ethnicity: _____ Contact Number: _____

Name of Child: _____Is your child involved in any afterschool math programmes? Y/N

Please Tick One:	Strongly Agree	Agree	Disagree	Strongly Disagree
1. Maths is very hard for me				
2. I can solve difficult maths problems				
3. I enjoyed studying maths				
4. I used maths in other subjects in school				
5. Knowing maths helped me get a job				
6. I can tell if my answers in maths make sense				
7. I hate maths				
8. I understand maths				
9. Many jobs use maths				
10. Maths comes easily to me				
11. I enjoy doing puzzles that involve maths				
12. I have used maths outside of school				
13. People do not need to know maths				
14. Maths is confusing to me				
15. Solving maths problems is fun				
16. I can solve maths problems that take a long time to finish				
17. I do maths problems on my own "just for fun."				
18. Maths is all around us in our everyday lives				
19. I am unable to solve most maths problems				
20. I enjoy playing games that involve maths				
21. Maths is boring				

A. I enjoy maths when:

B. I do not enjoy maths when:

C. I use mathematics for

D. Maths activities our family do at home are:
PLEASE TICK THE ONES THAT APPLY TO YOU: (Tick twice if the activity has occurred within the last week)

Games with Dice		Using a Timer	
Games with Dominoes		Wearing a Watch	
Games with Money		Measuring Ingredients	
Sudoku		Using Calendars and Dates	
Dealing with Pocket Money		Talking about Money when Shopping	
Learning basic facts		Playing with Calculators	
Card Games		Doing Schoolwork/Homework	
Learning Times Tables			

OTHER: _____
_____
_____

E. We engage in the selected activities above: (*Please circle one*)
Never / Rarely / Sometimes / Often / Always

F. I get involved in my child's mathematics education by:
(eg: help with homework/study, keep up with what they're doing at school, playing math related games etc)?

G. I think that it is/isn't important to parents to be involved with their child's learning in mathematics because:

Thank you for participating

Appendix F: Parent Interview

Interview Questions

Name: _____Age: _____ Ethnicity:_____

Name of Child: _____ Child's Age:_____

Opening Statement: Hi _____ my name is Shaunnie. Firstly I'd like to thank you for agreeing to take part in this interview with me. This interview will be looking at your involvement in your child's learning in mathematics and also what your opinions on parental involvement. If there are any questions that you do not want to answer let me know and remember that you can pull out of the interview at anytime. Your information will be kept confidential and anonymous at all times.

Before we get started I just need your permission to record this interview to transcribe and analyse at a later date. This is for the purpose of writing my thesis. The recording itself is for my own personal use and will be kept anonymous and confidential. There will be no identifying factors pertaining to you or your child.

Do you consent?

Thank you.

1) Tell me what you think about what's happening in maths in schools these days.
2) How do you personally feel about Mathematics?
3) How do you think your child feels about maths?

Warm up questions

4) What kind of conversations are you having about maths at home?
5) Do you think it is important for your child to do maths at home?
a. What kind of maths? (Can you elaborate)
b. How is this important?
c. How do you help them with this kind of maths?
6) What does being involved in your child's maths learning mean to you?
7) What do you think your role is in helping your child with maths at home?

Types of involvement
(Guiding Questions)

8) In your questionnaire you mentioned (PARTICIPANT'S ANSWER) about the importance of involvement, could you please elaborate?

Importance of involvement

9) Do you consider yourself to be involved in your child's mathematics learning?
a. why/not

Level of involvement

That is all our questions, thank you for your time.

Do you have any questions for me?
Thank you again.