Parent Engagement in Mathematics Education

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Abstract

While parents can partner with schools in many ways, research in both the New Zealand and international contexts draws attention to need for schools to further consider how they can more effectively engage with parents to achieve positive outcomes on learning (Robinson, Hohepa & Lloyd, 2009). This study, grounded in a sociocultural perspective and drawing on 'funds of knowledge' ideas, seeks to better understand ways in which home-school partnerships that respect the needs and contributions of all participants—students, parents/whanau and teachers—might be developed in the area of mathematics. Of particular interest are the everyday activities in which families are involved and how improved parent awareness of the mathematical opportunities presented in these activities might increase parent confidence to participate in mathematical discussions with their children at home and in their community setting.

A review of the literature identifies; parents' beliefs regarding their role in the learning, parents' sense of personal efficacy in relation to their ability to effectively help their child, the relationship between teacher and parent, and parents' life context, all as impacting the development of effective home-school partnerships. In addition, the historical positioning of parent's is also recognised as playing a part in determining parents expectations for involvement and the way in which they relate to their children's teachers and school leadership.

This study draws on qualitative research methods and uses a Design Based Research approach. Sixteen parents along with their students ranging from year five to year eight from a New Zealand primary school participated in a series of six mathematics workshops aimed at exploring the research question:

> In what ways can parents' confidence to engage in mathematics learning be better supported? A secondary question considered is, how might the increased awareness of opportunities connected to everyday experiences/activities support parent confidence to engage in mathematical discussions at home and in their community setting?

Semi-structured interviews, were conducted both before and after the workshops to gain information as to what parents saw as being necessary supports to facilitate their engagement in mathematics learning, and what activities from the workshops had been effective in achieving these aims. A researcher reflective journal was also used to gather data and monitor the success of the workshops as they progressed.

The study revealed that shared learning opportunities—involving both parents/whanau, students and teachers—can provide an effective means for: supporting parent understanding of current

approaches to teaching and learning in mathematics, provide better understanding of the language associated with the Numeracy Development Project and facilitate positive relationships between teachers and parents. Furthermore, adopting activities which model mathematics in everyday activities, similar to those in which families are involved, can act as an effective scaffold for parents to engage more effectively in mathematical discussions with their children in their own home and everyday setting. In addition, opportunities to watch teachers interact with students was found to be a powerful mechanism for parents to develop more productive communication strategies through which they could better support their children's learning.

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Introduction

1.1 Introduction

This chapter provides background information to the study. The background information presented in section 1.2, illustrates the need for greater consideration regarding the development of effective home-school partnerships between parents and educators from international perspectives and the perspective of the New Zealand ministry of Education. The focus in this study then is to identify ways to support greater collaboration between parents and educators in the area of primary school mathematics. Continuing disparities in achievement between ethnicities suggest that more needs to be done to improve access for all students and their families to mathematics learning. Researchers have demonstrated that effective partnerships with parents that acknowledge families' strengths have greater positive impact than remedial programmes for raising achievement (Hattie, as cited in Robinson, Hohepa & Lloyd, 2009), therefore further understanding of how schools can better support partnerships with parents is both timely and important. Section 1.3 describes my researcher interest in the project and factors contributing to choice of topic. Section 1.4 presents the aims of the project along with the specific questions for research. Then in section 1.5 an overview of the chapters is provided.

1.2 Context

Although there has been significant investment in teacher development and change to the way in which mathematics is presented in schools in recent years, many students still struggle to achieve success and confidence in this area of the curriculum. Recent TIMSS reports (Chamberlain & Caygill, 2012) which compare the achievement of students at Year 5 and 9 internationally, clearly demonstrate that New Zealand students are not achieving the same levels of mathematical competence as their Asian and European peers (Chamberlain & Caygill, 2012). While it is widely accepted that what teachers do makes a significant difference to student achievement (Anthony & Walshaw, 2007), we must not ignore the vital role of parents. Many studies have investigated and attest to the positive effects of parent involvement in learning (Biddulph, Biddulph, & Biddulph, 2003; Desforges & Abouchaar, 2003; Sheldon & Epstein, 2005; Merttens & Vass, 1990). Epstein (as cited in Anthony & Walshaw, 2007) further reiterates this point stating that "students at all levels do better academic

work and have more positive school attitudes, higher aspirations and other positive behaviours if they have parents who are aware, knowledgeable, encouraging and involved"(p160).

Despite accumulating research evidence and the range of resources available through the New Zealand Ministry of Education website—tki.org.nz—there remains significant variation between schools and even classrooms regarding the extent to which parents are encouraged to be involved in learning, and the extent to which parents themselves pursue being involved. A broad range of factors are identified as potentially contributing to these disparities. Hornby and Lafaele (2011) provide a summary of the many factors which may act as barriers to effective partnerships between parents and teachers/schools. These are grouped as: individual parent and family factors, child factors, parent-teacher factors and wider societal factors. Sheldon and Epstein (2005) further suggest that compared with other school subjects, developing effective partnerships' in mathematics may be more challenging. This may in part be due to a negative positioning of mathematics within society. Many adults report feeling nervous, anxious or as having a strong dislike for mathematics and some may struggle to see the relevance of mathematics to their everyday lives. In addition, as mathematics content becomes incrementally more complex across each level of schooling, parents may not feel that they have the knowledge to effectively support their child's learning, despite evidence which demonstrates high levels of content knowledge as not being necessary for effective support in mathematics. Concerns have been raised about the likelihood of parents passing on these negative emotions and beliefs to their children (Muir, 2009; Okagaki & Frensch as cited in Biddulph et al., 2003), particularly when parents' beliefs and expectations for their children regarding mathematics have been associated with student achievement (Cai, 2003).

Importantly, research demonstrates that where parents are provided with supports including information and training about how they can help their children at home (Starkey & Klein, 2000; Shaver & Walls, 1998) and where they have opportunity to engage in conversations with educators (Civil, 2002) they may become more positive in their attitudes towards mathematics and contribute more effectively to their children's learning (Anthony & Walshaw, 2007).

1.3 My interest in this research

This study began as a personal teacher inquiry stemming from school wide professional discussions regarding disparities in student achievement between ethnic groupings and my informal discussions with parents in recent years in response to their frequently tabled comment "I just don't understand how they teach maths at school anymore", and an article authored by Demie and McLean (2007)

describing high levels of achievement among African students in the UK. Their success was attributed to strong support from within the school, the active involvement of parents in students learning, and the honouring of families cultural identities. At this point I began reflecting on the ways in which my own school was working to support parents in participating in their children's mathematics learning. In sharing my thoughts with other staff members, I received a mixed response, including comments like "well if they would just teach them their basic facts, that would make a difference", or "if parents made sure that their children completed their homework, that would be great" or "it's not even worth spending the time organising homework when half of them don't do it". In amongst these conversations, the value and effectiveness of homework was also under cross-examination through the media. It seemed that everyone was frustrated, parents in wanting to help but not knowing how, and teachers who although knowing that parent engagement can have positive outcomes for student achievement, were equally unsure how to better facilitate this process. What was indisputable was that despite the compelling evidence illustrating the potential for improved achievement through effective partnerships with parents our current practices were not achieving positive outcomes for anyone.

1.4 Aims of the study

The aim of this study was to improve our understanding of ways in which home-school partnerships in mathematics might be developed and that respect the needs and contributions of all participants including students, parents/whanau and teachers. The study adopted a workshop based approach. Co-operative group games, problem solving activities that modelled mathematics in everyday activities and settings, and 'Maths in my week' reflections were used to support parent understanding of current approaches to teaching and learning in mathematics, to develop a broader appreciation of what mathematics and mathematics learning encompasses, and to support connections for mathematics conversations in the home and community setting. Adopting a Design Research approach the main research question that underpinned this study, was:

> In what ways can parents be better supported to participate in mathematics learning with their children?

A second supporting question was:

> Can increased awareness of the mathematics opportunities in everyday activities and experiences support parents' engagement of mathematical discussions with their children in their homes and community contexts?

1.5 Overview of chapters

Chapter two, reviews the literature from both New Zealand and international perspectives regarding the involvement of parents in learning. While much evidence acknowledges the involvement of parents as being desirable for student achievement and motivation, the enactment of these ideals is less straight forward, particularly in relation to mathematics education. Many factors influence the nature and level of parent involvement in learning. In developing partnerships the literature notes the importance of attending to potential barriers related to parents' own experiences with mathematics, their current life context, or level of education. Other barriers are more related to the way in which schools extend and facilitate opportunities for parents to be involved, and the way in which parents have historically been positioned. In addition, students themselves can act to encourage or discourage their parents' participation in learning. The literature review provides a broad understanding of the issues and reviews a range of parent engagement models undertaken in various contexts which seek to improve partnerships with parents in mathematics learning.

Chapter three presents the methodology for the study. The choice of a qualitative Design Based Research approach is justified. Issues regarding researcher positioning and the ethics of being a participant researcher are addressed. The methods of data collection including questionnaires, focus group interviews, and researcher journaling are described.

Chapter four presents the findings relating to the analysis phase of the study which identified parents' motivations for participation. Parents demonstrated a strong sense of personal responsibility for supporting their child's learning however, most were frustrated by their lack of understanding of current approaches to teaching and learning in mathematics, their lack of skills to effectively support their children, and a limited knowledge of opportunities or activities that could be utilised to positive effect. The initial findings also revealed a limited perspective of what mathematics and learning in mathematics encompasses. Typically parents saw mathematics as being the ability to recall basic facts and knowledge of specific algorithmic strategies for solving problems. These findings informed the overall design of the study and strongly influenced the focus of the workshops. The workshop programme itself is then described, details of activities and parent responses to activities are detailed in a summary of my researcher reflections.

Chapter five presents the responses from parents to the post-workshop interviews and questionnaires and describes the extent to which both parent objectives and my researcher aims for the study were met.

Chapter six discusses the findings of the study in reference to the literature and identifies where the findings are consistent with other studies and where there are deviations. While parents were positive about their experience with the workshops and felt that they had gained significant understanding about how their children are learning in mathematics, some of my researcher goals were not met to the extent that I would have liked. Reasons for this reality are discussed. The limitations of the study are acknowledged along with other opportunities for further research. In conclusion, key considerations for other practitioners seeking to develop partnerships with parents in mathematics education are presented.

Chapter Two

Literature Review

2.1 Introduction

Children's mathematics learning and sense of mathematical identity is significantly influenced by their engagement within the school, their home and community. While it is widely accepted that what teachers do makes a significant difference to student achievement (Anthony & Walshaw, 2007), it is also recognised that "parents have their own expertise and unique knowledge about their children" (Peressini, 1998, p. 578). From birth, parents are engaged with their children in an informal teaching and learning relationship. In mathematics in particular, children acquire a vast array of skills including language learning, early number knowledge and mathematisation skills from parental input prior to participation in formal education settings (Perry & Dockett, 2005). Despite this understanding the school and the home do not always operate in concert with each other. Importantly, an increasing pool of research evidence demonstrates that "effective partnerships between families and schools can result in better outcomes for students" (Mutch & Collins, 2012, p. 168). Furthermore, making connections to students' lives is recognised as a powerful educational strategy for enhancing student achievement (Robinson, Hohepa, & Lloyd, 2009). With this in mind, the challenge then for educators is to identify ways in which links between the home culture and the school environment can be bridged in order to support parents' ongoing engagement in their child's mathematics education (Anthony & Walshaw, 2007).

The following literature review seeks to explore issues related to developing effective supports for parents' engagement in their child's mathematics education. Section 2.2 considers ways in which parents' might partner with schools and what is currently known about the achievement effects of various types of partnership. Section 2.3 describes the embedded influences of parent role construction, expectations, self-efficacy, parent perception of invitations, and the importance of positive parent-teacher relationships. Section 2.4 reflects on historical approaches to parent involvement in learning. In section 2.5 the importance of identity, its role and influence on participation is discussed. Section 2.6 reviews a range of successful models of parent engagement in learning. In particular, those grounded in the 'funds of knowledge' approach which aims to strengthen and improve the engagement of all parents in mathematics learning is examined as a basis for the current intervention and exploration. Section 2.7 then summarises key understandings from the literature and reviewed models of engagement.

2.2 Forming partnerships with parents.

Parents and schools can form partnerships and cooperate across a range of activities on a number of levels and ways. Sheldon and Epstein (2005) describe six types of involvement that partners with schools: parenting—helping families establish supportive home environments, communicating about programmes and student progress, volunteering parent help at school, learning at home through homework and other activities, decision making through participation in school leadership, and collaborating with the community. Each of these types of involvement contributes in different ways to the overall effectiveness and development of the school as a community.

As noted by Harris and Goodall (2008) there is a distinction between parental involvement, and engagement in learning. While general parent involvement may be desirable as a means of building relationships between parents and teachers and between parents, Harris and Goodall state that "simply being in the school has little effect on individual attainment unless there are direct and explicit connections to learning. It is what parents do to support learning in the school and in the home that makes the difference to achievement" (p. 278). However, many parents themselves do not differentiate between involvement with the school and engagement with learning.

Consequently, there is a need for schools to become better equipped to support family engagement in learning. Hattie's (as cited in Hornby & Witte, 2010) meta-analysis drew on 37 studies, synthesis and meta-analysis—16 of these studies were from New Zealand and 21 from other countries—reported the effect size of parental involvement on student achievement as 0.51 for all schools. Similarly, Jeynes (as cited in Hornby & Witte, 2010) reports an effect size of 0.7 to 0.74 for urban primary schools. In contrast, educational interventions are reported by Hattie as having an effect size of 0.4, significantly less than the effects calculated for parental involvement.

Of particular interest are the types of involvement shown to have the highest level of effect. Hattie (as cited in Robinson, Hohepa & Lloyd, 2009) identifies joint interventions involving parents and teachers supporting children's learning at home and at school, along with teacher professional development that was informed by and supportive of community funds of knowledge, as having the greatest impact on student outcomes (effect size of 1.81). Also identified as having a high positive effect on student learning were "interventions involving teacher-designed interactive homework that engaged parents in assisting their children with their learning" and "interventions that incorporated

family and community knowledge into curriculum and teaching" (p. 144/5). The effects relating to engagement through homework ranged from 0.22 to 1.38.

However, it must be noted that several studies also identified that parent engagement activities can sometimes produce a negative effect. Negative effects were found in association with poor teacher-parent relationships and where parent helping strategies were in conflict with classroom practices or interfered with the child's independence and were controlling. These negative effects were related to students in both high and low achievement ranges. For some parents who were trying to support students who are underachieving, the anxiety caused by feeling responsible to help but being unable to do so effectively became a cycle of increasing stress affecting both parent and student.

2.3 Factors influencing parent involvement

The literature review indicates a broad range of factors that can influence the likelihood and extent of parents becoming involved. Parental involvement may occur spontaneously or as a result of attempts by organisations, such as early childhood centres, kindergartens and schools, to enhance parent involvement. Spontaneous parental involvement can be influenced by social class, maternal level of education, availability of material resources, maternal mental health, marital status, and to a lesser extent ethnicity (Desfoges & Abouchaar, 2003). Involvement is also influenced, at all ages, by the child themselves and their willingness to accept parent involvement and engagement in learning. The type of involvement accepted becomes more determined by the child with age, with involvement generally reducing through adolescence as children begin to exert greater independence and influence over their own life choices and outcomes (Edwards & Alldred, 2000). Additionally, parental involvement in school and education has typically been shown to be mediated by the child's level of success. That is, when children are doing well and achieving high levels of success, parents tend to be more involved (Desforges & Abouchaar, 2003).

While many factors influence parental involvement, once children reach school age, Harris and Goodall (2008) report work commitments as being the most commonly cited reason for parents' lack of involvement. For single parents, these commitments are often exasperated by the dual responsibilities of care for other children and work. Parents least likely to becoming involved in school activities are those in economically disadvantaged situations, parents from minority ethnic groups, single parents and parents from large family settings, parents who have low levels of educational attainment and parents with high rates of mobility (Mutch & Collins, 2012). Harris and Goodall (2008)

however, suggest that these issues reflect “a more complex social and economic picture” (p. 280) of society.

2.3.1 Role Construction and Parent Expectations

Walker, Wilkins, Dallaire, Sandler, and Hoover-Dempsey (2005) propose a theoretical model of parental involvement where positive role construction and self-efficacy along with invitations from the school and child to help, collectively serve to influence parents initial decisions to become involved. Harris and Goodall (2008) agree, contending that “the attribution of responsibility for education” (p. 280), or ‘role construction’, is significant in determining how involved parents may or may not become. They argue that parents will be involved if they see that “supporting and enhancing their child’s school achievement is part of their ‘job’ as a parent” (p. 280). Walker et al. (2005) add that role construction functions as a motivator of parental involvement because it “helps parents imagine and anticipate how they might behave in relation to a host of activities relevant to the child’s educational success” (p. 89). This understanding of ‘role’ and the subsequent engagement of parents in, for example, helping with homework or helping in the classroom, signals the importance of school learning to the child.

When students perceive education as being important to their parents they may in turn be motivated to meet achievement goals to gain further approval from their parents. Cheung and Pomerantz (2012), whose study focussed on students in the United States and China in seventh and eighth grades, found that parent-oriented motivation was distinct from other forms of motivation and predictive of student self-regulated learning and higher levels of achievement. They suggest that although parent-oriented motivation is mostly externally motivated, for example, to avoid punishment or gain reward, there is also evidence that parent-oriented motivation may become intrinsic and that students may also come to see the goals of their parents as being personally valuable.

Sheldon and Epstein (2005) found parents beliefs, attitudes, and expectations for their children regarding mathematics were a good predictor of student achievement in junior and middle school. A further example of this influence can be seen in Cai’s (2003) cross-cultural study which compared US and Chinese parents’ expectations and their sixth grade students’ mathematical performance. Cai found that Chinese mothers held strong beliefs about the value of hard work, diligence, and academic success. In contrast, the US mothers in the study were more interested in general cognitive development. In linking these expectations to the significantly higher performance of Chinese

students on both routine and non-routine problem solving tasks, it was noted that parents enacted their beliefs in different ways. Ninety percent of Chinese parents reported checking up regularly on their children's homework compared with fifty-five percent of US parents. Furthermore, ninety percent of Chinese parents had ensured through a variety of means that they were aware of the expectations for their child in mathematics in relation to their age, while only fifty percent of US parents reported this knowledge.

These findings echo an earlier study by Chao (1996) which reported that "Chinese mothers believed that the reason Chinese children do so well in school was because Chinese parents expect more from their children" (p. 410). Many mothers reported giving their children extra work to do over and above that set by the teacher and encouraged their children to develop their talents in specific areas. It could also be argued that because Chinese mothers had ensured that they were knowledgeable about the school expectations, they were more able to support their children with appropriate activities and conversations to achieve these goals. Chao also argued that parent beliefs about learning are communicated in subtle ways as well as directly and that the sources of parent beliefs, particularly as inherited through culture, also play a significant part in influencing student motivation and achievement. Li (2005) agrees, noting that Chinese culture carries a long and historical tradition of learning that is developed through the "process of socialization" (p. 190). This is of particular interest when considering ways to support families from ethnic groups where there is a history of underachievement.

2.3.2 Self Efficacy

Parental self-efficacy, the belief in one's own ability to achieve a goal, is also known to be a key factor in determining parental involvement decisions (Grolnick, Ryan, & Deci, 1991). Hoover-Dempsey, Brassler, and Brissie, (1992) suggest this may refer to parents' belief in their ability to perform mathematical tasks or, the belief that their involvement in their child's mathematics education will effect a positive outcome for their child. Their study, involving 390 parents from four schools, found that parents with higher levels of efficacy spent more time engaged in educational activities with their children, volunteered more hours at school and were engaged in fewer telephone calls with the teacher.

Mondel and Tyler (1981) also found that more competent parents tended to treat their child as an "active problem solving agent" (p. 74). They define parent competence as being the combination of positive self-efficacy, trust and an active coping style. Furthermore, parents who displayed higher

levels of competence interfered less in their children's problem solving, showed more warmth and acceptance, were less disapproving and offered more helpful problem-solving questions and strategies.

The extent to which parents' perceive themselves as understanding their child's school mathematics—which becomes more complex at each successive year level—contributes towards the formation of parents' self-efficacy (Sheldon & Epstein, 2005). The fact that mathematics is no longer taught in the same way it was when many parents were at school presents a further gap in parent's knowledge which may potentially increase their feelings of insecurity and anxiety about becoming involved. Moreover, Muir (2009) suggests that when parents recall mathematics in a negative light and refer to their own abilities in mathematics in negative ways (e.g., "I was never any good at mathematics"), they are likely to pass on these same attitudes to their children. These types of comments may also contribute to a lack of achievement in mathematics being seen as acceptable. Similar concerns regarding children's perceptions of negative parental beliefs are expressed by Okagaki and Frensch (as cited in Biddulph et al., 2003).

Efficacy may influence the likelihood of participation in home-school partnership, in so much as efficacy influences the types of activities that parents get involved in (Hoover-Dempsey et al., 1992). For example, volunteering in the classroom requires the belief that they have enough skills to help, whereas offering to be a parent helper on a class outing may be less confronting.

2.3.3 Invitations from the school and Parent/Teacher Relationship

Levels of parental engagement with their children's school learning are also influenced by expectations and experiences of support from the school and the classroom teacher. For example, the provision of literacy resources (e.g., alphabet activities and school library books) signal to parents the teachers' expectation for parents to be engaged in the learning. Most parents expect to be provided with a range of literacy supports when their children begin school and many will have already initiated these types of activities at home. However, unlike literacy, the provision of supports from teachers to enhance home involvement in mathematics, particularly in the early years is less common (Graue, Whyte & Delaney, 2014; Muir 2009; Savell & Anthony, 2000).

The perception of teacher invitations to be involved in learning is also affected by how parents perceive their relationship with the teacher. Minke, Seridan, Roo and Koziol (2014) discuss the idea of congruence in teacher parent relationships. Their study found that when parents felt more

confident in their knowledge and abilities to help, they were more likely to view themselves in an equal relationship with the teacher and make themselves increasingly visible and available. Teachers in turn were more likely to report positive relationships with parents when the parents were more visible at school. Lack of parental visibility is often misinterpreted by teachers as lack of interest and is identified as being an obstacle to positive parent-teacher relationships. For example, MacIntryre (2013) in the New Zealand context found that while Pasifika parents do want to have good relationships with their children's teachers, they were unlikely to go into the classrooms and speak to non-Pasifika teachers for a variety of reasons. For some this was because of poor English language skills, many also believe that they should not teach their children school subjects in case they do it wrongly, Pasifika parents also hold teachers in very high esteem and are reluctant to come into the classroom for fear of being thought to be 'spying' on the teacher and thereby causing an upset. These types of cultural beliefs present a significant barrier in developing good relationships between parents and teachers. MacIntyre suggests in working to build positive relationships with Pasifika parents, it may be important for non-Pasifika teachers to personally invite Pasifika parents on field trips, to come out of the classroom and involve themselves alongside Pasifika parents in opportunities such as cultural or fundraising activities in which Pasifika parents are comfortable to be involved. Collaboration between teachers and parents in these types of activities provides an informal opportunity for both parties to begin 'getting to know' each other, thus establishing a platform for communication. Opportunities for two-way communication appear to be an important element in the development of relationship congruence (Minke et al., 2014). Furthermore, those parents who have positive relationships with teachers also report more engagement in learning activities at home.

In the same way that parent self-efficacy influences parents decisions to be involved, teacher self-efficacy concerning the teachers' belief in their own ability to be effective, has also been associated with greater teacher reports of engagement with parents. Teachers with higher levels of self-efficacy, who value parent involvement and who view parents as being capable and able to make a difference, tend to be more confident in inviting and accepting engagement from parents in school activities including volunteering and helping with homework (Hoover-Dempsey et al., 1992). However, not all teachers embrace the idea of increasing parental engagement. Some teachers cite the increased demands of time required to have meaningful conversations with parents and preparation of extra materials as barriers (Bernie & Lall, 2008). Souto-Manning and Swick (2006) found that teachers make less effort to engage parents if they have previously had negative encounters. Furthermore, difficult experiences between teachers and parents may lead to a poor view of parent-teacher relationships for both parties and even to a negative stereotyping of the relationship process. Cultural backgrounds and experiences along with the school culture also influence the expectations of both the teacher and

parent in regard to the view of each person's role in the relationship. For example, MacIntrye (2010) found that Pasifika parents saw their role as teaching their children Christian faith, providing moral education, cultural values, traditional customs and other culturally related activities, while the teachers' role was to teach academic subjects. For many Pasifika parents these roles are very independent of each other. Cahill (2006) agrees that the lack of understanding of Pasifika world-views on the part of many non-Pasifika teachers likely results in unnecessary misunderstanding between cultures. Tuafuti and McCaffery (2005) describe these contrasting perspectives as creating a "mismatch between school culture and expectations, and the Pasifika community's culture and expectations" (p. 493).

2.4 Historical Approaches to Parental Engagement

Although efforts have been made to engage parents in their children's mathematics learning, historically these efforts have not been effective for all parents and students. In the New Zealand context Maori and Pasifika groups continue to be under-represented in mathematics achievement data. Harris and Goodall (2008) suggest that this is in part because schools tend to treat all parents and students in the same way offering what they describe as a 'one size fits all' approach. USA researchers Baquedano-Lopez, Alexander & Hernandez (2013) along with Bernie and Lall (2008) from the UK, agree that most attempts to involve parents are top-down 'school-centric approaches'.

Traditional paradigms of parental involvement typically promote individualism rather than community. Viewings parents as problems rather than sources of knowledge excludes "the valuable and legitimate interaction patterns of many families such as where parents and grandparents share stories through oral history means" (Souto-Manning & Swick, 2006, p. 188). Such views of parental engagement only serve to marginalise families whose traditions and ways of knowing are different from those of the school. Souto-Manning and Swick (2006) argue that what is needed is a paradigm which "emphasises the existing power of parents and families and creates empowerment strategies where they can use their skills and talents in diverse and culturally responsive modes" (p. 191).

Meaney (as cited in Anthony and Walshaw 2007) provides us with one example of a Maori School in New Zealand who engaged their community in the development of their school curriculum. This collaboration involved significant discussion and debate about how mathematics should be taught and the development of shared understanding and beliefs to ensure that what was agreed upon would be

relevant for the community. This type of collaboration is consistent with Kaupapa Maori theory which seeks to address "historical and ongoing power imbalances" (Bishop, 2003, p. 223) and to restore Maori language, culture and identity. Glynn, Berryman, Grace and Glynn (2004) support the notion that real collaboration is about the sharing of expertise between both teachers and caregivers and coming to an agreed understanding of the goals and process by which to get there.

2.5 Links to Identity

Understanding the range of factors contributing to parental engagement in mathematics education also involves understanding how learners come to identify themselves as participants and users of a practice. That is, how both parents and students identify with mathematics is formed by and influences the activities that they participate in and experience.

The acquisition of negative or positive identities does not typically occur as the result of conscious choice. Sfard and Prusak (2005) discuss the acquisition of identity in narrative terms, describing identity formation as occurring as a result of a person or group of people being part of a story in which alternative stories may not have been considered. For example, in New Zealand a history of underachievement for many Maori and Pasifika students and their parents too frequently serves as the basis of deficit identity and stereotyping in relation to mathematics (Hunter & Anthony, 2011). Martin (2006) describes this ongoing and negative positioning within society as a form of social devaluation which has significant consequences for the formation of identity, participation, and non-participation in mathematics.

Contributing to this is the failure of those in power to recognize and give value to the 'cultural capital', the knowledge systems, tools and ways of knowing of non-dominant groups (De Abreu & Cline, 2007). Recent research argues that there is significant power attached to having one's forms of knowledge recognised and valued (Bishop, Berryman, Cavanagh, & Teddy, 2007). In further understanding the development of identity, Nasir and de Royston (2013) acknowledge that "identity involves becoming a member of a community or social network and is related to an individual's acquisition and alignment with particular bodies of knowledge, goals and practices valued by that community" (p. 269). As well as creating and perpetuating social hierarchies, the validation of some forms of knowledge over others may continue to contribute to ongoing challenges for students in maintaining their own positive cultural identity from within a diminished social position in a school (Martin, 2006).

For example, Nasir and de Royston (2013) in working with African American high school students on problem solving strategies in the context of basketball, showed that in this context where the students had a high degree of working knowledge of the game and its point scoring methods, they were able to be highly successful in their application of mathematics strategies to solve a range of average and percent problems. Importantly, Nasir et al. (2013) suggest that when students were able to discuss mathematics in reference to areas in which they are expert, they displayed confidence, willingness and presented themselves as identifying with the practice and assumed a position of power. Civil (2002) in the same way found that students when able to connect their mathematical learning to experiences with which they were familiar, they displayed higher levels of participation, however when challenged to formalise their understanding in relation to important mathematical concepts many students withdrew from the discussions. Turner, Gutiérrez, Simic-Muller, and Díez-Palomar (2009) agree that encouraging and developing opportunities for students to engage in mathematical contexts which reflect their own lives, and that position students and their families as experts, are important for developing positive mathematical identities. This understanding is equally relevant for Maori and Pasifika learners, who also need to be exposed to role models and experiences which demonstrate that mathematics is relevant for them and not determined by culture or societal position. It is suggested by Sfard and Prusak (2005) that the presentation of alternative identities, for example, an identity of success in mathematics, is important for learners in order for them to imagine themselves in this light.

A number of studies (e.g., de Abreu & Cline, 2005; Demie & McLean, 2007; Fletcher, Parkhill, Fa'afoi, Taleni, & O'Regan, 2009) provide evidence of students from diverse ethnicities achieving positive mathematics results despite cultural challenges. Importantly in these examples, students' sense of cultural identity was maintained as they learnt to accommodate the new culture, its mathematical language, representations, and strategies. This was largely through the efforts of their parents. For example, de Abreu and Cline (2005), undertook a study of Pakistani and white British families in the south of England. They found that parents of high-achieving children actively worked to help their children acquire the mathematics skills that they believed important including those that they felt were neglected by the school. They also used their first language as well as English to talk about mathematics. Moreover, parents engaged "explicit strategies to learn about their children's school methods for tackling specific tasks in mathematics" (p. 718) in order to support them. Parents maintained their own mathematics representations and kept these as distinct from school mathematics. Some parents enabled their children to use both forms of mathematics, this choice was influenced by parents own level of mathematical confidence and/or the value that was associated with the relevant knowledge. Bridging the gap between parents' mathematical experiences and

current school mathematical practices was challenging for all parents, however this was more difficult for parents of low achieving children. This may be because the parents of low achieving children lacked mathematical confidence in the first instance. de Abreu and Cline (2005) further suggest that in order to build positive home school connections, parents need information regarding current practices so that they are informed and can feel confident in their knowledge.

Parental engagement in learning, along with a strong sense of identity again appear as key factors influencing the achievement of a group of students of Black African heritage in the UK. Demi and McLean (2007) undertook a study involving five schools where Black African heritage students were performing above the average based on GCSE results. The term 'Black African' is used to describe students from/or having family backgrounds predominately from Nigeria and Ghana, but may also include a range of other African nations. Families describe themselves as being from Africa rather than their specific country. In the words of one parent:

> We are Africans it doesn't matter which country. … We are trying to combine the British culture with the African culture, it has to work together, but we have to try to instil into the children where they are from so they do not lose their African identities. We have to instil their roots, but still they have to embrace the British culture, it has to go hand in hand (p. 418).

The Lambeth local authority is described as being one of the most ethnically diverse areas in Britain, while many families are also economically disadvantaged with 41% of students qualifying for free school meals. Black African students are the largest ethnic group and make up 24% of the total. A number of strategies were identified as contributing to the success of these students including strong school leadership and a well-coordinated support for African Heritage students. These schools operate as inclusive learning communities providing a broad range of additional after-school activities relevant to the culture and value of the students including gospel choir, mentoring programmes, catch-up classes and homework clubs along with sporting and cultural arts programmes. Nearly all school staff were from the local community and parents and staff frequently attend the same churches. A culture of achievement was valued by the students as well as parents and teachers. Parents held high expectations for their children and were very supportive of the school and the teachers. All parents believed that education is the only way to achieve success in the future. Performance data was shared with parents and parents frequently asked teachers how they could help and ensured that their children completed homework tasks set. In this context, there was a cultural belief that everyone has a job to play in enabling the success of the children.

Strong similarities are identified in a New Zealand study of Year 6 to 9 (10-14yrs) Pasifika students demonstrating high levels of achievement in reading. These students also attributed their success to factors such as parental support and love, the maintenance of cultural identity, high expectations from teachers and parents, strong home-school relationships, the central role of the church and the value of ICT in the learning (Fletcher, Parkhill, Fa'afoi, Taleni, & O'Regan, 2009). In addition to the importance afforded by parents and students to the maintenance of culture and cultural identity alongside the desire to succeed, the study also described the home-school relationships as critical to "supporting and advancing Pasifika students' literacy learning". The researchers concluded that "the development of effective partnerships between home and school is the most powerful way for schools to understand and meet the needs of diverse children" (p. 26). Mutch and Collins (2012) report similar findings by the Education Review Office of New Zealand, who after reviewing over 200 schools in New Zealand with regard to their engagement with parents and whanau (families), reported six factors as being key for effective engagement. These included school "leadership, relationships, school culture, partnerships, community networks and communication" (p. 177). They also add that "it was not just what the school did, but the spirit in which it was done that led to successful engagement"(p. 177). These findings are consistent with those mentioned earlier by Robinson, Hohepa, and Lloyd (2009).

2.6 Models of parental engagement

In recognising the potential of parent engagement, a range of initiatives have been undertaken to increase parent understanding of what their children are learning in mathematics at school and how they can support them at home. Initiatives have included: opportunities for parents to participate in mathematics lessons with their children, take home packs and activities for children and parents, and evening workshops providing information and activities for parents to participate in.

In the UK the *Oceans Maths Project* (OMP) provides opportunities for parents to attend mathematics lessons/workshops with their children during school hours over one school term (Bernie & Lall, 2008). During the sessions parents are encouraged to participate in the mathematics activities with their children and to use language that they feel comfortable with. Beginning in 2001 in response to poor achievement levels of children in one of the UK's most disadvantaged areas—a large housing estate in East London called Ocean Estate—the project had expanded by 2008 to include 27 schools. One of the primary aims of the project was to improve "parents' confidence and participation in children's learning and progress; parents' own learning and participation in the life and work of the schools" (Bernie & Lall, 2008, p. 4). The project cites a wide range of successes including improved

understanding for parents about current mathematics teaching and links to their own learning. Importantly, this project has tracked positive achievement outcomes for students within a number of schools since the programme was introduced. Although this initiative is only one factor that may have contributed to the change in achievement outcomes, it provides compelling evidence regarding its impact from the original schools:

> At Stepney Green, since introducing the OMP in 2001, nearly 20% more KS3 pupils have achieved level 5 or above (from 50% in 2002 to 69% in 2007, above the average for Tower Hamlets). … For Cayley it's 1998/9 KS2 SAT results were 30% level 4, one of the poorest in the borough. In 2007 this had risen to 92%. From no children obtaining level 5 in KS2 in 2001, in 2007 49% obtained level 5, well about the national average (p. 48).

A similarly focussed project—*At Home with Numeracy* (Muir, 2009)—was conducted in Australia. In this project parents of Year 1 and 2 students were provided with a weekly take-home interactive numeracy activity, materials and guidelines. Feedback sheets were provided for parents to comment on how well their child engaged with the task and what the parents noticed in terms of the child's mathematical understandings. A key finding of this study was that parents were able to observe and describe the mathematical behaviours of their children. Participants also felt that the activities provided them with a better insight of classroom practice. Other initiatives such as *Project IMPACT* (Merttens & Vass, 1993) and, *Engaging families in numeracy* (Muir, 2012), have adopted similar strategies of providing take-home activities (e.g., numeracy bags with game based activities) for parents and children.

The Mathematics Club (Muir, 2012), developed as an informal after-school mathematics group, provided an interactive opportunity for parents to investigate a range of mathematics topics that were of concern to them including: multiplication facts, fractions and mental computation. The sessions provided parents with a mixture of information, activities, games, resources and reading or websites to visit. The response to the initiative was positive with one parent commenting:

> It is a great opportunity to get together with other parents with similar concerns. As a parent I struggle to remember how to do the mathematics I did at school, let alone know how to help my children with their mathematics, so it has been very helpful to find out how mathematics is taught today and learn useful strategies that I can use to help my children with mathematics (p. 7).

In the New Zealand context, the *Home-School Partnership: Numeracy*—developed by the New Zealand Ministry of Education—(Fisher & Neill 2006; Holmes & Tait-McCutcheon, 2009) was piloted in 2006

following the success of a similar literacy initiative aimed at supporting Pasifika families. Forty schools were engaged in the pilot programme, which utilised community workshop sessions with parents and promoted engagement through games and the use of minimal or easily accessible equipment. While a model for the sessions was provided by New Zealand Ministry of Education, it is reported that schools quickly adapted the original model to meet the specific needs of their own environment. Regardless of the model adopted by various schools, the initiative provided a positive mechanism for schools to develop and improve their connections and communication with parents which up to the introduction of the partnership had been largely one way – school to home (Fisher & Neill 2006; Holmes & Tait-McCutcheon, 2009).

2.6.1 Extending ideas about partnership – Funds of Knowledge

While the previously described initiatives report positive outcomes, a growing number of parent engagement initiatives are working towards reinterpreting or re-defining the concept of partnership between schools and parents, based on the notion that each partner is given an equally valued opportunity to contribute to the learning process. Harris and Goodall (2008) in reviewing 20 of 100 secondary schools in the UK who had participated in *The Engaging Parents in Raising Achievement Project* (EPRA), concluded that effective engagement with parents was only possible "if major efforts are made to understand the local community and if the relationship is perceived to be genuinely two-way … parents need to be seen as an integral part of the learning process. They need to know that they matter" (p. 286).

'Funds of knowledge' is a key theoretical framework underpinning recent work focused on developing home and school partnerships (Civil, 2007). The fundamental belief at the core of funds of knowledge models is that "people are competent, they have knowledge and their life experiences have given them that knowledge" (Gonzalez, Moll, & Amanti 2005, p. ix). As such funds of knowledge can refer to both teacher funds of knowledge as reflected by knowledge gained from their life experiences and student funds of knowledge that are gained as a result of student participation in everyday life as well as popular culture. To develop true partnerships between educators and parents the funds of knowledge which all participants hold must both be acknowledged and given value. This means engaging in sincere and meaningful multi-directional conversations between parents, students and teachers. It means listening to the needs, values and aspirations of all parties and working together to achieve agreed purposes.

In the New Zealand context, Tuafuti and McCaffery (2005) describe this type of 'shared vision model' partnership as being fundamental to the development of Finlayson Park School's Samoan bi-lingual unit:

> The inclusion of Pasifika languages, cultures and parents and communities in all aspects of the establishment and running of bilingual programmes does have many positive effects, including: raising self-esteem, self-identity, self-responsibility, self-discipline and self-confidence. It also fosters cognitive and academic proficiency in L1 and then in L2. This is because key ideas about the world, curriculum and learning can usually be explored and understood best in a person's first language (p. 497).

A further example of work drawing on funds of knowledge models is the *Math and Parent Partnerships* (MAPPS) project implemented in the USA (Civil & Bernier 2006). In contrast to more traditional parent engagement initiatives, MAPPS sought to promote the leadership of parents in mathematics activities in home and school and to understand better the connection between out-of-school and in-school mathematics. A key difference in this project was that parents were viewed as intellectual resources and engaged in a number of roles such as parents, learners, facilitators and leaders. The researchers identify three key components as contributing to the overall success of the project. These were the inclusion of leadership development sessions where parents were engaged in discussions about the facilitation of workshops, different ways of learning and recruitment of other parents. Secondly, the use of parent mathematics awareness workshops (targeting specific topics in mathematics). Finally, there was also mathematics for parents that involved eight weekly sessions run for two hours to provide an opportunity for parents to gain in depth understanding of mathematical topics and how standards-based tasks were used in the classroom. Although many parents engaged initially in order to help their children, parents reported that as a result of the four year project they developed a better appreciation and understanding of mathematics for themselves. Additionally, participating parents felt more equipped to be better educational role models for their children and developed deeper relationships with their children's teachers.

Other parental engagement initiatives (e.g., Clarke & Robbins, 2004; Jay, Rose & Simmons, 2013) recognise that while many parents may not feel confident in engaging with school mathematics, children are still engaged in mathematical activities with their parents at home when participating in everyday activities. These initiatives focus on increasing both the visibility of mathematics as experienced in the everyday lives of families and the amount of mathematical talk used in the home. For example, *The Everyday Mathematics* project (Jay et al., 2013) provided workshops for families of year three and four students that encouraged families to come up with as many ways as they could to

incorporate mathematics into their everyday experiences. The *Numeracy Enacted Project* (Clarke & Robbins, 2004) involved families from four preschools taking home cameras and photographing their children participating in numeracy and literacy activities within the home and community. These were then shared back at the centres with the children's teachers and principal. These types of initiatives give recognition to family, social and cultural 'funds of knowledge' and the ways in which families engage in a wide range of mathematical discussions in informal ways.

2.7 Summary

A broad range of factors have been identified as contributing to or acting as barriers to parents engaging in their children's mathematical learning. These include: role construction, parents expectations, parent efficacy, perceptions of invitations to participate in the learning, along with positive relationships between parents and teachers. The literature review has shown how historically families whose traditions and ways of knowing are different from that of the dominant culture have often been marginalised in relation to mathematics reform. This is important as identity is acknowledged as playing an important role in influencing how parents and students participate in mathematics.

Despite these barriers, a range of effective collaborations in mathematics education, between parents and schools have been described. Key factors identified in the success of these partnerships include the establishment of relationships based on mutual trust and respect, and the establishment of bi-directional communication. In all programmes, outcomes are improved when there is a genuine valuing of the funds of knowledge each partner brings to the learning, and the belief that parents play an integral rather than a supplementary role in the learning. In addition, understanding of families and the contexts in which they engage in mathematical activities will be important for building connections between mathematics at school and mathematics at home.

Supporting parents understanding of the type of mathematics that their children are engaging in and how they are learning is important for parents to feel empowered and knowledgeable in their role as parent. Increasing parents' awareness of ways in which they can engage in mathematics through their everyday activities demonstrates the relevance of mathematics in their lives and also gives validation to their experiences as being authentic opportunities for mathematics learning.

Chapter Three

Methodology – Approach and Design

3.1 Introduction and Overview

Educational research may be viewed as an applied social science in that it attempts to build an "explanatory theory about people and their behaviour" (Punch, 2009, p. 9). Punch identifies two important elements in research: the role of 'real-world data' and the role of 'theory that explains'. Central to any inquiry are the *questions* for which we seek answers and explanations. Both qualitative and quantitative methods for data collection are used in educational research depending on what is known about the subject and what will be suitable as evidence. It is also acknowledged that the relationship between the researcher and the subject of the research has an influence on how the research inquiry is undertaken and the interpretation of the findings.

In recognition of the importance of home-school partnerships this study explores the overarching research question: In what ways can parents' confidence to engage in mathematics learning be better supported? A secondary question considered is, how might the increased awareness of opportunities connected to everyday experiences/activities support parent confidence to engage in mathematical discussions at home and in their community setting? To address these questions a qualitative approach using Educational Design Research was used. Section 3.2 backgrounds qualitative approaches and provides an overview of Education Design Research. Section 3.3 discusses issues relating to researcher positioning and my position as a participant researcher. Section 3.4 describes the participants and the setting along with sampling methods. In section 3.5 ethical considerations are discussed. Section 3.6 and 3.7 described the methods used in data collection and the data analysis processes. Section 3.9 considers the aspect of trustworthiness in the research. Section 4.0 provides a summary.

3.2 Qualitative Research

The distinguishing hallmark of qualitative research is its diversity. Qualitative research typically involves the study of people in their natural environments. In the current study the natural environment is considered to be the school community comprising of parents, their children, and teachers. Miles and Huberman (1994) describe qualitative research as being typically conducted within the field, with the researcher attempting to obtain data about the perceptions of the

participants 'from the inside'. The main goal of qualitative analysis is to develop deeper understandings of the factors influencing and contributing to the ways in which people respond and behave in their given situation. Cohen, Manion, and Morrison (2011) remind us that that the educational world is "a messy place" that needs to be studied as a whole "rather than in fragments if true understanding is to be reached" (p. 219). Given that the current study focuses on people in the context of education and the ways in which they engage with education, a qualitative approach was selected as being the most appropriate.

3.2.1 Educational Design Research

Educational Design Research (EDR) differs from other research forms in its commitment to simultaneously developing theoretical insights and practical solutions to real world problems in collaboration with important stakeholders (McKenney & Reeves, 2014). In EDR, design and research are intertwined, a distinct contrast to the more traditional methods of experimental design, in which a researcher would test a predetermined design against a comparison design and measure outcomes (Cobb, Confrey, Lehrer, & Schauble, 2003). The close links between design and research further enable practical lessons for the improvement of education practice—providing a "relevance to practice" (Gutiérrez & Penuel, 2014) that makes it a productive path forward in educational research.

Van den Akker, Gravemijer, McKenney, and Nieven (2006b) describe three motives for EDR. The first motive is "to increase the relevance of research for educational policy and practice" (p. 3). Weak links to practice have been the basis of much past criticism directed at educational research. The second motive concerns justification of theories. Research must demonstrate its relevance through application in naturally occurring settings as opposed to those which are seen as optimal. The third motive relates to robustness of the design, by making explicit the learning in order to contribute new knowledge to ongoing efforts aimed towards further improvement of solutions. These motives align with the current study's focus on adapting and developing what is known about effective home-school partnerships to consider how best to support parents' engagement in their children's mathematics learning. Namely the study explores how to raise awareness of and give value to everyday experiences in mathematics by providing models of contexts in which mathematics conversations might be developed by parents in the home. Other studies in international contexts including; MAPPS (Civil and Bernier, 2006), The Home School Knowledge Exchange Project (Feiler et al., 2008), have reported a positive effect on children's mathematics learning and sense of mathematical identity by increasing parent opportunities to engage with their children's mathematics. An exploration of whether there

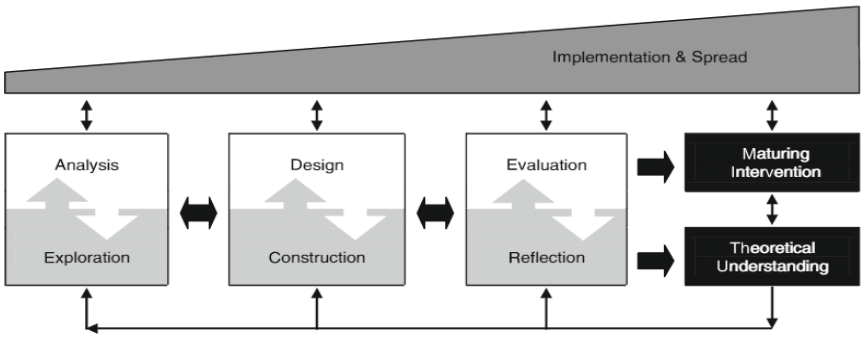
are similar effects in the New Zealand setting will identify conditions that are productive and relevant to these aims.

EDR is described by Zhao and Cobb (2006) as a "highly interventionist activity" (p. 457) with decisions on how to proceed being continually informed by ongoing analysis of the participants activity. They suggest that for the researcher this means maintaining a "bi-focal" attention, meaning the researcher is continually designing the activity while at the same time undertaking rigorous research. In this study, researcher journaling—conducted after each workshop session—has been used as the method for reflection and analysis and to inform ongoing adaptations to the design and is discussed later in the chapter.

A specific outcome of EDR is to develop meaningful changes in practice. Practical interventions developed should produce reusable knowledge. Educational products or solutions developed within an EDR project may include outputs such as a learning game, a specific process that supports learning, a programme of workshops to develop an identified skill, or a policy for implementation. In this instance the intended changes in practices concern the school and the parents in the local context. That is, in a partnership frame it is expected that the school (teachers within) will value and give importance to the development and empowerment of parents' experiences, will learn more about parent's funds of knowledge and parents will be supported to help build mathematical connections through everyday experiences as demonstrated in their life context. Of interest will be whether parents perceive this role as being important and as having a positive effect on children's motivation, engagement and achievement outcomes in mathematics.

McKenney and Reeves (2014) identify three phases in the process of EDR. These include an analysis or orientation phase, a design and development phase, and an evaluation/retrospective phase. The following diagram (Figure 3.1) illustrates this process:

Fig. 3.1 Generic model (McKenney & Reeves, 2014, p. 135).



Importantly EDR does not identify itself as a methodology as such, rather it is an approach to research. Most frequently EDR uses mixed methods—qualitative and quantitative—to answer research questions. In this study qualitative methods include focus group interviews with parents and researcher journaling. Alongside these, questionnaires have been used to gather quantitative evidence adding further scientific strength to the findings which is a requirement of EDR (McKenney & Reeves, 2014). Focus group interviews and questionnaires were conducted at two time points. Pre-workshop interviews (Appendix A) and questionnaires (Appendix C) were used to develop a deeper understanding of the research problem and the needs to be addressed. Interviews and questionnaires following the workshop series were used to provide a rich source of information for understanding which aspects of the workshops have been most effective in addressing the research questions. These insights or 'lessons learned' are important for the bigger picture, (Reeves, McKenney, & Herrington, 2011) which is the ongoing contribution and involvement of parents in mathematics education through engagement of everyday activities to build powerful connections for students.

3.3 Researcher Positioning

Researcher positioning or positionality refers to the way in which the researchers' beliefs, sense of identity, gender, race, socioeconomic status and personal experiences influence the research. Positions of power within society may also influence positioning. The choice of methodology, along with type of questions asked and the interpretation of responses, are likely to be informed by any one, or combination of these factors. For these reasons it is important to consider how the researcher is positioned within the research and any likely effects on the research outcomes (Foote & Bartell, 2011).

My position in this research is influenced by my role within the school as a teacher[1], and my role as parent. My relationship with many of the families has spanned over a considerable period having been employed at the school for 18 years. Furthermore, my own children have and continue to attend the school. As a result my relationship with many parents, a number of whom are participants in this study, can be professional or personal, or both in any one day.

In further explaining the concept of positionality, Tetreault (as cited in Foote & Bartell 2011) states that positionality is "an idea in which people are not defined in terms of fixed identities but by their location within shifting networks of relationships which can be analysed and changed" (p. 46). Positioning theory then applies not only to researchers but also to participants.

[1] Although on study leave for the period of the research project

In looking at the positioning of participants, Davies and Harre (as cited in Ritchie & Rigano, 2001) note that it is also important to consider the way individuals are located in, and participate in the research conversation. This may include their visible behaviours or gestures along with the way in which their speech is delivered. Within that conversation participants may see themselves as players of a 'role' or as a character or holder of a particular 'storyline'. Storylines may be implicit or explicit. Explicit storylines are defined as those represented in for example church ceremonies or rule bound games. Implicit storylines refer to the socially or culturally held expectations regarding the way in which two characters typically are expected to behave. In this study, the storyline is implicit and could be described as 'the teacher and the parent' or 'the school teachers and the parents'. Teachers, in relation to parents and students, are often seen by society as being in a position of power and authority. The way in which each of the participants in the study behaves is likely then to be influenced by not only their personal beliefs, sense of identity, and gender etc. but also the way in which they perceive their position in relation to mine as teacher/researcher.

Heeding the findings of Ritchie and Rigano's (2010) study involving parents, I was concerned that my positioning could be perceived as dominant because I was controlling the design of the workshops, the procedures for interviews, and the design of questionnaires. Cognisant of Herbel-Eisenmann, Wagner, Johnson, Suh, and Figueras's (2015) contention that "positions may also be temporary and involve changes in power" and also "reciprocal, in the sense that when one positions oneself, others in the interactions are also positioned" (p. 4). It was my hope that the workshop experience would support further development of home-school partnership, with parents' positioning of themselves as valued partners in the learning process. Stringer (2007) agrees that the "role of the researcher is not that of an expert who *does* research but that of a resource person" who "acts as a catalyst" (p. 24) and stimulates change. My role in this study is to facilitate the process, the process is seen as being as important as the outcomes.

The pre-workshop interviews revealed a range of positions in which parents saw themselves and in which they saw me. These were made evident by their spoken expectations about what they hoped would be achieved as a result of their participation in the workshops. Predominantly parents indicated a feeling of disempowerment in relation to their lack of knowledge around current approaches to teaching and learning in mathematics, knowledge that they saw as being held by myself and the other teachers.

Building on Harvey's (as cited in Foote & Bartell, 2011) recommendation for researchers to "examine the similarities and differences between themselves and their research participants explicitly" (p. 47), it was also important to review the ways in which relationships, which drive 'conversations', are

formed and maintained, particularly in the teaching of mathematics, where relational issues arising from culture and life experiences have not always been a specific concern (Foote & Bartell, 2011). In order to reduce the impact of potential power relationships between myself and the participants (Reeves, McKenney, & Herrington 2010) a deliberate effort was made to position myself alongside parents rather than as an expert. To establish a platform of similarities from which we could operate, my personal story as a learner of mathematics was shared. This story included a description of my school experiences, my frustration of not understanding at various points, my feeling of being 'left behind' and not being able to keep up, and my withdrawal from mathematics study after what was formerly known in New Zealand as School Certificate examinations (current equivalent NCEA Level 1). I also described my own family background, having come from working class parents with no formal education but who were capable with practical skills in building and sewing and lovers of the outdoors, and who encouraged myself and my siblings to engage alongside them in many of these activities. I discussed my beliefs that these experiences and a supportive home environment enabled me to be successful at school. I hoped that this discussion would prompt the parents involved in this study to recognise that their experiences, skills and family histories, just like mine had value regardless of whether they had formal recognition. The faces of the parents, their nods and smiles indicated to me that they could relate to these stories.

Funds of knowledge researchers Civil and Bernier (2006) also acknowledge the existence of positioning issues relating to power between teachers and parents. They agree that developing trust or 'confianza,' along with opportunities for parents to genuinely feel that their voices are being heard, are important in achieving positive relationships with parents. The atmosphere in post-workshop interviews was less reserved with parents responding very openly and comfortably and adding to each other's comments as they discussed their experiences in the workshops. These types of interactions suggested that I had been successful in reducing the 'power relation' between myself and the participants. Parents made suggestions of things that they would like to see modified in future workshops. There was also discussion about ways in which parents who had not participated in the workshops might be reached in future workshops, or what other formats might be suited to making the same information accessible to other families who had not attended. It is feasible to interpret these suggestions as indicators of parents taking on a more assertive role within our researcher/parent relationship, and within the school community.

3.4 Participants and Setting

The study took place in a decile four school within the Taranaki region. The school principal and board of trustees were provided with a copy of the research proposal and gave consent to conduct the research at the school site and with members of the school community. The school is a full-primary catering for students from new entrant to year eight. 170 families contribute to a school role of 225 students including 83 Maori, and 18 Pasifika. Most families would fit into the middle to lower socio-economic range of New Zealand families.

Purposive and volunteer sampling methods were used to invite participants for this study. Purposive sampling can be used when a researcher wishes to focus on a specific issue or case (Cohen et al., 2011). Parents who had children that were participating in the Accelerating Learning in Mathematics Programme[2], or who had been participants in that programme the previous year, were identified as families who might be particularly interested in the workshops. These families were personally contacted and invited to participate in the workshops and made up nearly half of the final sample. In order to involve more participants an open invitation was made to all families in the years 5-8 group (ages nine-thirteen), giving a potential pool of families from four classes. The decision not to extend the invitation to the whole school was made for two reasons. Firstly, I did not feel that I would be able to meet the needs of a group that might represent students from years one through to year eight (five year olds –thirteen years old). Secondly, it is recognised that parent involvement declines as children progress through the school system (Desforges & Abouchaar, 2003) and many parents become more anxious about participating in mathematics as their children progress in to the senior area of the school and as mathematics content becomes more complex (Sheldon & Epstein, 2005). Developing strategies to support the continuing engagement of parents of students throughout year's five to eight, was the focus at this point of time.

Although the initial information evening attracted only 12 families, it was quickly established that a number of other families who wished to attend had been unable to do so as a result of their children being committed to local church youth group activities. An information evening was held the following evening attracting a further three families. The scheduling of the workshops was arrived at by consensus to enable maximum participation. Over the six weeks 18 families engaged with the workshops with a weekly average of 12 families participating. Accounting for parents, children, and teachers this meant an average weekly group size of 26 attendees.

[2] Accelerated Learning in Mathematics (ALiM), an in-school intervention for students who are achieving just below expectation in mathematics.

3.5 Ethical Considerations.

All research must account for the way in which ethical issues will be managed in the course of the research (Punch, 2009). The Code of Ethical Conduct for Research, Teaching and Evaluations Involving Human Participants issued by Massey University was used as the guideline concerning ethical issues in this research. The primary ethical considerations made in the study were in reference to the potential for harm, consent, privacy and confidentiality.

An initial information sharing evening provided information to the potential participants regarding the focus of the workshops, and the research component of the study including the requests to complete survey questionnaires and group interviews (pre and post workshop). Parents were invited to engage with two examples of workshop activities as a way of increasing their understanding about the level and type of mathematical activities involved. The parents were given an opportunity to ask any questions and relevant contact information should any matters or concerns arise that they wished to discuss.

Cohen et al. (2011) remind us that the principles of informed consent are derived from the recognition that participants have a democratic right to freedom. In line with ethical practice, the parents were informed that they were under no obligation to participate and that they had the right to withdraw from the research study at any time without consequence. A written information sheet (Appendix E) was provided along with a consent form to be returned at the first workshop. This meant that parents had opportunity to think about and weigh up any possible risks from participating without pressure to make an immediate decision. Punch (2009) further points out that the "issue of consent is an ongoing process" (p. 51). It was assumed that voluntary weekly attendance also represented a willingness to participate. Moreover, a number of participants were able to join the project after the initial workshop had been delivered. They were provided with the same information and consent forms as those who had attended the information evening.

Although children participated in the all of the workshops along with parents, no data was collected from any children and formal consent was not sought from the children.

3.6 Privacy and Confidentiality.

In this study, and because of my role as both researcher and participant, consideration for participants' rights to privacy and confidentiality was particularly relevant. With regard to the survey

questionnaires and the interviews, participants were assured that all questionnaire information would be held in a secure location, and be inaccessible to other (including school) personnel. Assurances were also made that their comments to me during interview conversations would remain confidential and would not be discussed by me with any other teachers or staff members. Participant identities were protected through the use of pseudonyms in the reporting of the research. Cohen et al. (2011) suggest these as the principal means of providing anonymity for participants.

3.7 Data Collection Methods

3.7.1 Surveys

Questionnaires are a common method of data collection allowing the researcher to collect a wide variety and quantity of information quickly and easily (Mertler, 2012). Questionnaires can be composed of either open-ended or closed questions or may adopt the use of Likert Scale items. Mertler advises that open-ended questions can be problematic due to the possible ambiguity in responses, however this can be reduced through the use of rating scales. The questionnaires used in this study drew on Likert scale design to reduce ambiguity. Likert Scale items measure respondent's strength of feeling in response to a statement (e.g. a five point scale including strongly agree, agree, neither agree or disagree, disagree, or strongly disagree). The inclusion of a neutral position on a scaled response continuum is contentious. People generally have an inclination to choose a neutral position and avoid having to consider more carefully how they feel. However when a neutral position is not offered, the respondent is forced to take a position even if they do truly hold a neutral feeling (Mertler, 2012). The questionnaires used in this study involved a six point scale, with no neutral option.

The purpose of the questionnaires in this study was to ascertain the level of feeling participants had towards a range of matters in the context of mathematics. Data collected from pre-workshop surveys and post-workshop surveys investigated any changes in feeling as a result of the programme intervention. Indication of a change in feeling is more relevant in this study than position on the scale. Consideration was also given to the 'end-point descriptors' and extreme options were avoided as it is reported that respondents tend to avoid extreme responses (Cohen et al., 2011). For example, in response to the statement: *I know how I can use everyday experiences to start a mathematics conversation with my child*, end point descriptors 'not really' through to 'yes, I have a pretty good idea' were used, rather than more extreme options which might begin at 'no, not at all' through to 'yes, I use them every day'.

Cohen et al. (2011) highlight limitations regarding the use of rating scales in questionnaires. This includes that numbers may be interpreted differently by different respondents. For example, where one person might represent their opinion with a '2' while another respondent may have a similar feeling but choose a '3' as their response. It can also not be assumed that where '2' and '4' are on a scale of '1-5' that '2' is twice as strong a response as '4'. Although it is argued that rating scales offer a "degree of sensitivity and differentiation of response while still generating numbers" (Cohen et al., 2011, p. 386) it may be that the respondent would like to add other comments about the subject. In order to allow for this possibility, semi-structure group interviews were also conducted following the administration of survey questionnaires.

The first questionnaire (Appendix A) was designed for two key purposes. Firstly, to gain background information that might support the design of the workshops. This included questions relating to parents' feelings towards mathematics, how they rated their own ability in mathematics, and whether they saw mathematics as being an important part of their life. The second purpose was to establish baseline information relating to parents' understanding about current methods of teaching in mathematics, how confident parents felt in supporting their child, to what degree they felt they were able to be part of the learning, and if they felt they knew how to use everyday experiences to talk about mathematics with their child. These questions were also included in the post-workshop questionnaire (Appendix B) in order to assist in the evaluation of the intervention and in order to report on the extent to which parents felt more confident to support their child in mathematics learning.

A number of questions included in both pre- and post- workshop questionnaires were adapted from the work of Marshall and Swan (2010) who undertook a series of mathematics workshops with parents in Australia and the work of de Abreu and Cline (2005) who compared a number of case studies involving the performance in home and school mathematics of high and low achievers from two ethnic groups in the UK. Both questionnaires were piloted with two parents. This assisted with ensuring the readability of the questions and the elimination of any ambiguity in the wording.

3.7.2 Interviews

Interviews give recognition to the idea that knowledge is generated between individuals as a result of conversations and that these ideas are situated within the social setting in which the participants live (Cohen et al., 2011). Commonly used in qualitative research, interviews are described as an effective way of "accessing people's perceptions, meanings, definitions of situations, and constructions of reality" (Punch 2009, p. 144). Stringer (2007) suggests that interviews should have an informal

conversational feel that allows participants to say what they really think or feel and that regardless of the points of view presented, it is important that interviewers remain neutral and do not challenge the participants' perspectives. Perceived judgement or criticism will likely inhibit further responses or cause the participant to respond with comments that they think the interviewer wishes them to give as opposed to their real opinions or deeply held beliefs.

In this study, focus group interviews with parents, rather than individual interviews were used to collect data at two time points. Punch (2009) claims that one of the advantages of group interviews is that the interaction of the group often produces data which would be less likely to emerge without interaction. The group environment can be effective in stimulating people's views and reasoning, comments made by individuals may also be agreed upon by others, thus giving those opinions greater value. Particularly relevant for this study was the assertion that group interviews can be useful when a group of people have been working collectively together for some time with a common purpose (Cohen et al., 2011).

Following Mertler's (2012) suggestion that semi-structured or open-ended formats are best suited to a qualitative study, the focus group interviews took the format of general questions (see Appendix C & D) followed by supporting prompts. Opening with general questions allowed the participants to explore the topic in their own words. For example, in this study an opening general question used in pre-workshop interviews was: *What do you think when you hear the word mathematics?* This question allowed parents to respond by sharing a wide range of experiences, recollections, and feelings. The following order of other planned questions was taken in response to these initial reflections (See Appendix C for the interview schedule). General questions were supported with relevant follow-up prompts used to gather more detailed information or examples which might illustrate or provide further clarification to responses as the interviews unfolded. Group interviews were undertaken with small groups of four participants (one interview had two participants as one participant was unable to attend) both before and after the workshops and in the same location as the workshops as this would represent a familiar and comfortable environment.

Interviews like any data gathering tool have their weaknesses. In the case of the group interview, it is possible for one person to dominate the discussion. As previously mentioned, it is also possible that participants may offer a more publicly acceptable line of thought as opposed to their true and honest opinions (Cohen et al., 2011). There was no evidence to suggest that participants were not providing honest opinions in the interviews. Within groups a range of experiences were shared and opinions expressed. When a participant was observed to be dominating an interview, the questions were deliberately redirected to other participants in order to obtain a range of views. No time limits were

applied which ensured that all participants were able to fully express their views. Most interviews took around 25 minutes.

One of the purposes of the post-workshop interviews was to gather data that would support or clarify survey responses. One question I was particularly interested in finding out more about was the way in which participants could describe their use of everyday experiences for mathematics discussions at home. Heeding Punch's (2009) claim that there is often a mismatch between "what people say, what they do and what they say they do" (p. 152), I wanted to verify the questionnaire data focused on everyday experiences for mathematical conversations by asking participants to give examples of practice.

For accuracy, all interviews were video-recorded. Care was taken to position the video-recorder to be as unobtrusive as possible. One individual interview was conducted and recorded via telephone where the participant was unable to attend any of the planned group interviews. Participants were advised that a written transcript of the interview would be available for them to verify and validate the transcription as being an accurate account of our discussion. All participants declined and said they were happy that their words would be faithfully recorded.

3.7.3 Researcher Reflective Journal Writing

Researcher journaling is described by Banks-Wallace (2008) as a means for researchers to reflect and engage in critical thinking on the process of research in light of their knowledge and personal experiences. Journaling - allows the researcher to examine their actions as a part of the wider and more complex interactions occurring between themselves and the context in which they are engaged. It also helps identify barriers to connection between themselves and others, and better understand the cultural stories in which they are surrounded.

Journals may also be used as a method of data collection—a way of documenting specific experiences and the impressions associated with them (Hayman, Wilkes, & Jackson, 2012). In differentiating a journal from a diary or a log, a journal is defined as being "a diary and a log in that it blends personal reflections, accounts of events and descriptions of experiences" (Hayman et al., p. 28).

In this study, my researcher journal has been used for both of these purposes. Throughout the course of the workshops I detailed an account of the activities that were undertaken and my reflections regarding challenges and successes. The morning following each workshop session I recorded my thinking in terms of possible approaches or adjustments that I felt were necessary when looking ahead to the following weeks programme. My descriptions also included any significant comments that had

been made to me by any of the parents regarding their experience in the workshops including comments relating to gap in knowledge for parents between traditional and current teaching strategies, their approach towards problem solving in mathematics, and what they were finding useful or interesting in the workshop sessions. The journal entries were also shared with my supervisors in order to provide an opportunity for collaboration between myself and other experts. Feedback (sometimes formal and other times in-the-moment) regarding choice of activities and relevance for the participants informed further planning for workshops. This iterative development is consistent with McKenney and Reeves (2014) and Zhao and Cobb's (2006) description of EDR.

3.8 Data Analysis

The qualitative analysis of data mostly involved descriptions and explanations concerning parent perceptions of behaviours and beliefs around mathematics, and mathematical experiences involving the parents and their children. Data collected through group interviews, questionnaires, and researcher journaling was used together to provide an overall interpretation of the findings. Attention has been given to describing recurring themes arising in the data which related to the research question including factors affecting parent confidence to participate in mathematics with children, identification of aspects of the workshops which have contributed to an improvement in confidence to participate, and evidence of contexts in which parents are able to use their everyday experiences mathematically.

A small amount of quantitative data was collected from questionnaires. As previously discussed, questions, which acted as variables, were scored on a rating scale, providing a range of ordinal numbers which could be compared. Each participant's response was entered into the SPSS statistical analysis program. Responses to each question were tabulated, to provide a total number of responses for each possible score and an overall range for the participants on each item. From this information, positive shifts in responses were able to be identified when comparing the distribution of scores for the group between pre-workshop and post-workshop questionnaires. Statistically significant differences in pre and post workshop scores were found, however these have not been reported as the sample size is small and cannot be seen as representative of the wider parent population. For a full list of questionnaire items see Appendices A and B. A number of questionnaire items were also asked in interviews. Participants' verbal responses were then considered alongside interview data to triangulate the findings.

Interview data was transcribed by the researcher with each participant being given a pseudonym. Transcription included non-verbal communication (e.g. hand gestures) and laughter where this occurred. Group agreement with a speaker's comment either audible or gestured (e.g. group nodding in agreement) was acknowledged. In the few instances where it was difficult to hear what the speaker had said and where speech was indecipherable this was recorded in brackets as "(indecipherable)" within the flow of the conversation. There were also a number of instances with one speaker where the grammar of the speaker made their meaning difficult to understand. Where this has occurred I have put what I believe their meaning to be in brackets alongside their actual words.

Following transcription, interviews were re-read and codes were placed alongside dialogue identifying important or frequently used phrases, words or ideas. This type of coding may be referred to as 'in vivo' coding and is said to be appropriate for almost all qualitative research and particularly for beginning researchers (Miles, Huberman, & Saldana, 2014). Following this first analysis, codes from each of the interviews were transferred to a table. Each interview question was given a separate table on which responses from all the interviews were attached. This enabled me to view the responses to questions from all of the interviews simultaneously as well as the range of opinions, where there was consensus or difference in the responses. Following this, recurring themes were identified and colour coded. Alongside this process and underneath each table, I began to construct my own analytic type memo's (Punch 2009), reflecting on how the data related to what has been identified in the literature.

3.9 Trustworthiness

An important aspect of any research is the extent to which it may be considered valid and reliable. In qualitative research validity might be assessed by the degree that the data demonstrates honesty, richness, depth, and scope. Qualitative research is subject to the opinions and views of the participants, therefore validity can only be viewed in terms of degree rather than as an absolute (Cohen et al., 2011). Cohen further describes several principles that are important in ensuring validity in qualitative research. These include but are not limited to where the researcher (being) "part of the researched world, (ensures) there is concern for process rather than simply with outcomes, catching meaning and intention are essential" (p. 180). Lincoln and Guba (as cited in Cohen et al., 2011) argue that the key criteria for establishing validity in qualitative research are credibility, transferability, dependability, and confirmability. Although there is considerable debate over the ways in which validity and reliability might be defined, what is common to these discussions is that the researcher must demonstrate that their claims can be backed up by the data that has been collected; this also

means that there must be accuracy in data collection and recording. Attending to these issues is important for internal reliability. It is not expected that this research will generate any significant degree of external reliability. However, it is hoped that the workshop activities (and parents' experiences) can assist other teachers/schools and communities in their initial design of home-school partnership experiences.

Triangulation also increases validity in research. Triangulation refers to the collection of different types of data that might complement each other and provide a more in depth picture of the research (Punch, 2009). As has been discussed, this study has used both quantitative (questionnaires) and qualitative data (focus group interviews and researcher journaling). These data sets have been collected concurrently and at two time points. Badiee, Wang, and Cresswell (2012) describe this as a parallel convergence design. In this design both sets of data are merged to provide and overall interpretation of the research findings. Badiee et al. (2012) describe a number of advantages for the use of multiple data collection methods in the research design including the reduction of survey error, provision of overall stronger evidence and a means of addressing the weaknesses in any one approach. The use of multiple data sources also enlarges the volume of data through which deeper understanding of complex problems can be obtained.

4.0 Summary

This chapter has provided a rationale for the methodology that has been applied to this research. Educational Research Design has been the dominant approach taken in order to develop and research a programme that might increase parent confidence and participation in supporting their child's mathematics education. Purposive and volunteer sampling were used as the methods for gaining a participant sample. Sixteen participating families consented to contribute to the data. Group interviews and questionnaires were used in combination to gather data and were analysed alongside my own reflections from the workshops to provide a rich account of the findings. Relevant ethical considerations along with consideration for reliability and validity have been made in all phases of the research. My position as a participant researcher within the context has been fully described. Due to the small sample involved generalisations should be made with caution.

As a participant research, it has been very humbling to be entrusted with the stories of the parents, to hear their fears and anxieties around mathematics and feel the sense of hope they held in me to support them to become a more effective partner and supporter of their children's learning.

Chapter 4

Designing and Enacting the Workshops

4.1 Introduction

In this study, a series of workshops for students and parents was designed and implemented with the purpose of further exploring home-school partnerships in mathematics and understanding ways in which parent confidence to participate might be better supported. In line with design research methodology (McKenney & Reeves, 2014), the first phase of the study involved an exploration and analysis of the situation. This included reviewing relevant literature which provided a broad understanding of the factors influencing parent participation in mathematics education, and described a number of initiatives that have been explored internationally. The literature review identified how partnerships can be developed with parents that highlight and give value to the everyday mathematics used within families' situations. In addition, to identify a relevant design of workshops for the specific group of parents pre-workshop interviews and questionnaires were conducted. The analysis of this data informed the overall design of the workshops. Throughout the workshops, a researcher journal recorded observations of issues arising on a weekly basis—reflections that also contributed to the ongoing adaptation of the workshop design.

The findings presented in this chapter provide a context for the study. In preparing for the workshops, section 4.2 describes the initial factors influencing parents' participation in the workshops including the barriers of time and shift work. Section 4.3 then details the parents' motivation for participation. Four factors identified include the parents sense of responsibility for their children, a desire to increase knowledge about current approaches to teaching and learning, knowledge about expectations for achievement, and an interest in upskilling themselves through the development of teaching skills.

An overview of the workshop programme is then described. Section 4.5 outlines the aims of the workshops. Happenings from the first workshop are detailed as this was an important trial for the workshop design. Section 4.6 provides an overview all six workshops along with a summary of my researcher reflections. These reflections prompted modifications to the workshops each week and the design of the problem solving activities. Section 4.7 reports on the effectiveness of the 'Maths in my week's space and Facebook page which were initiated for parents to communicate back to each other and myself ways that they were engaging in mathematics through their everyday activities with their children.

Preparing for the workshops

4.2 Barriers to participation

In reflecting upon parental engagement in programmes designed to facilitate home-school partnerships it is important to understand the factors which may influence participation. Identifying potential barriers can support the development of inclusive opportunities for parents and inform the design of the programmes so as to support ongoing active participation. In the current study, 18 families chose to participate; however there were other families that were unable attend. These included a number of families who were relatively recent immigrants to New Zealand with three families being from the Philippines and one family from India. For the Filipino families, the requirements of shift work hindered their involvement and language difficulties were a key barrier for the Indian family. Initially, three other families reported that they were unable to attend due to commitments to local church activities on the particular evening selected. This along with feedback from parents attending the initial information evening highlighted the need for flexibility in scheduling the workshop sessions in order to be inclusive of families with prior commitments. Accommodating requests for a change to the proposed schedule ensured a greater number of families were able to attend.

4.3 Motivation to participate in the workshops

In analysis of the interview data four key factors were identified as influencing parental interest in the workshops. Firstly, a deep sense of responsibility for ensuring the achievement of their child stemming from the recognition of the importance of mathematics in their lives. However, parents' confidence to support their children was negatively impacted by a lack of understanding of current approaches to mathematics teaching and learning. This was a second important factor of motivation for parents' participation. A third motivation concerned gaining further information about the expectations for learning at each year level. Finally, both impacting on parents' confidence and their motivation to participate was the parents' desire to upskill their own capacity to better support their child's mathematics learning. These factors will be elaborated further in the following sections.

4.3.1 Sense of responsibility

In the pre-workshop interviews (PWI) and surveys (PWS) there was a strong tendency from parents to report a deep sense of responsibility to be able to provide help and support for their children as they

navigate their way through school mathematics. For a number of parents, this was fuelled by an awareness that their own child was struggling, in many instances in a similar way to how they had struggled themselves. Those parents who had struggled, expressed a clear desire not to have their own mathematical histories repeated by their children, while at the same time feeling desperately inadequate in terms of being able to offer any real support. They also held concerns for their children about the implications of not achieving and the potential of the longer term impact on their children's emotional well-being, their future educational success, and career and employment opportunities:

> I feel like I'm the blind leading the blind. I struggle so therefore what do I have to offer my child (apart from empathy), one struggler to another struggler. I make up in other areas, but that doesn't help my kids in the long run, and it disadvantaged me with my career options, with jobs and that's I guess why I get anxious when my kids are struggling with maths, because I can see it's going to disadvantage them. So that's why we have to get the basic facts and stuff sorted. [Joanne[3], PWI]

> I'm just concerned that it will go into other areas of their life at school … you know, because I see my daughter, how mentally she's just so down on herself about maths and I can see that quite easily transferring into, you know the rest of her life. [Marie, PWI]

Parents' sense of responsibility was also related to their awareness of the importance of mathematics in their lives both personally and professionally:

> It's surprising how often you use it, without even thinking you are using it. [Claire, PWI]

> I wasn't very good at it when I was at school, but we do use it in everyday life, I have to use it at work, I have to do calculations all the time. [Paula, PWI]

The recognition by parents that competence in mathematics is an important life skill was further evidenced by the parents' reports of the variety of activities that they were already engaging in. This was in response to a desire "to do something" to support their children's learning at home. For example, parents described playing monopoly and card games with their children and getting them to "add it up" just rolling the dice and adding them up, or getting the children to tally up scores with "quick fire dice games". One family described having discussions in the car about how long a trip might take. Another family was using mathematics games that had been provided by the school at a previous 'Maths Week' family night and reported those as being very successful, particularly for the boys.

[3] Pseudonyms assigned to all parent participants

Money was recognised by parents as another potential context for developing understanding in mathematics. Also acknowledged was the importance of financial literacy; many families had organised bank accounts for their children and a system of pocket money. For some this was payment for chores and included fines for offences such as swearing. Others were given a spending allowance that they had to manage. Two families were very specific that the money their children were given was for savings and that their children were allowed to watch it accumulate and gain interest but it was not money that they had permission to spend.

As reflected in the examples above, the parents participating in this study did not feel that achievement was the sole responsibility of the school. In contrast, their responses indicated that they viewed themselves as partners in guiding their children's learning and viewed it as a responsibility of the school to provide opportunities and guidance for the parents as to how they might participate in the teaching and learning. In some instances this was influenced by parents own experiences as learners and the way in which their own parents had helped them with mathematics:

> Well I'm concerned that my son is behind and not doing well at school, so I don't think that it just the teachers job to … you know … I think parents have to be involved, so if I can do anything to help… [Denise, PWI]

> My daughter hasn't brought home anything this year, nothing in terms of maths, only what I'm setting … which I find odd … her teacher said when we had the interview at the start of the year, that homework isn't really our problem, that she'd set it but she's come home and there's nothing in the homework book. [Kevin, PWI]

> Well my upbringing was that you were always given a set amount of homework to get done, whether you liked it or not, there was always going to be a test at the end of the week or each morning, "show me your homework book", I remember that really strongly … I have heard that one myself (indicates agreement with Kevin's statement about homework), I don't always automatically set homework for homework's sake (referring to the teacher), and that's my eldest boy at high school … and that came from his maths teacher. [Joanne PWI]

The sense of responsibility was felt more acutely by parents who were participating in order to better support their low achieving children. Almost half of the parents, eight out of seventeen who participated, reported their children as low achieving. For these parents, many who had struggled with mathematics themselves, there was a clear sense of desperation, a feeling that they were trying their

best to support their children, but “nothing seems to be working”. As a result, these parents now saw both their own and their child’s lack of mathematics skills as being a result of genetics:

> (My child) actually tries really hard at maths, I just think it’s a genetic thing, I don’t think she’s got it, like I don’t have it. I can read any book and comprehend it, but give me numbers and no way, I can’t do it and never have been able to. [Mary, PWI]

> We always come to the conclusion that our family are just hopeless at maths, we’re not mathematicians and it feels like we sort of just missed out. [Joanne, PWI]

4.3.2 Knowledge about expectations for achievement

Many of the parents, including those whose children were not meeting achievement expectations and those who were, sought further clarification about expectations. In particular, the parents wanted to know what skills and knowledge their children should be expected to know at each year level of school. Current systems including reporting at mid and end of year were not seen as providing regular enough information as to how children were progressing:

> A little bit of feedback on what they should be, what they are up to in their learning
> (Claire adding to the conversation) And where they should be at.
> (Paula continues) At least if they are coming home with certain worksheets and stuff, at least you know what they are up to and what they are supposed to be learning at the time, otherwise … there’s no actual feedback coming back from the classroom as to whether or not they are doing (achieving) what they’re meant to be doing (achieving), and what they should know by the end of the year as well. Last year, I went and said, so what maths, what multiplication should she know? Two’s, three’s, fives, tens, right OK we can work on that, so we did. [Paula & Claire, PWI]

Parents’ expectations were further influenced by their perception of what it means to learn mathematics and a narrow perception of the skills which are necessary for success. For a number of parents who were supporting children who were struggling, concern was expressed about whether or not basic facts were “even being taught at school anymore” with some parents believing that an apparent lack of attention to basic facts skills might well explain present poor levels of achievement.

4.3.3 Understanding of current approaches in teaching and learning mathematics

Parents were particularly interested in gaining an understanding of current approaches to teaching and learning mathematics. This was due to the realisation that the way in which mathematics is now being taught is significantly different from the way in which parents had learned mathematics. Parents recalled mathematics learning as being about knowing specific methods or "formulas" for solving problems, knowing how to do it and that there was "only one way it could ever be done". In terms of content, others recalled experiences related to the rote learning of times tables and memorizing the facts:

> When we learned our times tables, you just learned it by rote, like saying one times one is… and you would just go through it every day, all the times tables up to ten. [Paula, PWI]

> I just remember it being horrid … there was only one way it could ever be done, and I remember being able to kind of figure it out in my head but being told no, you have to work it out with this formula. [Mary, PWI]

These experiences continued to shape parents' expectations regarding both what they should be helping their child learn and how. In interviews and throughout the workshops, frequent references were made to the "new strategies" and the gap in the knowledge that this has created. Some parents felt that the strategies their children were using and their methods of recording were so different from the way in which they would solve problems that they likened the "new maths" to trying to understand or learn a foreign language. Some parents expressed concern about not wanting to 'confuse' their child with the way that they had learned:

> I don't get her strategies and how she's working stuff out and I try to explain it to her like the way I know and she's like, what? [Paula, PWI]

> (Adding to the conversation) Yes and it gets them more confused. [Claire, PWI]

> I'm hoping that I can learn more of the strategies, to help the kids, cause that's my big thing, it's that … like my daughter will work something out and I will be like what, how did you do that? [Paula, PWI]

> I'm hoping to, just being able to come across the different strategies, being able to come across to the kids, and be able to teach them a bit more too, and that sort of thing. [Greg, PWI]

> It will actually benefit me a lot because in the way of the kids are being taught … I might be putting in (giving instruction) that's not the same with what the school is teaching. [Grace, PWI]

> For me it's about confidence (for myself) and my kids, well especially my daughter, cause I think that she's at the stage now where she just goes, 'don't ask Mum', and I don't want her to be like that, cause at the moment I'm not sure, I don't understand that (strategy), go and ask your father, you know and I don't want to do that and I don't want her to come home with some maths homework that's gotta be done and go, actually I'm not going to bother with Mum cause she'll probably flip her lid again, you know, I just want to be able to go OK, we might not be able to quite do it right but, you know I can try (laughter). [Mary, PWI]

> More knowledge, more understanding (of the strategies) just, probably not every formula out there but basic understanding where I feel comfortable. [Michelle, PWI]

For some families, the lack of knowledge about current approaches was causing frustration and tension:

> (My husband) is really impatient, and he'll quite often say "think about it!" and I'm looking at him going, she has been and she doesn't get it, but he's quite quick with maths and so he thinks we all should be, and I'll read something and I can't understand that (strategy) right, one of the questions she came home with one day was, add too much then take away something, and I was like, why would you add too much, that doesn't make (sense) … you know there was a reason for it but to me I straight away went, well why the hell would you add too much? [Mary PWI]

4.3.4 An opportunity to upskill

Parents saw the workshops as an opportunity to upskill, and enable them to support their children with homework in a manner consistent with the approach of the school. Some parents, although confident in their own understanding of mathematics concepts, felt they lacked teaching skills having only their own, often less than productive, learner experiences to draw on. For some the inability to communicate and effect successful learning outcomes meant either, leaving the child to try and figure things out on their own, just doing the homework for them, or referring the child to another family member (e.g., "you'll have to ask Dad, he's good at maths"):

> I will try and explain something, which I'm obviously not explaining it very well or clear enough, or in a way that she can understand it easily. She feels a lot of pressure from me to actually get it, so I've decided to really step back from trying to do that because that wasn't working. I think professionals might know how to actually teach her, but I'm not a professional, I'm just a mother. [Marie, PWI]

> I can help out, but can't really teach, you keep trying different ways to be able to bring it across so they do understand, sometimes they don't understand, and if I can bring it to them in a way that they can understand, I suppose, I just give up sometimes. [Greg, PWI]

One parent had engaged a tutor to reduce this pressure and provide support and another mother who felt unsuccessful in her efforts to support her child wondered if one-to-one tutoring could make a difference for her child who was struggling. She noted that she had herself received tutoring in science as a child and this had been successful in terms of her gaining understanding and lifting her levels of achievement. If that support was not available however, she was at a loss as to how else she could support her child to move forward in their learning.

4.4 Summary

This section outlined the motivations of parents in participating in the workshop series. Pre-workshop interviews provided valuable information regarding parents' sense of their role and responsibility for their child's learning. Many parents were already attempting to support their children at home in a variety of ways and these were described. The struggle of parents who were attempting to support low achieving children was identified. While parents felt it was their responsibility to help their child, their ability to do so was hampered by the contrast between their own learning experiences and those of their child. The lack of understanding of current approaches to teaching and learning, specifically understanding of current strategies for problem solving left many parents feeling inadequate in terms of being able to offer support. Parents were also unsure about the expectations for achievement for their children and were basing their expectations on recollections of what they had been expected to know when they were at school. Further to this, many parents felt that they lacked skills both in their understanding of the strategies that their children were using and knowing how to lead their children through the learning process. This was a key motivation for participation.

The Workshop Programme

4.5 Aims of the workshop programme

The parent participants engaged in the workshops were diverse in terms of occupation and levels of education. This diversity also included their previous levels of involvement in schooling activities. Other differences included the expectations of what would be achieved from the workshops and conceptions of current methods of teaching in mathematics. Some parents expressed nervousness about placing themselves back in a learning environment as their previous experiences had not been positive. Facilitating a series of workshops that would cater for these diversities, the range of motivations and needs as represented by the group, as well as achieving my researcher goals was a challenging balancing act.

The aim underpinning the design of the workshops was to further explore home-school partnerships with parents and identify ways to support and develop confidence in parents to participate in productive mathematics experiences with their children. In line with design research methodology (McKenney & Reeves, 2014), the workshop design drew on the analysis of interviews with the parents. As outlined previously, parental objectives were to gain a better understanding of the way mathematics is now being taught at school including strategies for addition and subtraction, multiplication and division. They also wanted to be able to help their children at home to fulfil what they saw as their personal responsibility to support their child. The initial design of the workshop activities and format drew on these parent aims, while also adhering to the goal of providing increased awareness of the opportunities in everyday experiences for parents to have rich, informal, mathematically based interactions with their children in their home and community setting.

The workshops were constructed to take the format of a typical mathematics lesson, including a warm up activity, usually in the form of a game, and a set of problems with a different mathematical focus each week. In response to the interest focused on basic facts, times tables, and mathematical strategies, most of the workshop activities focused on number concepts. To facilitate and develop an awareness of opportunities for mathematics at home, there was also a time during the workshops to reflect and share happenings in which parents noticed a mathematics connection in their everyday activities. Additionally, a Face book page provided a way for families to collectively share pictures that reflected mathematics and opportunities for mathematics in their home and lives. Each workshop concluded with supper and time for informal conversation.

Building on resources from the NZMaths website and the page 'Maths at our house' (New Zealand Ministry of Education, 2010), the workshops linked to nine opportunities in the home for mathematics including cooking, gardening, watching sport, going places, shopping, recycling, reading, playing games and doing puzzles. Each workshop had a designated mathematical focus, for example, addition and subtraction, and applied to a different home context. This approach provided opportunities for parents to engage in a range of mathematical content areas. At the same time it provided a model through the use of contextually based problems of how they could integrate mathematics into activities at home.

4.5.1 Getting underway – Workshop One

The initial workshop was an important opportunity to trial the workshop design and reflect upon whether the types of activities and problems were appropriate for the participants. Teaching staff, along with the Principal and Deputy Principal, were invited to attend all the workshops and participate in a supporting role—for example, passing out materials, supporting families with problem solving, or participating in activities. The seating configuration allowed two or three families to be seated together and collaborate on problems in a similar way to how students might work in a classroom.

Initially, parents who arrived early to the workshops appeared uncomfortable. In response I provided a dice puzzle activity for all participants to take part in as they arrived. Our starting activity then was to explore the various solution strategies while formally welcoming participants to the session. This facilitated an informal, rolling opening to the workshop series and provided a relaxed atmosphere. Providing families with an activity to start straightaway became the standard format for all of the workshops and worked well throughout the series. This strategy also meant that as other parents arrived I could greet them individually and introduce the game/activity; or where two families were seated at a table, the first family could explain the activity to the family joining in. It also meant that anybody arriving a late did not have the discomfort or embarrassment of arriving to a quiet room and feel that they were interrupting.

In the first workshop, the dice task was followed with an open-ended problem asking table groups to think about seating arrangements and devise a plan for how they might seat a specified group of people using different sized tables. Large sheets of paper and pens were provided and people quickly got busy making a variety of arrangements. The following researcher workshop one reflection [W1R] excerpt illustrates how different this type of learning experience, where more than one answer is possible, was for the parents:

> *Immediately there were questions, can we have spare seats, do all the tables need to be fully occupied, one Dad said that doesn't work there isn't a right answer! Anyway, people continued and came up with a variety of solutions, one with four tables off four and one table of six and one table spare. Others had similar four tables of three, two tables of 5.* [W1R]

The contrasting way in which parents and students responded to the task was notable. Many parents appeared frustrated and uncomfortable with the openness of the task, while the students were happy to be able to apply their own reasoning and solution to the problem. After about ten minutes, people were encouraged to share their solution strategies. It was evident that students were more comfortable sharing than the adults.

As a researcher, two important pieces of learning emerged for me from this activity. Firstly, the activity demonstrated the influence of parents' prior experiences of mathematical learning environments where there is typically one correct answer defined by the teacher. In completing the task, parents viewed their role as determining the expected answer from the teacher. Rather than beginning the task, many parents appeared unsure how to get started and a typical response was to wait for an available teacher to come and provide support. They wanted to know what the rules were so that they could get the answer right. As a researcher and facilitator I had not anticipated the extent to which this historical learning style would impact on the way in which parents engaged with the workshop tasks. It also warranted what I had noted in the interviews regarding the relatively narrow view of mathematics held by many parents.

Secondly, it was evident that the students (children) were comfortable to lead the learning. Although the students themselves ranged widely in achievement levels, they willingly applied their knowledge to problem solving and shared their responses. Parents tended to listen to the students and support them in problem solving by helping them work out the required basic facts. Although I had not planned for students to essentially lead their parents in the learning, this is in effect what happened.

Following this task, families were asked identify the activities that they enjoyed engaging in together and to consider where mathematics might happen in each of these situations. To support parents to see the ways in which ordinary activities or tasks could have the potential for mathematics discussion, a photograph of my family having dinner together was shared as a starter prompt. Families then looked back at the activities they had listed and chose one or two to write as many mathematics related questions as they could. As well as providing a list of activities that could be mathematised

(van Oers, 2013) this activity also provided more information about the participant families contexts that could be utilized in problem writing in subsequent weeks.

The activity also provided information related to the sensitivity required when using terms such as 'family' 'Mum' or 'Dad' for the workshop design. For one mother and her son the phrasing of this question almost ended positive participation in the workshop. As a result of a recent separation and Dad leaving the family home, from the son's perspective they no longer engaged in any activities as a family. This meant that the son felt that he was unable to participate in the activity despite his mother explaining that it just meant to talk about things that they enjoyed doing together. This was a good reminder of the importance of anticipating and understanding the meaning that people attach to particular terms and to be as inclusive as possible in the phrasing of questions. A better question might have been: What activities do you enjoy doing with other people at your house? This type of question allows for a much broader definition of family including extended family and people who may not be blood relatives but are held in the same importance of those who are.

4.6 Overview of the workshop series, researcher reflections and design modifications

The following section—Table 4.1—provides an overview of the workshop series and my researcher reflections which prompted ongoing adaptations to the design as the series progressed. Following this, the way in which the 'Maths in my week' time was used to design problems for the workshop in the following week is described. In the final workshop a rich task,—how big is the giant?—was presented. This task aimed to demonstrate the integrated nature of mathematics and the range of opportunities, including opportunities through literature, for mathematical discussion. How participants responded to and engaged with this task is fully discussed.

Table 4.1: ***Overview of the workshops and summary of researcher reflections***

Workshop 1 – Multiplication and Division	**Reflections (summarised)**
Welcome: • At the workshop – seating problem; • Brainstorm, activities you like doing as a family; • Show my family photos, dinner, tramping trip; Table groups discuss - What maths might be associated with these activities? Show model of possible questions, reflect on own family activities,	• 14 Families attended, 34 parents and kids, 2 teachers; • Positive response to workshops; • Some parents arriving early seemed a little uncomfortable, need to have an activity out on the table for something to do when people arrive; • Seating problem was met with lots of questions about 'how to do it', parents clearly looking for a set method, children responded happily and took charge of the problem solving;

choose two to write as many maths questions as you can; • In the classroom – share model of multiplication questions that children are solving in the classroom e.g. Canisters of tennis balls, books in boxes; Ask parents how these questions are different from their recollections of multiplication problems e.g. story context, related to real life. • Present three problems for solving. Source NZMaths arrays hooray; • Things to think about this week… Where can we find examples of arrays in our daily activities, e.g. carton of eggs 2x12 Facebook page set up to share examples; Supper	• Ran out of time for discussing the problem solutions for the array problems. Need to allow more time for sharing peoples problem solutions next week; • Also need to have a summary sheet of the problems, parents wanting to take questions away with them.
Workshop 2 – Addition and Subtraction Welcome: • Opener, train for two, card game with object of making 25; • 'Maths in my week' reflection time, what examples of multiplication did you notice throughout the week? Share some photos of multiplication from home, e.g. 4 pairs of shoes at the front door, eggs in the tray, cans in the cupboard; families asked to write some maths problems that might accompany the photos; Aim: to support families to see opportunities in their environment; • Double the recipe (following from photos of baking laid out in arrays on trays); • Introduce addition and subtraction problems, adding it all up. Context, collecting countdown animal cards, talk about different ways to solve the problem. Second problem, finding the difference, context, play station game, how many more points do I need to beat my sister. Third problem, how may left. Context, cars in the carpark; • Review: skills for addition and subtraction e.g. counting on, counting in 10's, 100's, splitting number into parts, understanding place value; • This week… looking for opportunities to include maths in our conversations e.g. at sport, watching a game, attempts at goal.	**Reflections (summarised)** 14 Families attended, 30 children and parents, 3 teachers • Train for two. (Playing cards had been identified as being something lots of families did together last week). Much better having game on the tables, gave me a chance to talk to each family and ask them about their week as they arrived; • Disappointed that no-one had contributed any photos to the Facebook page that was set up for the group; • Double the recipe, took a lot longer than expected, but triggered some really interesting conversations about how people solve a problem like this at home. One Mum commented she simply puts in two of the stated amount, doesn't actually do any 'mathematical doubling'; • Addition and subtraction problems – some interesting feedback from parents. Two mums commented that they were learning a lot themselves, another dad said he could see how the kids were getting really quick at solving problems in their head with the different strategies, had also been talking about the workshop with another dad at work; • Need to have less in the programme so that there is more time for discussion. Parents really happy to be able to take away a sheet of all the problems, and a summary of the skills being developed.
Workshop 3 – Fractions • Opener – How did you spend your day? Strips of paper divided into 12 or 24 segments. Parents and children identify what portion of the day might be spent, sleeping, at work/school, leisure time, eating etc.	**Reflections (summarised)** • 13 families attended • Families engaged with opening activity really positively, great to see parents and children working together adding up how many minutes etc. and then

• Maths in my week – share photos that one of the families put on Facebook, sharing crackers. Families given large sheets of paper to record any opportunities they had made use of during the previous week to make a maths connection; • Opportunity to share back with the whole group; • Fractions Problems – Context Sport, find the fraction of a set, how many parts make a whole, which is bigger - comparing fractions like 4/5 and 7/10; • This week, thinking about fractions at your sports games, what fraction of the game time is the ball in your half or quarter? Supper	working out the portion of the day this is e.g. 20mins 1/3 of an hour 8 hours sleeping 1/3 of a day Again took quite a lot of time, need to have shorter opener; • Some really interesting Maths in my week discussions, most parents seem to be noticing more opportunities for maths in their environment. Some more actively engaging in discussions others still seem a bit unsure, but some good maths talk happening; One Mum said it was really good having a copy of the problems because it meant she could ask similar problems at home; Might need to think about how I can support this a bit more; • Teachers commented at the end of the session that families were really enjoying working on the problems and working with the teachers, talking about strategies and different ways to solve problems etc.
Workshop 4 - Place Value • Opener – Target 15287 and Place Value Game; • Maths in my Week - Shared a photo of a car number plate. Whole group discussion of how we might be able to use car number plates for mathematics; Family's then completed their own 'maths in my week' reflections and shared with table group; • Whole group activity, split group into four, make the biggest/smallest number with the A4 sized digit cards; • Place Value problems Problem 1- context: The Lotto Shop, how much money is in the till? Ideas, 10x1=1x10, Multiplying by 10. Problem 2 - Context: Cooking for the Gala, making meat patties, each patty needs 100g of mince; How much mince for 10, 25, 100 patties? Problem 3 - Context: Buying a car, comparing odometer readings; • This week, family challenges, summary handout of problems also included some directed challenges for families to further support families who were struggling to find opportunities for maths discussion. Supper	**Reflections (summarised)** • 10 families attended, lots of apologies due to a tummy bug going around; • Used a couple of school games as openers this week, as I had trouble thinking up an activity that would replicated an everyday situation with a place value focus (and that wouldn't take too long!); Families enjoyed the games, some children had played it in class and really enjoyed sharing it with their parents; Parents could see the learning in the game; • Had some technical issues and couldn't get photos off face book page to share with group. A couple of families talked about how they had used last week's problems to prompt mathematics discussions during the week; Overall families were more confident in describing maths that had been part of their week and had more examples to share, finally feel like I am making progress; • Problems went well, very related to the jobs and activities that many families are involved in. Boys really liked the activity working out which car was the best buy based on odometer reading, lots of talk about this; • Overall timing of activities much better this week; • One of the most successful aspects of the workshops so far has been the opportunity to build relationships between families, between teachers and families and particularly with parents who are working and we don't see a lot at school.
Workshop 5 – Maths through Games • No opener tonight as focus is games;	**Reflections (summarised)** • 12 families attended, 33 parents and children, 4 teachers and Principal

• Maths in my week – Shared some of the maths in my week with my children (6yrs), followed by families sharing in table groups; • Card games – highlighted maths connections through card games as well as social connections and fun; • Cards made 20 (own game), 2 games from Cards on the Table by P. Swan; • Dice game – cross out numbers 1-12, the 1-20; • Maths version of Paper, scissors, rock; • Puzzles – pentomino puzzle; • Discussion about the value of games as a learning/rehearsal mechanism. Supper	• Maths in my week, lots more talk about maths opportunities at home this week; • All the games used minimal equipment or none at all (paper scissors rock); • Really impressed with the patience of parents in supporting their children, children really responding to the opportunity to engage in learning with their parents; • General discussion – parents agreeing that games were a great way to rehearse things like basic facts, and a lot more fun than worksheets! Great to be developing these ideas; • Lots of families took home copies of the games so that they could play them at home. Teachers also took copies of games to add to class collections; • People hanging around chatting till 8:00, one session left!
Workshop 6 – Maths and Stories (making a connection to literature) • Opener – Cover it, dice game using multiplication, aim - cover as much of the grid paper as you can; • Maths in my week – table group reflections; • Problem – How big is the giant? Extremely oversized footprints were laid from the front entrance and through the library; PP screen displayed a story explaining the problem …police are putting together an identikit, and need to work out how tall the giant might be, can you help them? • In Roald Dahl BFG, the giant is described as being a creature 24 feet high, how large do you think his footprints might be? Supper – desert, cupcakes, milo, tea, coffee.	**Reflections (summarised)** • 13 families attended, 34 parents and children, 3 teachers, Principal and DP; • Connecting maths across strands e.g. measurement, number, statistics and with literature; • Cover it! Game was picked as it relates to the area aspect of geometry and the year 5/6 group were focusing on measurement in class; • Maths in my week reflections, monopoly, game of life, FIFA world cup, baking, church fundraising; • Giant foot print problem was very engaging, families were very active in measuring the footprints, measuring their own footprints and making comparisons e.g. giant footprint is five times larger than mine, then comparing the size of their foot print with their overall height, and using these proportions to work out the height of the giant; students really excited about sharing their solutions and comparing the different people's footprint to height ratios; did a quick survey of the whole group to see what most people's ratio was; • The Roald Dahl BFG problem, converting 24feet to metres and centimetres prompted a really great discussion with one dad about division, he used his short division method to solve the problem, and was really interested in how his son used a multiplicative method to work it out; • Parents really positive about the workshops – keen to see more in the future.

4.6.1 Design of problem solving activities

As the workshops progressed, participants appeared increasingly relaxed and happy with the format of the evenings. As mentioned earlier, problem solving activities were designed around contexts that

were relevant and familiar to families in order to illustrate and support parents' understanding of how these everyday activities might be used for mathematical conversation. A second goal in engaging parents in problem solving along with their children was to demonstrate the range of skills and learner dispositions required in mathematics learning (e.g., persistence, risk-taking, trial and error, communicating).

Problem solving activities generally involved three problems and a problem variation or extension to the problem, based on activities that some of our families reported on the week before. The weekly 'Maths in my week' space, while initially appearing difficult for many families, provided evidence of families becoming increasingly aware of and able to reflect on opportunities for mathematics in the home context, and is discussed later in the chapter. The following examples illustrate the way in which the 'Maths in my week' time prompted the design of weekly problems. The first problem, (see Figure 1) builds on reports of the mathematics within sports was used for Workshop 3.

Figure 4.1: Basketball Problem - Workshop 3

The students quickly engaged with the problem relating the context to similar conversations among their friends regarding who is the best shot. This problem also generated discussion between students and parents about methods for converting fractions to percentages.

The following excerpt from researcher reflections following Workshop 3 illustrates two examples of contexts for mathematics identified by families during 'Maths in my week'. This reflection was then used to write a problem for the following week that might support families in seeing how this everyday context might be used for a mathematical conversation:

The two families that I spoke to were quite contrasting, one of the Mums said that she was definitely seeing lot of maths happening in her life particularly with baking, but it was usually when the kids were at school, so she didn't feel she had been able to make many connections for her kids, although she had been getting her daughter to work out how long her and her sisters could play at the playground if they had to be home by a certain time. The other Mum said that she had been talking to her daughter lots when she gets home from work about balancing the tills, and how she has to count up all the 10, 20, 50 dollar notes and has been asking her daughter how much will I have if there are e.g. 14x50 dollar notes. They had also been playing monopoly and counting the money in that. [W3R]

The design of the following Week Four problem (see Figure 2) written in response to this reflection is as follows:

Figure 4.2: At the Lotto Shop - Workshop 4

Using problems related to contexts that were relevant to the families attending appeared to be well received by the parents and students alike.

While workshops one to five involved two or three step context based problems built around activities that families were familiar with and demonstrated the functional nature of mathematics, workshop six aimed to extend parents perspectives by illustrating the integrated nature of mathematics across curriculum areas, showing that mathematics is not a 'stand-alone' discipline. Also, that mathematics can offer opportunities for creativity and creative thinking. For example in solving the problem: How tall is the giant? (See Figure 3), mathematics was integrated with literature (Roald Dahl's BFG) and human biology.

Workshop Six

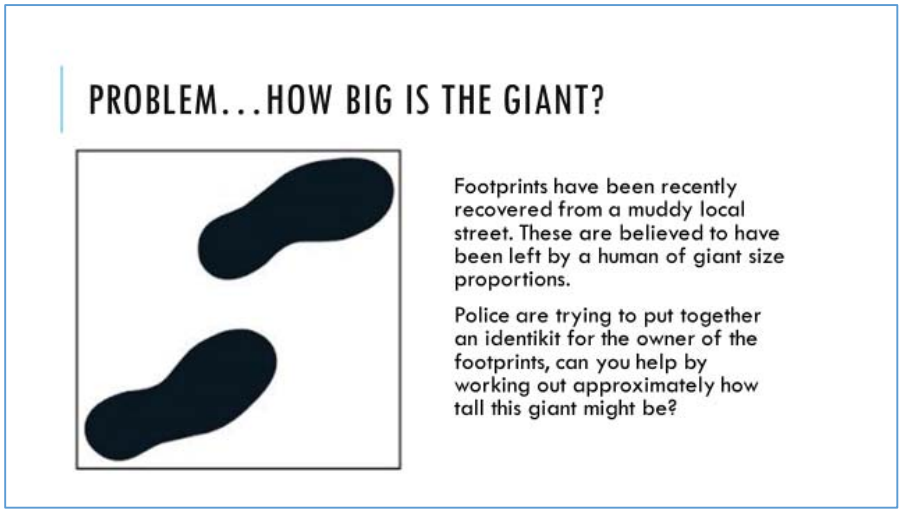


Figure 4.3: How big is the Giant? Workshop 6

Figure 4.4: The BFG - Workshop 6

Students and parents were highly motivated and engaged with this activity. As families had arrived, they had followed a trail of oversized footprints into the library area and were very curious as to why they were on the floor. Initially families were unsure how to approach the problem, some students placed their feet on the foot prints and made statements regarding the contrast between their own foot size and the foot prints. A range of measuring equipment were put out on tables to support their thinking and develop more accurate answers. A lot of talk occurred between parents and children as they worked together to develop a solution to the problem including hypothesising about whether or not people with different sized feet would come up with different answers. Some children and parents were aware of facts including the length of the foot being the same as the distance from the inside of

the elbow to the wrist. This rich task was also effective in continuing to support the development of parents' understanding of the range of skills involved in learning mathematics including conjecturing, conducting trials and making comparisons, being persistent and the ability to communicate thinking by being able to make justifications. As previously mentioned, parents' own learning experiences had left most of them with a limited perception of what mathematics learning involves, typically finding one correct answer:

> *Problem – Seating arrangements*
>
> *One Dad said that doesn't work there isn't a right answer! … Later I talked a bit more to him and he was blown away that there could be such a thing as a maths problem that had more than one answer. In his experience maths was the one subject where there was one answer and you could get it right and get 100% on a test. [W1R]*

This activity also highlighted the continuing nervousness of some parents in sharing and explaining their own methods for problem solving, not wanting to confuse their children by teaching them something different to the methods that the school is teaching:

> *One of the dad's showed me his short division method to solve the problem 720cms divided by 6 foot lengths giving a foot length of 120cm or 1.2m I had talked through the problem with his son who didn't understand Dads method, we had solved it by working out that 600÷6 is 100 and then 120÷6 is 20 so the same 120cm, we (Dad and I) had a short discussion about the two methods and that yes we still teach and use short division, yes it's ok to show your son how you use this method. Which tool/method is not so important as long as students has a tool that they feel confident to use.* [W6R]

4.7 Supporting parents' awareness of mathematics in everyday activities.

While context-based problem-solving tasks had been used to illustrate current approaches to teaching and learning in mathematics and provide parents an opportunity to gain an understanding of new strategies, a further aim was that the familiar contexts would prompt and support parents to see opportunities in their everyday activities for mathematical conversations with their children. 'Maths in my week' and a group Facebook page were then provided as opportunities for families to share these conversations and encourage each other. They also provided weekly evidence regarding the

degree to which parents were able to identify and make use of the opportunities in their everyday activities.

4.7.1 'Maths in my week'

Many parents in pre-workshop interviews described activities that they were engaging in to support their child's mathematics learning including, playing card games, monopoly, understanding money through shopping and having bank accounts. A review of research literature highlighted the importance of giving value to the everyday experiences of families, and promoting these as opportunities to engage in mathematics. It was important then to expand these initial ideas to include a wider range of contexts and the types of mathematics being discussed. In supporting and developing parental awareness of opportunities for mathematics through everyday activities, the first two workshops 'Maths in my week' space provided models of some of my everyday activities and facilitated group discussions for families to collectively brainstorm what mathematics they thought might be represented in the photographs.

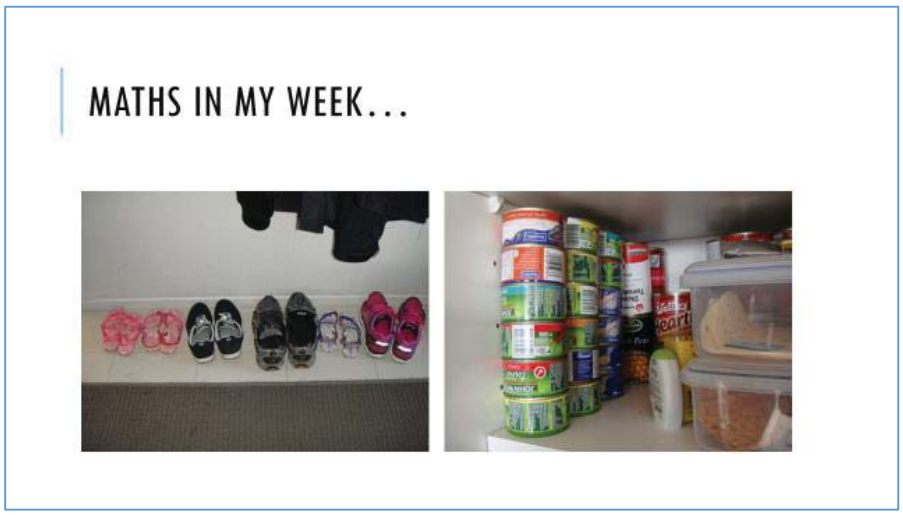


Figure 4.5: Maths in my week - Workshop 2

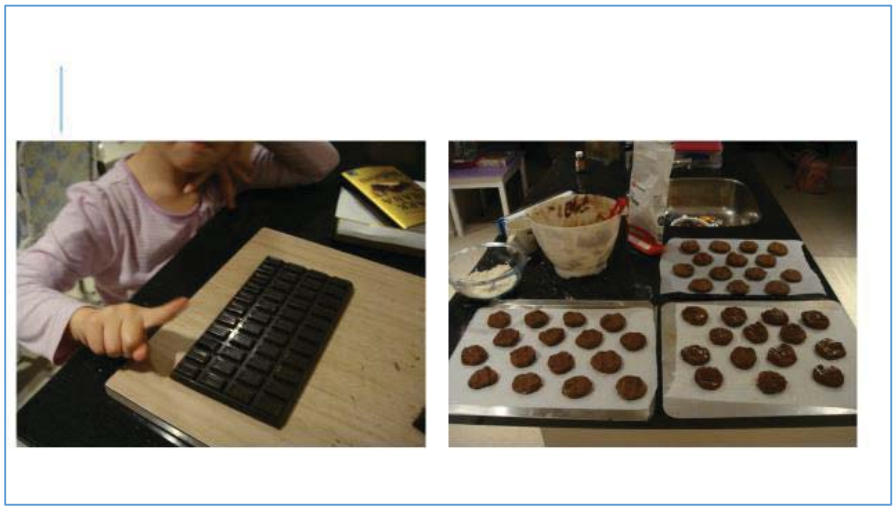


Figure 4.6: Maths in my week - Workshop 2

Families (particularly students) were easily able to make a mathematics connection from the photos and on large sheets of paper wrote down a range of possible mathematics questions (e.g., six pairs of shoes are left at the front door, how many shoes are there altogether? What fraction of the shoes are pink? What fraction of the shoes have laces? If there are four rows of four cookies waiting to be baked, how many cookies are there altogether?).

The weekly opportunity for families to feedback and report on where they had noticed mathematics occurring in their daily activities and their deliberate engagement in sustained mathematics conversation did not appear initially to be occurring to the degree which I had hoped. However, the summaries of the 'Maths in my week' conversations do indicate that families were becoming more aware of the mathematics opportunities in their everyday lives. The following excerpts, taken from researcher weekly reflections, are evidence of parents identifying and engaging in everyday opportunities for mathematics conversation with their children throughout the workshops:

> *The two families that I spoke to were quite contrasting, one of the Mums said that she was definitely seeing lot of maths happening in her life particularly with baking, but it was usually when the kids were at school, so she didn't feel she had been able to make many connections for her kids, although she had been getting her daughter to work out how long her and her sisters could play at the playground if they had to be home by a certain time. The other Mum said that she had been talking to her daughter lots when she gets home from work about balancing the tills, and how she has to count up all the 10, 20, 50 dollar notes and has been asking her daughter how much will I have if there are e.g. 14x50 dollar notes. They had also been playing monopoly and counting the money in that.* [W3R]

Jarred and his Mum had been at the FIFA U20 world cup and had had a discussion about how many adults and children might have been in the stadium, they knew that there were 8585 people there. What if half were children? What if 1 third were children how many children and adults would that be? They had also discussed how much money would have been collected through ticket sales. The Evans family had worked out what fraction of the goals Grace had scored at her netball game over the weekend (this was great as it demonstrated use of a question that had been modelled last week), Ruby had finished reading a book and had worked out that she was averaging 17 pages per reading session. [W4R]

The Greens' had discussed a headlining article that had appeared in a local paper about a local girl who had designed the "kindling cracker" and how much money she the designer would make if she sold x number of devices. Bradley, their son, said that he had been checking the speedo in the car and noting the distances travelled – this was a question from last week's workshop. [W5R]

Table 4.2 shows the increasing number of contexts in which parents and children were able to make mathematical connections across workshops three, four and five, and the frequency of which each context was referred to in the reflections.

Table 4.2: ***Parent References to Everyday Activities***

Everyday Activities		
Workshop Three	Workshop Four	Workshop Five
Food (6) Money (7) Time (5) Sport (1) Reading (1) (number of references to)	Food (3) Money (5) Time (2) Sport (8) Reading (2) Computer Games (2) Construction (1)	Food (6) Money (4) Time (3) Sport (3) Reading (1) My family (1) Quiz Scores (1) News (1) Travelling (1)

4.7.2 Sharing opportunities for mathematics via Face book

At the beginning of the workshop series, families were encouraged to join the workshop Facebook page. This had been set up with the intention of providing a further forum for families to share the opportunities they might have discovered for mathematical conversations in their everyday activities and provide a support network of ideas between families. It was assumed that with the proliferation of Facebook usage as demonstrated on our school Facebook site that families would be keen to share their experiences in this forum. However, very few families made use of this facility. While nine of the seventeen families joined the page, only five made any contributions. Three people made one contribution, one made two contributions and the fifth person made five contributions. This was unexpected in light of the widespread use of social media for commenting and engaging with issues. It may be that families didn't see their mathematics as being able to be easily represented visually.

4.8 Summary

This chapter has described the impact of the pre-workshop interviews on the workshop design. Parental motivations for participating were combined with the findings from the literature review to inform the overall workshop design. The initial workshop trial was described along with my researcher observations and reflections. Following this, an outline of the workshop series was presented along with researcher reflections which prompted ongoing modifications to the design of the workshop series. Further description of the problem solving activities and the way in which these were generated was also provided. Finally, findings relating to the way in which parents were beginning to observe opportunities for mathematics in their everyday activities as demonstrated in the 'Maths in my week' reflections were presented. The overall impact and effectiveness of the workshops, as reported by the parents, will be presented in the following chapter.

Chapter Five

Impact of the Workshop Programme

5.1 Introduction

The previous chapter outlined findings relating to pre-workshop interviews and provided descriptions of the workshops design and activities. This chapter focuses on the impact of the workshops in relation to the aim of exploring ways to better support parent confidence to participate in mathematics with their children. The findings are based on the series of post-workshop researcher reflections [WxR] concerning parents' engagement in workshop activities and pre [PWI] and post-workshop interview [PostWI] data—data that was triangulated with the pre and post workshop questionnaire data.

Of note is that these findings are based on the interview data from 11 parent participants (from a potential 18 parent participant families) who had participated in four or more workshop sessions. Questionnaire data was completed by sixteen parent participants both before and after the workshops and has been used to provide quantifiable evidence of positive effect from the workshops.

Section 5.2 reports on the impact of the workshops in supporting parents to develop a new and more positive relationship with mathematics. Section 5.3 describes the extent to which the workshops met parents' objectives for participation including the degree to which they felt they had gained better knowledge of current strategy approaches to problem solving. This section highlights parents' increased understanding of the broad range of skills and learner dispositions required for success in mathematics. Section 5.4 then discusses parents' growing ability to support student learning through awareness of opportunities for mathematics through everyday activities. In addition, section 5.5 illustrates how parent capacity to support their children's learning was strengthened through the opportunity to observe teachers in action within the workshops. Section 5.6 presents data evidencing the overall positive effect of the workshops in supporting parent confidence and engagement in mathematics learning with their children. Finally, section 5.7 presents some thoughts from parents related to how schools can continue to help build partnerships.

5.2 A new relationship with mathematics

In contrast to the negative experiences and emotions which had dominated parents' description of their prior experiences with school mathematics, parents reported that the workshop experiences had provided them with an opportunity to develop a new relationship with mathematics. Many of the parents expressed this relationship in terms of emotive feelings, feelings that sometimes surprised them. For example, one parent reported:

> [The workshops were] good, a lot better than what I expected, because the truth is I was feeling a bit nervous about them because maths was something that … I completely struggled with, I drew a mental blank over it and then I just developed an attitude towards maths. [Nicola, PostWI]

In the PWIs many parents had described their prior experiences of learning mathematics as being boring, irrelevant, frustrating, or horrible. In contrast, the workshops were described as being really good, interesting, practical, different, enjoyable, much more basic, and even fun:

> What I remember at school was that most of what we did was in the book, so it's book learning, … so I do feel that a lot of the stuff they are doing now is experience based and its hands on and it's like you're using a whole different range of methods to teach and I think it's not as boring! [Nicola, PostWI]

Parents in the post-workshop interviews frequently noted the impact embedding real life contexts and practical applications within the mathematics:

> The games, and the whole practical side of doing and measuring and measuring the foots (feet), and how tall you were and all of that stuff was yeah (good) anything where you had to actually … I think it's visual as well which was the thing that was really helpful. [Michelle, PostWI]

> It's more relevant to real life, with all the home examples and maths in your week, rather than I'll learn this but I'll never use it like we had at high school. [Sonya, PostWI]

> I like the more practical sense of doing the maths, you know not so much the board sense, you know when you're doing with theory, you know trying to break it down to make it the (more) practical, like seven sheep and how many legs have they got and those sorts of stuff you know, that way rather than the early way when we had a text book and you had to work it out. [Mark, PostWI]

The notion of learning and doing mathematics as a community through group based tasks was particularly affirming for some:

> The first couple of weeks it was just getting out of the ughhh, its maths mentality, (then) … we were both doing this together and it became a real fun activity. [Joanne, PostWI]

Parents who had had previously struggled with mathematics as students, for the most part, presented as being more comfortable in talking about mathematics and mathematics learning in the post-workshop interviews [and as noted in research workshop reflections]. This was attributed to the relaxed atmosphere of the workshops and the opportunity for parents to be observers and or participators depending on how confident they felt:

> I found them (the workshops) really good, good that you could meet with others you could sit back and watch other people, you could hear the conversations and there was actually no pressure, it was really good. [Michelle, PostWI]

5.3 Gaining confidence through understanding of current approaches to teaching and learning.

Questionnaire and interview data indicated a positive shift for parents in their understanding of current approaches to teaching and learning particularly strategies for problem solving. Developing better understanding of strategies and the associated terminology enabled parents to see how their own knowledge related to the way in which their children were learning at school:

> [Before the workshops] when he did come home from school … we did go back to the way I was taught because I could then walk him through it, but for him to come home with some of these strategies, I didn't see it (understand) so I couldn't help him and that's when the frustration came in, so maybe now that I've seen some strategies by watching the teachers and the kids, I can sort of get my head around it, but six weeks is not … a little snippet really. [Joanne, PostWI]

> I really liked getting to know strategies, there's no wrong way really, whereas when I grew up you did it one way, and everyone did it the same way … getting my head around that, it doesn't matter as long as you can document how you got there. [Sonya, PostWI]

In particular, parents who had reported previously feeling frustrated by their lack of ability to communicate successfully with their child now reported feeling like they were "speaking the same language" and that the communication barrier had been lifted:

> It was quite good cause the way we used to get taught maths, that's completely different than the way you teach it here, so coming here and learning the way that you fullas actually teach the kids compared to the way I'd do it at home, and teach him a different way, so coming to these classes was actually quite good to see, understanding how they are doing it. [Greg, PostWI]

> I feel a bit more that I'm on her level now, cause when they were coming home with their things, I'd be oh that (goes) here, and they'd be nah Dad that's wrong, I thought I was on a different planet, but now it's all the same, it's just relating to it, … I just think it's the communication, the talk of the curriculum. [Mark, PostWI]

> (Adding to the conversation) Yeah, now I know we're on the same wavelength, it just gives us a bit more understanding and we come down to their level and work it out the way that we've been taught to work it out here as well instead of butting heads over different ways. [Greg, PostWI]

> I did like how you um, knowing you've taught the kids to work things out, and the methods that you've taught them how to work it out, once explained to me made sense. [Denise, PostWI]

Questionnaire data also indicated a strong positive shift for parents in their understanding of current approaches to teaching and learning (see Table 5.1).

Table 5.1: Understanding current approaches to teaching and learning in mathematics.

Question: To what extent do you feel you understand current ways of teaching and learning in mathematics?							
Little understanding	1	2	3	4	5	6	Good understanding
Pre Workshop	**3**	**3**	**4**	**4**	**2**	**0**	**16**
Post Workshop	**0**	**0**	**3**	**3**	**8**	**2**	**16**

A better understanding of current approaches to teaching and learning was also reflected in parents observing that the goal was not simply to get a correct answer and a tick from the teacher. They could see that the process had become as important as finding a solution:

> There is no set way to get to the answer and sometimes the answer isn't the goal, and that's what I got out of the activities that you did with the kids, it wasn't like working out something to get an answer to get a tick from the teacher to be great. It was more the processes were important … it was good for us as parent to work with our kids and for them to work collaboratively towards something but it didn't have to be right or wrong. [Esther, PostWI]

> (Adding to the conversation) Yeah, like back at school you would have got out the text book and you would have worked through page 77 and 78 for the teacher to mark it, but that's just my memories of doing maths, you know, so for these kids like maths must just be so much better, it's not just getting right answers. [Rachel, PostWI]

In the pre-workshop interviews and early workshops some parents reported being unconvinced about the merits of current approaches to teaching and learning in mathematics, and had voiced concerns particularly about the lack of use of algorithms and rote teaching of basic facts. Post-workshop responses indicated a growing appreciation of the current focus on sense making:

> I can see the sense of sharing it out (referring to place value strategies) and using whole numbers (tidy numbers) and learning that way, it still makes sense to me the old way but some of the new is making sense as well, just will take more time I think. [Michelle, PostWI]

In reflecting on the use of games for rehearsing basic facts, parents felt that this made the learning a lot more fun:

> [Games are] such a neat thing like just tricking the kids into doing maths really, like if I said let's sit down and do some basic facts, it'd be like nah, but you know (my child) and I've been playing memory like when you've got to match, but matching 10, and so she thinks it's the best game ever (lots of group agreement) but she's doing maths. [Esther, PostWI]

Although the "new strategies" were starting to make sense for many parents, some commented that they would still use their own methods for solving problems as those methods still made better sense for them.

A number of parents struggled with the creative licence and opportunity to solve problems using a range of strategies. In watching parents solve problems in the later workshops there was a sense that they wanted to use new solution strategies in much the same way as they would a traditional algorithm. That is, they regarded the new strategies as a further set of algorithms that they needed to become up-to-date with rather than as a sense making way of approaching the problem. This was particularly evident in the final workshop, where the problem involved working out the height of the giant based on the size of the footprints on the floor (see Figure 4.3). Parent reflections provided further confirmation that the preference for teacher specified methods for problem solving remained:

> I have to admit I lost my way with the big foot on the last night (lots of agreement from the group), I really couldn't work it out, and I was sort of going … I just didn't know the strategy and that was my frustration, I didn't know the strategy to work it out, and people were doing it in all different ways, but I didn't know the strategy and I still don't know the strategy, if I went home now I couldn't work that out, I don't know how to work that one out. [Joanne, PostWI]

> Sometimes I did feel a little in the dark, because I didn't know how they were supposed to do things, but that's all part of the process. [Sonya, PostWI]

> In some ways I liked that (different ways to solve problems) and in other ways I found that even more, like ahhh, because it was like this idea that there's not one way to do it, I thought that was cool in some ways but it's freaky in others, cause I think, cause of my personality I just want to know how to do it, just tell me how to do it and I'll use the formula and I'll work it out. [Nicola, PostWI]

Despite parents still coming to grips with problem solving approaches, they were however unanimous in their reporting of increased understanding of strategies and the approach to teaching mathematics:

> I think the language is like a massive thing, like the terms and terminology that is used all through maths and you'd see it in the reports and … Hearing it I think through the workshops made more sense, like you could make those connections and have a better understanding from them, … was quite helpful. [Michelle, PostWI]

This increased understanding was also evident in their reports of improved understanding of language used in school reporting:

> [The workshops] gave me a lot better understanding of where the kids actually are, you can see a report come home or you can go to a parent teacher interview, here he is on the graph, and that's cool, it's a nice line, but it doesn't tell me anything about what he's doing.
>
> Interviewer: So you feel that having these sorts of workshops meant that it gave you a broader understanding of how to interpret that information?
>
> Yes, and some of that just physically seeing what he's up to. [Steve, PostWI]

5.4 Supporting student learning through increased awareness of opportunities for mathematics in everyday activities.

Along with developing a more positive feeling towards mathematics, the workshops contributed to parents' becoming more aware of the mathematics connected to their everyday activities as reflected in the following response:

> The Workshops made me a lot more aware of how maths does factor a lot in your life, like you probably haven't given it much thought, but after doing the course, you realise how much it is part of your everyday life. [Denise, PostWI]

Aligned with the increased participation in the' Maths in my week' reporting (see Fig. 4.7), parents reported gaining greater confidence to engage in mathematical discussions with their children in the home as the workshops progressed. Overall parents reported feeling more confident about incorporating mathematics into their conversations, and in engaging with mathematics through their everyday experiences. Some parents were able to engage mathematically across a wide range of everyday experiences with their children. The range of ways and opportunities that parents found to engage in mathematics did not appear to be related to the parents own level of mathematical competence, but more their ability to use situations creatively:

> I think, it has made us more aware, like the other day [the conversation] was about being late for work, you know five minutes late in the morning, leaving five minutes early, an extra five minutes at lunchtime. How does that add up, and how does that add up over a year? Giving them an awareness that five minutes three times a day translates to so many hours … and from a business point of view that's lost paid time. [Steve, PostWI]

Below are examples from parents who reported as having struggled with mathematics themselves, actively engaging in conversations across a range of contexts:

> So, we've tried to bring it in in a more fun way and like less pressure, incorporating it more and thinking about other stuff (opportunities) like when we went on a trip in the holidays, our daughter is really into reading maps and stuff as we are driving along, so she was trying to work out how far we had to go and looking at all the little numbers (kms) on the map and adding them up. [Nicola, PostWI]

> I know I try to think maths, like I know I 'm trying to do something and I know it's got a math's connection, and normally I would have just pottered on, but now I actually try and purposely put maths into the conversation where I can see it would go. For example …the dominoes, so ok, how are we going to share them out to make it fair… so you got six each, so eighteen divided by three is six. Before it would have been in my head that it was good maths but I didn't verbalise it for them. [Rachel, PostWI]

> Yeah, well trying all the time, like the other day, cause they want to do chores so they can charge me either $5 to do the dishes or the dishwasher and those sort of things, (laughter from the group) so they say let's go to the Warehouse and have a look, and we get there and look at the prices of things and then I say to them, how many times are you going to have to do the dishes so you can get it? [Mark, PostWI]

> Just using those different ways of (opportunities for) maths, like we were going for a drive and ok so it's 60kms, so if we done 30kms how many have we got left to go, or if we are shopping and things like that, just using those everyday things to include the kids in it. [Michelle, PostWI]

Other parents reported growing confidence in their ability to have a mathematical conversation with their child but also reflected on the need to consciously incorporate these into everyday life:

> I've been always doing it in my head, but I haven't been imparting it to them, so it's been yeah, I should explain this, and just take the time, cause those things take time … but it's me stopping and going yeah, I need to have a conversation. [Joanne, PostWI]

Interestingly, parents' increased confidence and awareness of opportunities to activate everyday experiences mathematically meant that conversations were sometimes initiated with the wider

family. For example, one parent reported that younger children in the family were also benefitting from increased levels of mathematical conversation happening in the home as follows:

> We have been talking more about fractions and even the younger kids are getting into it because we are talking about it a bit more. [Sonya, PostWI]

However, no reports of impact on older siblings were noted.

Table 5.2 further illustrates a positive shift in the degree to which parents felt they were able to use everyday experiences for mathematical conversations with their child.

Table 5.2: Use of everyday experiences for mathematical conversations.

Question: I use everyday experiences to talk about mathematics with my child							
Never	1	2	3	4	5	6	Regularly
Pre Workshop	**0**	**1**	**6**	**5**	**1**	**3**	16
Post Workshop	**0**	**0**	**0**	**5**	**5**	**6**	16

Pre and post- questionnaire comparisons (see Table 5.3) suggest that improved understanding of school mathematics and awareness of everyday contexts as an opportunity for mathematics learning contributed to parents feeling more able to be a part of their children's learning.

Table 5.3: The extent to which parents feel part of their child's learning in mathematics

Question: How much do you feel you are a part of your child's maths learning?							
Not involved	1	2	3	4	5	6	Very involved
Pre Workshop	**1**	**3**	**7**	**5**	-	-	16
Post Workshop	-	**1**	**3**	**2**	**6**	**4**	16

5.5 Supporting student learning through improved parent teaching capacity

Confidence to support learning was also built through parents having the opportunity to watch teachers in action during some of the workshop activities. As previously mentioned, teachers were invited to attend workshop on a volunteer basis. Those teachers who attended[4] worked alongside families as they engaged in the mathematics activities providing support through teacher questioning, explaining, or prompting. Parents identified the teacher involvement as a specific factor that enhanced their understanding of school mathematics. Indeed, the opportunity to talk to teachers about ways of solving problems received the highest mean rating score in the post-workshop survey completed by the nine participants who answered the question according to the directions.

Table 5.1: Usefulness of Workshop Activities

Usefulness of Activities

Rate the following activities 1-5, with 1 being the most useful.

Participant	Everyday problems	Playing games	Opportunity to talk to teacher	Maths in my week	Handout information
A	4	3	1	5	2
B	1	3	2	4	5
C	1	2	3	5	4
D	1	4	2	5	3
E	2	4	1	3	5
F	2	1	3	4	5
G	1	2	3	4	5
H	4	3	1	5	2
I	3	2	1	5	4
Sum	19	24	17	40	35
Average	2.1	2.7	1.9	4.4	3.9

[4] Between two and four teachers attended each session with most attending two sessions.

Parents commented that it was the opportunity to observe teachers talking to their children which contributed to their increased confidence of knowing how to help:

> The teachers were really good and different teachers too had different strategies for different (problems), like you could see their (preferred) way which was good, and just having the mix of teachers all the way through was quite good as well. [Michelle, PostWI]

In particular, observing the types of questions and prompts used to help the children get started or to break the problems down and work through them step-by-step were identified as useful modelled actions:

> It's asking those right questions, that's what I noticed from the teachers when they were sitting next to you, they would start chatting with your child and they were just really good simple questions. [Joanne, PostWI]

> Saying, you can do it, just break it down and that was, you know how you have teachers, I think Mrs Smith she was saying, just break it down, what's a quarter of 228, or you know and then literally where we would do the long division, she was saying just break it down, like what's a quarter of 200, a quarter of 20 and a quarter of 8 and literally breaking it into segments so yeah … so to [now] be able to support him a bit more and say just step through it, have a think. [Sonya, PostWI]

5.6 Overall impact of the workshops in supporting parents' confidence to participate in mathematics learning.

Trends in the pre-and post -questionnaire data demonstrated an overall improvement in parents' confidence to help their children and participate in mathematical activities. This could be attributed to the collective impact of better understanding of current approaches to school mathematics along with knowledge of how to support children's learning and an increased awareness of opportunities to discuss mathematics in everyday activities.

Table 5.5: Knowing how to help

Question: I know how I can help my child with their mathematics							
Not really	1	2	3	4	5	6	Yes, I know how to help
Pre Workshop	**1**	**3**	**7**	**4**	**-**	**1**	16
Post Workshop	**-**	**1**	**3**	**3**	**5**	**4**	16

Table 5.2: Confidence to participate in mathematics activities with my child

Statement: I feel confident about participating in maths activities with my child							
Not really	1	2	3	4	5	6	Yes, I feel a lot more confident
Post Workshop	**-**		**1**	**3**	**7**	**5**	14
N/A, I didn't lack confidence prior to the workshops						**2**	2

*Confidence levels were not measured in pre-workshop questionnaires

For a small number of parents who still felt that their lack of mathematical skills limited their ability to support their child, there was an improved understanding and definition of their role, and confidence to be active in seeking help. They now saw that they could act supportively by talking through the mathematics with their child, or by engaging in a conversation with the teacher to get the necessary help:

> I think we play a massive part, whether it's me trying to use the language, or going OK what are the other solutions and going to see [the teacher] and saying, what is this, I don't understand? … and still just saying OK, we don't know, just find out, just that whole working together. [Michelle, PostWI]

Some parents who reported feeling confident with supporting their children at primary school level, expressed concern about their ability to help in the future when their children reached high school:

> Getting into my sons level, I probably feel like there is some stuff that I'd wanna get, that I still don't feel that 100% confident with and that freaks me out for going into the older years. I'd love to be able to go into the high-school years where I'm like, oh, actually on to it, but I don't think that's going to happen, but it's ok, because my sister in-law is doing a PHD in mathematics. [Nicola, PostWI]

The literature (e.g., Cai, 2003; Harris & Goodall, 2008; Walker et al., 2005) reported parent role construction and self-efficacy as being powerful influences on parent participation in learning. In light of this understanding, deliberate efforts were made to emphasise the importance of parents as teachers, and the difference that their interest and encouragement makes in their children's learning. Tables 5.7 and 5.8 demonstrate that post workshop, parents were seeing themselves as being more influential and important in their children's learning.

Table 5.3: Role of parents in learning

How important do you think your role is in your child's maths' learning?							
Not very important	1	2	3	4	5	6	Extremely Important
	0	0	**1**	**2**	**4**	**9**	16

Table 5.4: Positive difference from parent help

I think my helping makes a positive difference for my child?							
Disagree	1	2	3	4	5	6	Strongly Agree
	0	**1**	0	**4**	**5**	**6**	Total 16

5.7 Parent-school partnerships

Parents were unanimous in their opinion that workshop opportunities need to be ongoing and available to all parents. All parents wanted to know how their children were learning at school. They were firm in their belief that parents should be involved in their children's mathematics education and

that the school needs to continue developing avenues for communication between themselves and parents regarding learning:

> My son for instance couldn't explain it to me, so I didn't get it, but in a group like that, you got to understand how they were doing things so that you could actually support him a little bit more. [Steve, PostWI]

> Unless they bring homework problems home, I don't know what I'm doing. [Greg, PostWI]

Parents felt that unless the school supported them by letting them know what their children are learning about and how, they would be limited in knowing the best way they could contribute their support:

> I think that the parents' need to be brought in, like you know you had the workshops, I don't know maybe quarterly or on a six monthly basis, just to refresh the parents side of it, cause there's a lot I feel anyway, things that maybe we could step up too for them, to help them along the way. [Mark, PostWI]

> Yeah, I would like to see some more (workshops) … we would come to something once a year, but with our daughter as well that would mean twice a year (daughter in a younger age group), and that would be our limit (because of other commitments), … our daughter desperately wanted to go to them, she just felt really left out … but yeah I think a year 3-4 one would be great. [Nicola, PostWI]

5.8 Summary

This chapter has described the impact of the workshops in relation to both the parent and programme objectives. Qualitative data was used to give an authentic parent voice to the findings. Factors contributing to the overall improvement of parent confidence in to participate in school and home mathematics were described. These included, better understanding of current approaches to teaching and learning in mathematics, and a broader understanding of the current sense making approach to learning. Parent's ability to support student learning was enabled through greater awareness of the opportunities for mathematics through everyday activities, and improved capability to support their children's learning.

It is recognised that these findings are unique to the group of parents who participated in this series of workshops and that the group is too small to make generalisations from. The following chapter will present a discussion of the findings in relation to the broader literature base and further development of home-school partnership endeavours.

Chapter Six

Discussion and Conclusion

6.1 Introduction

This study has sought to investigate ways in which to better support parent confidence to participate in mathematics learning with their children at home and in their community setting. The previous two chapters have described the design and enactment of the workshops, along with the impact of the workshops for parents in relation to: their motivation for participation, which included gaining a better understanding of current approaches to teaching and learning, and my researcher aims of supporting parents' confidence through improved awareness of opportunities for participation in mathematics through everyday experiences. This chapter discusses these findings in relation to the literature. Section 6.2 describes the initial barriers to participation identified in this study. Section 6.3 then identifies the motivation for parents' participation in the workshops. Section 6.4 describes the activities and opportunities which related to the overall increase in parent confidence. Section 6.5 discusses the impact of greater awareness of everyday activities on parents' ability to support student learning. In section 6.6 parents' perspectives on how they see schools as being able to offer support are discussed along with the need for ongoing development of school communication practices. Section 6.7 summarises key findings from the study relevant to other practitioners considering implementing parent engagement initiatives. The limitations of the study are acknowledged in section 6.8 and then some final thoughts are presented in section 6.9.

6.2 Understanding barriers to participation

A wide range of barriers to participation were reported in the literature review. Attending to these issues and alleviating them where possible was important in order to gain the participation of a willing and interested group of parents, and design a programme that met their needs. As described in chapter four, while eighteen families did participate, there were many other families that were unable to attend. While many of the barriers were similar to those described in earlier studies (e.g., Fisher & Neill, 2006), the current study identified additional potential barriers. Barriers for families who had expressed interest in participating in the workshops included shift work, language, and church commitments. In an earlier New Zealand study, Fletcher et al. (2009) also reported lack of time as

result of shift work being an issue for many Pasifika families. Access issues highlight the need for schools to carefully attend to flexibility and the needs within the parent community when organising activities such as workshops.

6.3 Motivation for participation

Participating parents were motivated by a deep sense of responsibility to help their child with mathematics learning. Role construction, that is parents' beliefs about what their responsibility is in relation to their child's education, is consistently reported in the literature as being a significant motivating factor for parent participation (Desforges & Abouchaar, 2003; Harris & Goodall, 2008; Hornby & Lafaele, 2011; Walker et al., 2005). In this study, a strong sense of role construction was expressed equally by parents regardless of whether their children were thought to be higher or lower achievers. This finding is in contrast to that reported by Desforges and Abouchaar (2003) who, in the UK context, suggested that parents were more likely to be involved when students demonstrated high levels of achievement. In this study, parents of low achieving children reported that they were keen to find out more about their child's learning in order to be better equipped to help them at home. As such, for this group of parents, participation appeared to be more strongly related to parents' sense of role construction than their child's achievement.

Equally, there was no evidence to suggest that role construction was influenced by parental level of education or socioeconomic status; the parent group was highly diverse on both measures and with most parents describing a range of activities in which they were currently engaging to support their children's mathematics learning. Similar findings were reported in a UK study by Melhuish et al. (2008). In their study, they reported that while parental qualifications and socioeconomic status do factor into parent engagement, the provision of a quality learning environment, being characterised by a high presence of quality mother-child interactions, played a more influential role. Instances of quality home learning environments were provided by parents who did not have qualifications or high levels of material support. Equally, the study reported instances of learning environments that demonstrated limited effectiveness despite parents having qualifications and access to material supports.

In the current study all parents voiced an awareness of the importance and impact of mathematics on their everyday lives and career pathways. Supporting their children's achievement in mathematics was further motivated by the desire to ensure their children's ability to manage future independent living needs and to enhance employment options. The view of education as being the key to upwards

socioeconomic mobility, particularly in schools of lower decile rating, is described by a number of authors (Demie & McLean 2007; McKinely as cited in Biddulph, Biddulph & Biddulph 2003; Walshaw 2006).

The fact that all parents who participated in the workshops demonstrated a strong sense of role construction, regardless of level of education, aligns with most other related studies. However, we need to be aware that not all parents have a strong sense of role construction—and consider the possibility that the workshops did not attract an important target group of parents. Hornby and Lafaele (2011) note that parents who do not possess a sense of role construction in relation to their children's education are unlikely to be involved in parental engagement activities. Although increasing parents' levels of role construction was not a focus of the workshops, researcher reflections captured some incidences of when role construction was reinforced (see W6R). Parents' belief in the importance of their role in learning was reflected in parents' post workshop interview comments. For some parents their sense of role construction was influenced by their family heritage. This was demonstrated through references made to parents' own schooling and the types of activities in which they had engaged in with their own parents. These parents wanted to know why those same types of activities were no longer part of their child's routines. Cline and de Abreu (2005), along with Muir (2012), also report parental expectations for engagement as being influenced by family and cultural heritage.

6.4 Increasing parent confidence - A new relationship with mathematics

Exploring ways to support parent confidence/efficacy to participate in and with mathematics was a major focus of this study. As evidenced in the pre-workshop interviews, parent confidence in this study linked to two main factors: firstly a desire to understanding of current approaches to teaching and learning, and secondly—for many parents—their own level of mathematics education. All parents were interested in gaining a better understanding of the "new strategies" their children were using within the mathematics classroom. Civil and Bernier (2006) describe similar interest from parents in wanting to understand school mathematics. Muir (2009), along with Prichard (2004), also found that most parents have little idea about 'how' their children are learning school mathematics. When faced with attempts to support their children with mathematical activities, their only resources then are the methods that they are familiar with and able to recall from their own school experiences. Post-workshop findings indicated a positive shift for all parents regarding their understanding of current

approaches, inclusive of a range of solution strategies associated with the Numeracy Development Project (NZ Ministry of Education), in mathematics.

In this study parents who had experienced greater difficulty in learning mathematics, and who had voiced nervousness about attending the mathematics workshops because of their level of education, indicated that they themselves had learned a lot more mathematics through participating in the workshop activities. They also reported finding the new computational strategies much easier to understand than the traditional methods that they had learned at school. Importantly, where some of these parents had previously held a fixed view of their mathematical intelligence and the mathematical intelligence of their child, they were now able to imagine that with more opportunities to learn their mathematical knowledge could improve. The importance of confronting parental beliefs about intelligence as a way of improving parent efficacy (Honby & Lafaele, 2011; Mutch & Collins, 2012) and as a way of developing a growth mind-set in parents cannot be underestimated. In this study parents reported this shift in belief was already having positive implications for ongoing participation in learning of both student and parent.

Better understanding of current approaches to teaching and learning enabled most parents to feel confident that the new strategies their children were learning were developing important mathematical skills. This was particularly relevant for parents who had expressed concern about what they perceived as a lack of attention to the learning of 'basic facts', and a preference for memorisation and rote learning styles. Parents could see that the current approaches which emphasise mathematical practices that include creative problem solving, trial and error, and explanation and justification were equally as important as answers. A small number of parents remained neutral in their support of current teaching and learning strategies. While they agreed that the approaches made learning more fun and interesting they remained firm in their belief of the critical importance of memorised facts. In this study, the small number of parents who held this position were typically parents whose children were struggling, but parents who themselves had not experienced difficulties in learning mathematics. These parents saw traditional methods as being more efficient. Indeed one parent with advanced mathematical skills, who had been engaging traditional approaches with their child at home and without success, remained firm on this point. de Abreu and Cline (2005) along with Savell (as cited in Anthony & Walshaw 2007) also comment on the difficulties for parents in supporting low achieving children. Careful consideration then needs to be given to the types of activities and supports made available to these families to ensure that parents of low achieving children have the opportunity to see that their helping is having a positive impact on their children's development. The importance many parents place on the acquisition of mathematical knowledge over strategic

understanding, and a preference for memorisation and drill and practice exercises was also noted by Goos and Jolly (2004) and Marshall and Swan (2010). Over ten years later, it appears that the provisions of opportunities for parents to broaden their perspective on what it means to learn and do mathematics remains critical to developing positive relationships with mathematics.

The knowing how best to 'teach' and interact with their children mathematics at home appeared to be a concern for a number of parents. Parents described frustration at their lack of teaching skills, reporting that despite their best efforts they felt ineffective in communicating with their child in a way that the child was able to understand. Civil, Quintos and Bernier (2003), describe opportunities for parents to observe teachers in action as being a powerful way for parents to enter the conversation about current approaches to teaching and learning. In their study parents observed and commented on the use of equipment, something that was quite different from their experiences, as being clearly helpful in developing children's understanding. Other researchers (Bernie & Lall 2008; Muir, 2012) have also commented on the need to empower parents by sharing information, such as teaching strategies, so that parents feel more confident and able to contribute effectively to their child's mathematical development. The opportunities within some of the workshop activities to watch teachers modelling a range of questioning strategies, and seeing how the teacher supported students to identify ways in which to begin thinking about the problem, were reported as being particularly helpful in developing their own skills to better support their children. It could be argued that rather than 'teaching skills' parents have been exposed to, and picked up on good strategies for effective talk. Having more effective skills for communicating and being better resourced to engage in positive high quality interactions is likely to have positive outcomes in terms of improved parent confidence and student willingness to be involved in learning together. Barnes & Freude-Lagevardi (as cited in Melhuish et al., 2003) in reviewing interventions aimed at increasing quality parent-child interactions with 0-3yr olds also found that interventions where both the parent and the child were engaged together achieved the greatest gains. Melhuish et al. (2003) agree that this demonstrates that effective parenting behaviours including communication skills, are learnable.

Seeing teaching in action is not common; few parents are ever part classroom lessons or have the opportunity to watch a teacher working through a learning sequence with children. In these workshops the encouragement of the children to apply thinking skills and explain their reasoning, prompted parents to discuss the change in emphasis on learning with understanding as opposed to having a 'formula' to memorize and apply. A further benefit of parents being able to observe teachers and students discussions was that where students themselves were not overly competent in explaining their strategy or their thinking, through the questioning and clarifying talk modelled by the

teachers, parents were able to get a clearer understanding of what the students were trying to do. One parent commented, that although his son had explained various strategies that he was using, he had not been able to fully grasp what his son had said; however in the workshop environment, and through observing the conversations with teachers and with other parents, he felt that he had developed a much better understanding of what his son was doing.

Further thwarting parents' understanding of current approaches to mathematics teaching and learning is the issue of language. A significant amount of new terminology (e.g., tidy numbers, halving and doubling, and compensation) is associated with the Numeracy Development Project which was first introduced in New Zealand in 2001 (Thomas & Tagg, 2006) in New Zealand classrooms. Marshall and Swan (2010), in the UK, also report similar difficulties for parents regarding new language and terminologies. With many of the workshops sessions focussed on problem solving activities involving students and teachers modelling a range of mathematics strategies, parents had frequent opportunities to develop familiarity and understanding of the language and related strategies, particularly as they watched teachers and students discussing and solving problems. One parent commented that "hearing the language on a weekly basis, helped it make more sense". It is easy for teachers and schools to underestimate the extent of the role which language plays in contributing to parents feeling alienated from the modern mathematics classroom. Although parents in this study felt that they had gained a better understanding of mathematics strategies and associated language, some still felt that they would like to have further sessions where strategies and language were explicitly explained, as opposed to the more informal approach which the workshops had adopted. Potentially, some of these explanations could take the form of written exemplars in newsletters, or school blog pages that feature students' work.

The workshop learning environment also appears to have had a positive effect in developing a more productive relationship for both parent and student with mathematics. Although students' perceptions of the workshops were not measured in this study, parents reported that their children had been very positive about the workshop experience and were far more motivated to engage with them in mathematical activities at the workshops than they would have been at home. In one instance, when a parent had to attend another meeting, the child persuaded the parent to let him/her come with another family. Although supper was identified by a number of parents as being a motivating factor for students, it appeared that the novelty of attending workshops in the evening within a very sociable environment that included parents, may also have contributed to this positive response from students. Desforges and Abouchaar (2003) report the opportunity to spend time with parents as being a motivating factor in children inviting parents to participate in their learning. D'Amanto (as cited in

Anthony & Walshaw, 2007) also found evidence to suggest that students will respond to opportunities that appear to have 'situational significance' for them. That is, the situation presents an opportunity to maintain or further relationships that they value. In this instance the workshops presented an opportunity to spend time with parents and school mates. Providing opportunities then for parents to have positive learning experiences with their children, particularly parents whose children are struggling, may also be important in improving parents' feelings of efficacy.

When considering parent efficacy issues, it is more commonly thought to be a concern, and thus impact parent participation at senior levels in schooling. For example, Desforges and Abouchaar (2003) report a diminishing level of parent engagement as children get older. While this study has demonstrated that improving parent confidence to participate in senior levels of primary schooling can be achieved, developing partnerships in mathematics learning from an earlier year level may be important in reducing what has been described as typically diminishing levels of engagement. Confidence in parents to participate in learning, including mathematics learning, is known to be at its peak when children are pre-schoolers (Glatz & Buchanan, 2015). It would seem opportune then to continue building on the high levels of efficacy that parents have in the early years; by providing ongoing opportunities for parents to understand current approaches to mathematics teaching and learning, and mathematics content, right from point of entry and being on-going as they progress through the school system with their children.

6.5 Supporting learning through greater awareness of opportunities in everyday contexts

Building parent confidence through increased awareness of opportunities within everyday activities for rich, informal, mathematically based interactions was a further focus of this study. Whereas parents' level of education had been an influential factor in predicting parents' confidence to participate in mathematical activities, parents and children's general enthusiasm for mathematics and personal creativity appeared to play a greater role in identifying everyday opportunities for mathematics. Regardless of the prior level of education, many parents described a range of everyday activities that had become the basis of sustained mathematical discussion. Interestingly, the parent with the most advanced mathematics qualifications reported only one context –scoring in scrabble— that might involve mathematics in his everyday activities with his child. It may be that because the mathematics that this parent was dealing with on a daily basis was so far removed from the entry level mathematics of primary school, he found it difficult to relate to mathematics at that level.

Contextual word problems which modelled everyday experiences were used extensively in all of the workshops. Parents saw the use of word problems which related to everyday contexts as a positive change in mathematics teaching and learning. The consensus was that these problem tasks made mathematics a lot more relevant, practical, interesting, and fun—descriptions that had been significantly lacking in recalling their own mathematics learning experiences. Parents also said that the context-based problems had initiated further mathematical conversations at home and given them ideas of similar questions that they could ask at home.

As described by Wager (2012), the use of familiar contexts in word problems is a very common way of connecting out-of-school experiences to school mathematics. This type of context based learning enables students to see their everyday lives reflected in school mathematics. It is also reported to positively impact on student motivation and perseverance (Taylor, 2015). Contrastingly, when learners are unable to see their own life reflected in mathematics being taught they are less likely to develop positive mathematical identities or see mathematics as being relevant to them (Hunter & Anthony, 2011). For many parents, the lack of connection and relevance between their school mathematics experience and real life was been perceived as the reason for their lack of interest and negative views of mathematics.

In post-workshop interviews, parents clearly indicated an increased awareness of the ways in which everyday activities might provide opportunities for greater engagement in mathematical talk with their children. For some parents it was the first time that they realised that many of the activities (e.g. shopping, cooking, playing games) in which they had already been engaged presented relevant and valid opportunities to engage in mathematics and or mathematical conversations. Other parents admitted that although they knew that many of their daily activities involved mathematics, they had not been accessing these opportunities for their children prior to participating in the workshops. As a result of the workshops most parents reported that had become much more conscious of taking the time to include their children in mathematical discussions as and when the opportunity arose. Importantly, as the workshop sequence progressed, the cumulative provision of examples of parents' use of everyday contexts in mathematics supported participants to develop a broader perspective of mathematics and mathematics learning. However at the end of the workshop sequence, some parents, while feeling that they knew how and that they should have more relevant mathematical conversations with their children, still felt that they were not actually doing it effectively enough.

Although parents were able to describe many instances where mathematics was involved (e.g., shopping, cooking, travelling and sport), and reported feeling more confident in having a mathematics conversation with their children using these contexts, some reported that these efforts still felt

somewhat contrived. This may be because although the context could be activated mathematically, having a mathematical conversation wasn't something that the parent would normally do, or because the parent was more conscious of trying to bring school mathematics into the conversation as opposed to discussing with their child the informal mathematics that they use. For example, one parent commented that although money and shopping is a regular everyday activity involving mathematics the use of eft-pos transactions has made the mathematics somewhat invisible. The increasing invisibility of mathematics is also described by Niss (1994), who explains that this is largely because mathematics lies often in the background of our activities rather than at the forefront. Wager (2011) warns that applying mathematics to a situation or context in a way that it normally wouldn't be applied diminishes the motivation and meaning of the mathematics. For example when using shopping as a context, the use of eft-pos means that it would be inappropriate to discuss which notes and coins are necessary to pay the bill. A more appropriate discussion may be one that involves figuring out the total cost of the items and working out how much might be left over for other expenses. Wager refers to this type of mathematics as embedded mathematics. These types of embedded mathematical opportunities are recognised as providing a more powerful connection for learners to mathematics. There are significant challenges however in generating these types of authentic opportunities in a workshop situation. For these reasons, it would be fair to say that Wager's form of truly embedded mathematical investigations or mathematics in action, was not experienced in an authentic way in this series of workshop. Rather out-of-school contexts were used as the basis for school mathematics. Although this may seem like semantics these practices are distinctly different. Turner et al. (2009) along with Winter, Salway, Yee, and Hughes (2004) agree that pursuing mathematics in authentic situations is complex. Furthermore is not always easy to predict which aspects of the situation will present themselves as being mathematically interesting to the learner or what questions they may ask. Moreover, the mathematics required to solve the problem may be beyond the ability of the students, or may not be feasible give the time constraints (Turner et al., 2009). In this study, although this type of mathematical engagement was sought, in honouring the needs and requests of parents there was insufficient time to gain the depth of knowledge required to develop fully mathematical investigative opportunities in authentic situations within the whole group setting.

Likewise, due to time constraints a deeper understanding of the informal mathematical practices (Lave, 1988) employed among students (Masingila, 2002) and their families was not realised. Some parents in pre-workshop interviews had revealed that despite their lack of success with school mathematics, they had had their own strategies for working things out and had been frustrated that these strategies were not approved of at school, furthermore they still engage these methods in

solving the mathematical problems relevant to their current adult everyday life. Lave (1998) also acknowledges the range of informal strategies used by adults particularly in contexts such as shopping and figuring out best buys. Similarly, de Abreu and Cline (2007) describe the distinct mathematical practices of sugar cane farmers in Brazil. The estimation practices basketball players used when comparing players' skill level and ability was described in the literature review (Nasir 2013).

One small glimpse of other potential everyday practices occurred in the addition/subtraction workshop (W2R). In this workshop cooking was adopted as a context that all families had identified as involving mathematics. The scenario was that if a double batch of cookies were been baked, how much of each ingredient would be required? My teacher-based assumption was that parents and students would double each quantity using school-based procedures. One parent shared that she wouldn't do it like that at all—rather she would put the required amount in twice. Wager (2011) also reports a similar finding when using cooking to develop student understanding of fractions, finding that only one student had used measuring cups in cooking—preferring to measure by way of handfuls of rice or simply pouring it straight into the cooker and estimating. This example illustrates the difficulties in bridging the gap between school mathematics practices and the practices which are actually engaged in by families in their homes. It may also help explain why some families struggled to describe the activities in their week in which they had made a mathematics connection, some of them may simply have not seen their practices as being mathematical or at least not related to school mathematics.

Winter et al. (2004) also reports many parents as being unsure if they possessed information or knowledge that might be relevant or useful in the classroom. Furthermore, students themselves may not wish to share their families' mathematical practices. In one particular case in Winters' study a student who used a culturally specific mathematics practice for counting at home, was firm in the position that she did not wish to share this with her teacher, seeing what she does at school as being quite separate from what she does at home. If this is the case, then finding out about family and cultural mathematics practices, and then developing meaningful links to school mathematics practices, may be more difficult than expected. The challenges and processes of effectively building on parents 'funds of knowledge' is an area for continued investigation (Civil, 2007) and is one that would require significantly more time and effort on the part of teachers. Given the diversity among families within the school, achieving this would require prioritisation and additional support from both school leadership, teachers and the community.

6.6 Parent perspectives on opportunities for schools to provide support

While parents were positive about their workshop experience, they recognised that this type of programme would not be able to be sustained throughout the year. However, parents were unanimous in their desire for ongoing opportunities to be informed about how their children were learning at school and how they could be involved at home. Many parents expressed the wish to have regular homework/interactive type activities provided by the school. The provision of homework type activities by the school was seen as an important opportunity of communication from the teacher to the parent regarding classroom learning, providing information which they felt could guide their conversations' with their children and enable them to contribute more effectively. Parent requests for books or homework sheets as guidance was also reported by Marshall and Swan (2010). Epstein (as cited in Hornby & Lafaele, 2011) also reports parents as being more effectively involved when teachers actively encouraged and facilitate their engagement. It could also be argued that homework constitutes an invitation from the school and from the student to participate in the learning. Parents' perceptions of invitations to participate are also known to influence parent engagement in learning. If invitations to participate act as a signal to parents that the teacher and the school see their role and engagement as important, not sending home information and suggestions about ways to help parents may equally be interpreted as the school not valuing parents' engagement and participation. Moreover, Walker et al. (2005) found that invitations from the child were the strongest predictors of home-based involvement. This may also explain why some parents, when left with the responsibility of identifying and initiating opportunities for mathematical discussions, found it difficult to remember to do so. These parents may be more inclined to operate in response to their children's needs and requests as opposed to leading and initiating the interactions themselves. An activity provided by the teacher then gives the child a means to invite their parent to participate in their learning. Importantly, Walker found that when schools do provide appropriate guidance (through parent evenings, newsletter, exemplars, and websites) parents are able to engage productively in mathematics activities regardless of their own level of education.

Open lines of communication, or bi-directional communication was identified in the literature as being a feature of effective partnerships with parents. In this study deliberate efforts to facilitate bi-directional communication have been demonstrated through the acknowledgement and response to parents requests for information in pre-workshop interviews. However, in terms of parents sharing back to the school their knowledge and ways of knowing in mathematics, less information has been returned. Winter et al. (2004) describe similar outcomes, reasoning that this may be because these types of exchanges are not familiar to parents. Parents are not used to being in a relationship with the school where their knowledge is given equal value as the schools knowledge. This was further evidence in pre-workshop interviews when parents expressed the wish "not to confuse" their child by

showing them different ways of doing things. Students also pick up on these types of messages and likely come to see the 'schools way' as being the 'right way'. This type of positioning between families and schools may also continue to generationally perpetuate the ongoing power relationship between schools and families. However, if schools genuinely desire to draw on parents 'funds of knowledge' and cultural resources these types of exchanges will need to be developed (Winter et al., 2004). Clearly there is still a long way to go in terms of developing a sense of true equality in the relationship between parents and the school.

6.7 Key findings

The aim of this research was to investigate ways in which parent participation in and with their children's mathematics learning might be better supported. Much recent research indicates the positive influence parent involvement has on student achievement outcomes (Anthony & Walshaw, 2007; Desforges & Abouchaar, 2003; Hattie as cited in Robinson et al., 2009; Mutch & Collins 2012). While many schools are aware of the importance of parent involvement and many initiatives have been trialled, typically schools are left to their own devices in terms of what they provide and how. What this study has highlighted is:

- Role construction, parent self-efficacy, and sense of identity are powerful influences on parent participation. Parents need to know that they matter, and that their involvement does make a difference in the achievement outcomes of their child.
- Lack of parental visibility at school should not be misinterpreted as lack of parental interest in learning.
- It is important that schools provide opportunities for parents to access information about current approaches to teaching and learning in mathematics. Parents want to know how their children are learning mathematics at school. They are particularly interested in understanding new strategies and terminologies associated with the Numeracy Development Project.
- There is a significant distance/difference between students' experiences with learning mathematics and those of their parents. Traditional approaches experienced by parents' emphasis ability to recall specific facts and procedures for solving problems. This in stark contrast to the sense making approach in which students are learning today. In light of this schools need to consider ways in which they can provide opportunities for parents to see how their children are learning. While evening workshops may be one way of attending to this need, there may be many other options (e.g., open days where parents come and participate

in a mathematics lesson with their child, displays of children's mathematical work in public places, classroom walls, and school mathematics web page) to make children's mathematics learning visible and available to parents and wider family members.

- With support parents can become more confident in knowing how they can participate in their children's mathematics learning. Increasing awareness of opportunities in everyday activities is one way of supporting this. It is important that teachers actively seek to identify the knowledge that each parent brings to the learning environment and make every effort to connect to contexts that are familiar and valued by students' families.
- Parents' expect the school and their child's teacher to take the lead in inviting them to be part of the learning and in providing guidance as to ways in which they as parents might help at home.
- Positive relationships between teachers and parents are fundamental to any form of partnership. Successful partnerships with parents hinge on both parties perceiving themselves to be in an equally valued relationship. This means showing respect for diversity in all areas including cultural, economic, social and educational backgrounds. Not all teachers view parents in this way and it is important for school leadership to develop this mind-set among staff members'.

6.8 Limitations of the study and Opportunities for further research

While this research continues to build understanding about the engagement of parent's in mathematics learning, and highlights the opportunities presented in everyday activities, the limitations of the study must also be acknowledged. Importantly, although much attention has been given to the voices of the parents, no data was collected from either teachers or students both of whom are important stakeholders in the process. An understanding of the impact of the workshops from these perspectives would add another dimension to the knowledge gained.

Although positive effects have been documented following this six week programme, no other known follow-up activities have been planned by the school at this stage. Further research would be justified in assessing if the short term positive effects might be maintained over the long term. However, on the plus side, it is known that this project will act as a catalyst for further discussion and improvement to ways in which the school works to support parent engagement in mathematics learning in the future.

This study focussed on supporting the confidence and efficacy of parents of students from year five through to year eight, where the cognitive demands of the mathematics curriculum are significantly more challenging than in the early years. Additional research into programmes aimed at improving parent levels of confidence and efficacy in the junior and middle school may also present an interesting opportunity for comparison. Furthermore, as earlier described, reported parent engagement levels are known to diminish as children progress through school, a relevant question then may be, if efficacy is able to be maintained, can the typically diminishing level of parent involvement be reduced? While all efforts to improve parent engagement are rooted in the overarching aim to improve levels of student achievement, no attempts have been made in this study to quantifiably link improved parent confidence to participate in learning to student achievement outcomes.

Role construction has been identified as a highly significant factor in motivating parents to participate in learning, and could arguably be said to be the primary determining factor. Further consideration then of ways in which schools might develop parents' understanding of their importance in their child's learning may be a worthwhile investigation. Although many other factors are acknowledged as barriers to parents' participation, some of these may become less of a barrier if parents' sense of role becomes more important.

6.9 Concluding thoughts

This research adds to the collection of knowledge regarding the engagement of parents in mathematics education. The study has shown the importance of listening to parents and genuinely seeking to understand the barriers and aspirations for parental participation in order to effectively meet parents' needs. When parents have the opportunity to state what they need, and when these needs are responded to, bi-directional communication occurs. In this study this has meant: providing opportunities for parents to become informed about current approaches to teaching and learning, facilitating activities which develop a broader understanding of what it means to learn mathematics, providing an opportunity for parents to develop their teaching skills, and increasing parents' awareness of shared engagement opportunities for mathematics in their everyday activities.

While the study has produced findings that are publically available and hopefully informative to others who wish to embark on facilitating home-school partnerships within their school context, an important outcome of the study has also been the personal growth for myself as teacher-researcher in terms of the new knowledge that I will take with me back to the classroom. In particular, I am now much more aware that engaging parents is not about telling parents what to do, rather it is about

supporting parents by informing them about what their children are learning and making them aware of opportunities in which they can be involved and support the learning. Engaging parents in the learning process is not a quick fix solution to poor achievement scores. Effective partnerships must be viewed as a long-term investment that requires persistence and genuine commitment from both partners to developing relationships where children's learning is the priority. The finding that I have learnt much from working with the parents and sharing in their lives has affirmed that the model of engagement designed for this study represents one way of building effective partnerships that benefit all participants relationships with mathematics and mathematics learning.

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Appendices

Appendix A: Pre-workshop questionnaire

Pre Workshop Survey

Thank you for taking the time to complete this survey, your views and opinions are valued and will provide a rich source of information from which we can continue improving maths learning and teaching with your child and other children at [redacted]. I hope that you will continue and be part of the Maths workshops and in growing maths at [redacted] School.

Information from individual surveys will remain confidential between the respondent and the researcher. Overall results may be reported in this research study. Many thanks, Lisa Haenga (Researcher)

Please answer the following questions with 1 as the least and 6 as the highest score

1. Do you enjoy math's activities?
   Not at all 1 2 3 4 5 6 I really enjoy maths.

2. How would you rate you own everyday maths skills?
   Poor 1 2 3 4 5 6 Excellent.

3. Would you agree, Maths skills are an important part of my job and everyday life?
   Not really 1 2 3 4 5 6 Definitely

4. In what ways do you expect to be/are you involved in your child's learning? (can tick more than one)
- ☐ Attending Parent Interviews
- ☐ Helping with weekly homework
- ☐ Seeing their test results
- ☐ Attending other school activities
- ☐ Other

5. To what extent are you familiar with current ways of teaching and learning in maths?
   Unsure 1 2 3 4 5 6 Very familiar

6. How much do you feel you are part of your child's maths learning?
   Not involved 1 2 3 4 5 6 Very involved

7. I use 'everyday experiences' to talk about maths with my child. E.g. at the supermarket, cooking, time.
   Never 1 2 3 4 5 6 Regularly

8. Do you feel you know how to help your child with their maths?
   Not really 1 2 3 4 5 6 Yes, I know how to help

9. Have you been involved in helping your child with maths homework/activities this year?
- ☐ Yes
- ☐ No

10. If you answered yes, how frequently do you support your child with maths activities?
    (Thinking about this year) Rarely Occasionally Often

11. How well do you feel the school enables you to support your child's learning in maths?
    Not helpful 1 2 3 4 5 6 Really helpful

12. How many years have you been involved in education at Puketapu?
    1-2years 3-4years 5-6years 7-8years 8+years

13. Do you have maths equipment available in your home? (tick as many as appropriate)

- ☐ Cards
- ☐ Calculator
- ☐ Dice
- ☐ Pencils
- ☐ Paper
- ☐ Ruler or tape measure
- ☐ Scales
- ☐ Counters or Objects for counting
- ☐ Play money
- ☐ Maths games online

14. Which phrase best describes your communication with your child's teacher? (Regarding your oldest child)

- ☐ I haven't had a conversation with my child's teacher yet this year.
- ☐ The teacher talks to me at parent interviews about my child's learning.
- ☐ I regularly chat with the classroom teacher.
- ☐ I regularly make contact with the teacher and ask for information about my child's progress and test results.

Are there any other factors that prevent you from being involved in your child's maths education? Or is there anything else that you would like to mention in relation to your child's maths learning?

_____
_____
_____
_____
_____
_____

Name: _____ (Required for Post workshop data analysis only)

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

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Dr Brian Finch, Director (Research Ethics), telephone 06 356 9099, ext86015, email humanethics@massey.ac.nz".

Appendix B: Post-workshop Questionnaire
Post Workshop Survey

1. To what extent do you feel you understand current ways of teaching and learning in maths?

A little understanding 1 2 3 4 5 6 Good understanding

2. What were the most useful activities for you at the workshops, **1** being the most useful, **5** being the least

- ☐ Problems that reflect everyday situations
- ☐ Playing Games
- ☐ Opportunity to talk with teachers about ways of solving problems
- ☐ Maths in my week reflections
- ☐ Hand out information

3. I think the way maths is taught in classrooms today is effective.

Strongly disagree 1 2 3 4 5 6 Strongly Agree

4. I know how I can use everyday experiences to start a maths conversations with my child.

Not really 1 2 3 4 5 6 Yes I have a pretty good idea.

5. I use 'everyday experiences' to talk about maths with my child. E.g. the supermarket, cooking, sport.

Never 1 2 3 4 5 6 Regularly

6. I feel confident about participating in maths activities with my child.

No, not really 1 2 3 4 5 6 Yes, I feel a lot more confident

OR

- ☐ Not applicable, I didn't lack confidence prior to the workshops.

7. I know how I can help my child with their maths.

Not really 1 2 3 4 5 6 Yes, I know how to help

8. I think that my helping makes a positive difference for my child.

Disagree 1 2 3 4 5 6 Strongly agree

9. I think that games and activities are a good way to rehearse/practice maths skills.

Strongly disagree 1 2 3 4 5 6 Strongly Agree

10. How much do you feel you are a part of your child's maths learning?

Not involved 1 2 3 4 5 6 Very involved

11. How important do you think your role is in your child's maths learning?

Not very important 1 2 3 4 5 6 Extremely Important

12. Has participating in the workshops enabled you to get to know other families?

Not really 1 2 3 4 5 6 Yes, Definitely

13. Has participating in the workshops enabled you to get to know some of the staff better?

Not really 1 2 3 4 5 6 Yes, Definitely

14. Were you happy to participate in the sessions with your child, or would you have preferred to have engaged in the maths activities without the children present.

☐Happy with children present ☐Would have preferred parents only

15. How likely would you be to participate in future Maths for Families workshops if they were offered?

Not very likely 1 2 3 4 5 6 Very likely

16. How likely would you be to recommend Maths for families workshops to other parents?

Not likely 1 2 3 4 5 6 Very likely

17. As a result of the workshops, have you engaged in any discussion with your child's teacher about their progress in maths? (Other than at Parent/teacher discussions)

☐ Yes No

18. In what other ways have you been engaged with Puketapu School this year?

☐ Board of Trustees
☐ Parent Support Group or Gala Support
☐ Parent Teacher Interviews
☐ Monday/Thursday lunches
☐ Parent help on school trips
☐ Classroom support
☐ Coaching sport
☐ Attending sports games
☐ Other

19. Are there any other comments you would like to make? If you would like to email me directly, please feel free to do so. lisahaenga@yahoo.co.nz

_____
_____
_____
_____
_____
_____

Appendix C:
Pre-Workshop Focus Group Interview Questions

1. What do you think when you hear the word Maths, tell me about your experience learning maths?

2. What things do you do with your child that involves mathematics?
a. In informal or everyday settings
b. In relation to school maths?

3. Can you describe the ways you try to support your child's maths learning?
   Anticipate/Prompt: e.g. card games involving numbers, measuring and cooking, maths games online, puzzles,

4. In what ways do you help your child to become confident in maths?

5. How confident do feel about helping your child with school maths/homework?
   Are there any challenges in trying to help your child?

   Alt: Have there been any challenges for you when helping with school maths/homework?

   Anticipate/Prompt: me not understanding the strategies the kids have learned, children not understanding how I am trying to show them.
   Question: has there been any discussion about 'how to do it'?

6. Do you see any advantages/disadvantages for your child in the way children are learning maths now? (Adapted de Abreu, 2005)
   Anticipate: children don't learn their times tables like we did. …there seems to be lots of games, not sure if this is a very effective teaching method.

7. What do you hope to get out of participating in the Workshops over the next six weeks?

Appendix D: Post-Workshop Focus Group Interview Questions

Post Workshop Interviews

1. Tell me about how you found the workshops?

2. How have the workshops influenced the way you view mathematics at home? Did the workshops enable you to have more maths conversations at home? Did they help you to connect maths to your everyday activities? Can you share an example of this?

3. How do you feel about supporting your child in their mathematics learning now? Can you see ways that you can help and be part of the learning? What other support/knowledge/equipment would make that easier for you?

4. What did you notice about your own child's maths development, what they could do, what they were still are unsure about? What they are working towards next? Did you get an idea of the learning progression?

5. Was it useful having teachers at the workshops? In what way?

   How do you feel about talking about maths with your child's teacher now?

6. Did you gain a better understanding of how maths is being taught at school now?

7. In comparison to your own experience of learning maths, what do you see as being the positives or the negatives about the way in which maths is being taught now? (thinking about the use of contextualised problems, games)

8. Would you like to see a follow on of the workshops?

   Do you think that these types of workshops should be made more regularly available for parents?

   What would you like to see in a next series of workshops?

   How can we make these more 'parent friendly/accessible for parents'?

9. The NZC talks about children becoming 'numerate' or able to use maths confidently to solve their own problems, what does being numerate mean for you?

Appendix E: Information Letter to Parents

Maths Workshops

An investigation into - The potential of Parent Learning Communities to build home-school partnerships and increase student opportunities for participation in mathematical activities outside of the classroom.

Parent Information

This information sheet is provided to outline the purpose of the Maths workshops, what participation involves and your rights as a participant. This series of Maths Workshops for parents and students will form the field work aspect of my Master of Education thesis with Massey University. The purpose of the study is to investigate ways in which schools can develop partnerships with parents to increase opportunities for students to participate in mathematical activities outside of the classroom and in their daily life.

At the information evening we discussed that parents are the most important teachers in their children's lives and what they do with their children matters significantly. We also discussed that each of us has had a variety of experiences in learning and using maths ourselves and that these experiences impact on how we feel about engaging in maths with our children. Also, the teaching and learning methods that we grew up with are different from what our children are experiencing and it might be helpful for us to understand a little more about how children are currently learning in school in order to know what we can do to support them.

Participation in this project will mean:

- Completing a Parent Survey before the workshops commence and at the end of the series.
- Participating in a group interview which will be recorded with consent.
- Attend 6 workshops, or as many as possible, which will be held in the school library on Wednesday evenings at 6:30pm with your child. Workshops will last no longer than 1 hour.
- Engaging in some mathematical activities at home.

If for any reason you find you are unable to attend or decide you no longer wish to participate, you have the right to withdraw at any time.

The interviews will take no longer than 20mins. All information collected in the interviews will be stored in a secure location and only be available for access by the researcher. You have the right not to be recorded if you wish. Any views or opinions expressed in the interviews will be protected, pseudonyms will be used to protect the identity of the individuals in reporting. You have the right not to answer any questions if you do not feel comfortable to do so. All interview data will be destroyed after a period of three years. At the completion of this study findings will be made available to all participants along with an opportunity to discuss the findings and make comment. Findings will also be made available to the Puketapu School Principal and Board of Trustees.

If you have any further questions about this study you are welcome to contact me or my supervisors personally at any time;

Lisa Haenga: Phone 021 367557 or 755 1837 or email lisahaenga@yahoo.co.nz
Supervisors: Dr Glenda Anthony, Massey University 06 356 9099 ext. 84406 or
Dr Jodie Hunter Massey University 06 456 9099 ext. 84405

Appendix F: Workshop Reflections

Reflections Workshop One

Overall, Workshop 1 went really well. Fourteen families attended with a total of 34 parents and kids and two teachers helping out. A few people arrived early, and were clearly a bit uncomfortable with nothing to do, so I put out the 6 numbered dice activity that I wasn't going to use just for something to do while we waited for others to turn up. As people turned up they were all very interested in the puzzle and so I gave out extra sets of dice and people had a go at the puzzle which the all said they really enjoyed.

Then I welcomed everyone and thanked them for having time to talk with me in the interviews the previous week. We then looked at the opening problem which was organising people at tables. As I had rushed the organisation of the problem I basically stuffed it up and should have used a larger number e.g. 29 rather than 22 Immediately there were questions, can we have spare seats, do all the tables need to be fully occupied, one Dad said that doesn't work there isn't a right answer! Anyway, people continued and came up with a variety of solutions, one with four tables off four and one table of six and one table spare. Others had similar four tables of three, two tables of 5

When looking at the solution and responding to the Dad who said it didn't work, I asked him if life was like this problem, there's not always a tidy solution, he happily agreed and said that was true. Later I talked a bit more to him and he was blown away that there could be such a thing as a maths problem that had more than one answer. In his experience maths was the one subject where there was one answer and you could get it right and get 100% on a test.

Next week, I will have an activity on the table for everyone to look at as they walk in the door, prior to welcoming people and letting everyone know what the objective for the evening is.

Also at the end we ran out of time to really look at the ways in which some people and solved various problems, I will try and put a summary sheet together for this and next week make sure that we allow a bit more time for sharing.

Reflections Workshop Two

Last night our workshop focussed on addition and subtraction. Fourteen families attended with a total of 30 kids and parents, and 3 other teachers also attended to assist. We started the session with a simple game on the tables for people as they walked in. The game Train for 2 uses a set of cards 1-10 and player take turns to place a card down on the table keeping track of the total score as each player adds a card. The goal is to make a total of 25. A number of families had indicated the previous week that they enjoyed playing games and cards together, so this seemed a nice way to start addition and subtraction.

This was followed by Maths in My Week, because families hadn't taken many photos and I had trouble accessing the ones on Facebook I simply shared some of my own photos of maths in my week. I asked families to write a maths question that could go with the photos. These included the pile of shoes at the front door, the scooters, bikes and trailer in the drive, the baking on the bench. This went well and I think it will become a regular feature each week. Hopefully next week I will be able to access some more photos that families will contribute. I think it would also be good to maybe give families an opportunity to write down their reflection of maths in their week as there isn't a lot of time for people to share, I might also get families to share in small groups next week. We have created a set of sheets titled with lots of the activities that families said they were engaged in e.g. Biking, watching TV, going to the beach, eating together etc., and I have added all the maths questions that they wrote to go with these activities last week and a few more. I will put these sheets out on the tables for them to keep adding potential maths questions that they might have thought about during the week.

We then looked at a recipe that I had used the previous night to bake cookies for the supper. I had used double the recipe and so I asked the families to work out how much double of each ingredient would be. Families really enjoyed this activity. Lots of different types of measurements were involved including grams, teaspoons, tablespoons, cups of. One of the teachers reported that one of the parents had commented that she never works out how much double of many of the items is, she simply put two lots of the stated amount in, e.g. if the amount in the recipe is ½ a cup she simply uses the half cup measure and measures out ½ cup and then does it again. Families then also had to work out how many biscuits I would have baked if a single quantity was 48 biscuits. I also told them how many I got which was 38 less and asked how they thought that might have happened. When we brought the biscuits out for supper it confirmed as some of them had suggested that I must have made the biscuits too big.

It was a good intro activity, however it took quite a bit longer than I expected to complete and it was 7:00 before we started looking at the problems for the night. The three problems posed represented different types of addition, that it putting it all together, finding the difference, and finding what's left over. Families are enjoying solving the problems and watching how different children were using different strategies to solve problems. I am finding that I my role during this period is to explain to parents the strategies that they can see their kids using, as the kids aren't particularly good at articulating their methods, student explanations tend to be "I just did this, and then this and then this!" while pointing to various numbers.

One of my Mums who struggles significantly with maths herself, commented that she is learning heaps herself, and said that if her teachers had shown her some of the strategies that these kids are learning it would have made so much more sense, "I can do it this way (referring to the strategy), it is so much more logical than the way I was taught". Another Dad also commented that he could see how the kids were getting quite quick at solving problems in their heads and without having to write anything down, he had also been talking to "another guy at work" (which is great that he is talking about our maths

workshops with others!) who had also said that his kids who were a bit older were way faster at solving mathematical problems than he was as he still needed to get out the pen and paper to work things out using traditional algorithms. This dad said that he was really enjoying learning about different strategies and that he had been also using number plates when they were in the car to ask maths questions of his kids like adding up all the number on the number plate of the car in front, or what's the biggest number you can make with the digits on the number plate.

This week I had created a summary sheet of the problems, as stories, a maths sentence, and highlighting the skills needed to solve the problems. This was well received and I will do another sheet to go with last week's session as well.

Overall it has been really nice to see parents enjoying participating in maths with their kids, some of the parents who were feeling really nervous about coming because of their own lack of maths ability were visibly more comfortable this week. It's like an unintended learning outcome for me, I hadn't expected the workshops to be opportunities for parents to improve their own maths skills, but there are two Mums in particular who are really engaging in the learning for themselves. The ability range among the parents in the group is amazing. Two of the Dads are engineers, one with a Maths degree and the other who is currently also studying alongside working in engineering.

Reflections Workshop Three

13 Families attended. So lasts nights focus was on fractions. We started the night with thinking about what portion of time various activities take in our day, e.g. sleeping, working, going to school…. Families made a list of how they spend their day (weekday) and then worked out how many hours out of 24 these activities take, some students/families turned these into visual pie-graphs using a pie with 24 segments shown. Everyone engaged really positively with the activity and it was great to see students and parents working together working out how many minutes various activities like getting ready for school, having breakfast and meals takes we talked about 20mins being 1/3 of an hour, 8 hours sleeping is 1/3 of a day so 2/3's of the day are awake. However, again this activity took quite a long time.

This was followed by Maths in My week. One of the families had shared a picture of their kids sharing crackers for afternoon tea on Facebook, and had posed the question, if [redacted] and [redacted] eat 2/8 of the crackers what fraction of the crackers will be left for the sisters. With permission I shared this photo with the group and we then made smaller groups of about 6-8 to share any other maths that people had noticed or talked about in their daily activities that week. I got the teachers who were present to act as note takers for each of the groups, so that we could get a bit of an idea about what is happening at home. The two families that I spoke to were quite contrasting, one of the Mums said that she was definitely seeing lot of maths happening in her life particularly with baking, but it was usually when the kids were at school, so she didn't feel she had been able to make many connections for her kids, although she had been getting her daughter to work out how long her and her sisters could play at the playground if they had to be home by a certain time. The other Mum said that she had been talking to her daughter lots when she gets home from work about balancing the tills, and how she has to count up all the 10, 20, 50 dollar notes and has been asking her daughter how much will I have if there are e.g. 14x50 dollar notes. They had also been playing monopoly and counting the money in that. From the notes that other teachers took and parents cited talking about pocket money, comparing the cost of various possible birthday presents, time – what time is it now, how long till we need to leave for school, how long have you got to each your breakfast and get ready, adding up the cost of tickets to a theme park in Australia, comparing the difference between children's and adults prices, dividing fruit pieces between two children and how many will they each get. Another family said they were definitely thinking more about the maths around them. One said that they found food the easiest for talking about fractions. Another had noticed that there was quite a bit of geometry in Minecraft, they had also been allocating specific amounts of time for electronics usage. Might need to think about how I can support this a bit better.

Following this we presented a variety of fractions problems, finding the fraction of a set, rates, comparing different sized fractions, all in a sports context. Children and parents are really enjoying the problems, and teachers also commented that people are really enjoying solving the problems together and working with the teachers. Parents are really interested in the way children are solving the problems.

Parents were give a summary sheet of all the problems and various ways of solving them, and the skills that are needed to solve the various types of problems. One Mum said that it was really good have a summary of the problems because it meant that she could ask similar types of problems at home. One of the boys and his Mum said that they were going to be watching the Fifa World Cup soccer over the weekend and would be keeping a record of attempts at goal and successes… and that that would be something that would be really interesting for them to keep a record of at their own sports matches over the weekend.

Reflections Workshop Four

Last night's workshop focussed on Place Value. We had a slightly smaller group last night. Nine families attended and there were a number of apologies for sick kids, there has been a tummy bug going around!

The evening started with a Place Value game, using a pack of cards and a place value mat with ones, tens, hundreds, thousands, players take a card from the pack one at a time and place it on their mat, once the card is place it can't be moved, highest number for the round wins. Although this game doesn't immediately replicate an everyday maths experience I was having trouble finding a fun game that would meet the Place Value brief. A number of students said that they had played this game in class and were very happy to be showing it to their parents, all groups enjoyed playing the game and were able to read the numbers out and decide who had the biggest number and keep a score for their group.

This was followed by a Maths in my week sharing time, some technical issues with Facebook this week meat I couldn't get any family photos to share. I had a photo of a car number plate, ***979, and asked how people thought we could use number plates as a springboard for maths activities, suggestions included, adding all the numbers up 9+7+9 or 979 and how much more makes 1000, 97+9 , what is the biggest number you can make? 997, families then were given a sheet to record their activities over the week.

[redacted] and his Mum had been at the Fifa U20 world cup and had had a discussion about how many adults and children might have been in the stadium, they knew that there were 8585 people there, what if half were children, what if 1 third were children how many children and adults would that be, also how much money would have been collected through ticket sales. [redacted] had worked out what fraction of the goals [redacted] had scored at her netball game over the weekend (this was great as it demonstrated use of a question that had been modelled last week), [redacted] had finished reading a book and had worked out that she was averaging 17 pages per reading session. Amy had been shoe shopping and had had to find shoes that fitted into the budget. The [redacted] family had had discussions about the PreP programme that was happening in Daniels class and the mini-business that his group was running, Dad had added to the discussion in terms of how he has to pay wages to staff in his business and so does [redacted] Mum who also runs her own business, also talked about estimating, and pricing items for sale. The Murrays had been looking at how the numbers were allocated on the back of the Rugby players jerseys, there daughter was also involved in the PreP programme and had had to purchase some items for this. The [redacted] family had won a block of chocolate at an event over the weekend and had worked out how many pieces there were by multiplying the numbers and the rows and then how many pieces each family member would get. The kids had played soccer and had worked out how many goals had been scored altogether if they had scored 10 and the opposition had scored 8, that made 18 altogether and they had won by 2 goals.

I felt that families were starting to engage their kids more this week in the maths that they could see happening around them, and parents seem to be feeling good about doing it, this is definitely a shift from last week when I was starting to wonder if I was approaching this whole project in the wrong way!

Reflections were followed by an interactive group activity, I passed out some large sets of digit cards, and we had an inter group challenge to make the biggest number, the smallest number (only two decimal places allowed), a number between 50-60,000. This was a nice light hearted way to move back into the maths. I gave families a very short 30second briefing about looking to see how they

could use Place Value, ten times bigger, ten times smaller, as they solved the problems for the evening. The first problem was At the Lotto Shop, which one of the families Mums works at, and I had posed questions about how much there would be in the till if there were various numbers of $10 notes, $100 notes, or how many $10's or $100's there would be if the till had $3650.

The second question involved making meat patties for the school gala, each patty weighed 100g, how much mincemeat will we need to make 10 burger patties, 100 burger patties, or 50 burger patties. Then what would the profit be if we make $2.50 off each burger.

The final question was determining which car would be the best buy in relation to the odometer reading. Four different odometer readings were given to order from smallest to largest, the boys liked this activity. I was also posed that if the trip metre read 29.8kms and if after going to town and back it read 38.9kms, how far is the trip to town and back.

I added two at home challenges for families to try this week, based on how I had been feeling at the end of last week's session, and wondering if I need to give more support/direction in regard to where to look for opportunities at home for maths talk. One was comparing heights and how much more will I need to grow to be as tall as Dad, or Mum or the tallest person in our house. The other challenge was to record their family car odometer reading at the beginning and the end of the week and work out how many kilometres they travel in a week. It will be interesting to see if any families use this opportunity or if they pursue their own ideas.

We only have two workshop sessions left, next week the plan is to look at how we can use games as opportunities for maths discussion/rehearsal. Different ways of using dice etc… Some reading to do around this as I decide what games to choose.

One of the particularly successful aspects of the workshops so far I think has been the opportunity for relationship building both between teachers and parents and between groups of parents who have children in the same classes in the school. I always felt that we had a strong school community, however I can see that the sense of community is improving even further which is really nice.

Reflections Workshop Five

Workshop 5 was all about engaging in maths through games. 12 families attended the workshop, 33 parents and children plus, four staff members and myself, so a total of 38 people. There apologies from two families and two others didn't attend.

Because the focus for the night was maths through games, we didn't have a game type warm up, but simply started with "Maths in my week" reflections. The [redacted] shared that maths for them this week had involved baking scones and measuring ingredients. Also time management, they had had a busy week and had had to be very conscious of time so that they could get everything done! The [redacted] had had pizza one night and had talked about the fraction sizes of the slices. [redacted] had wanted money to buy something for $23 and they had negotiated a range of jobs that would pay him that value of money. Also there had been some maths talk around the sports scores that week, and point scoring at the BMX track, at the grocery store, and baking biscuits. The [redacted] had discussed the homework problems that [redacted] had brought home, also she had been practising kicking soccer goals and so they were scoring 3points for every goal so that she could get better at her three times tables. The [redacted] had been talking about some of the measurement that [redacted] had been learning about in class, (this is the first time a family had mentioned talking about the learning at school in maths at home). Also how many books she could read/issue from the library. Mum had baked cupcakes, how many cupcakes there were in the trays. They had also been comparing ages, how much older or younger people in their family were. The [redacted] had discussed a headlining article that had appeared in a local paper about a local girl who had designed the "kindling cracker" and how much money she the designer would make if she sold x number of devices. [redacted] said that he had been checking the speedo in the car and noting the distances travelled– this was a question from last weeks workshop. There had also been other discussions in their family about time, pocket money and speed limits. The [redacted] said that most of their maths discussion had been at the supermarket – comparing prices of different branded items.

Following reflections, it was straight into the games. All the games for the evening were based on games that could be played with a pack of cards, or dice, or no equipment at all. No games involving special boards or equipment were used as I wanted all the games to be games that could played simply with what people had at home. Also many of our families had reported that they enjoyed playing card games at home so it was good to build on something that many of them already enjoyed doing. Our first game, was Cards make 20 a game that I had designed for my ALiM kids who were struggling with basic facts, similar to Numero. This was followed by two games from P. Swans book Cards on the Table (2005). We then played the dice game Cross-Out, numbers 1-12 and finally the maths version of Paper, Scissors, Rock, from NZ maths which people thought was great.

I was particularly impressed with the patience that [redacted] Mum demonstrated when playing a game with her daughter, she was really supportive in helping her work out the problems, and I could see that [redacted] was really responding to the positive encouragement from her Mum.

After an hour of gaming, we had a quick summary of why games are a worthwhile mathematical activity, how they do constitute work, parents agreed that they couldn't count the number of problems that they would have solved in the time we had been playing games and it was a much better way of rehearsing than by doing mindless worksheets. It was great to see parents agree with this idea and connecting games with learning, also cards appeal across generations, and cultures, they offer an opportunity to; work in an interactive way, rehearse with the support of other more skilled players, develop communication and reasoning skills. Also because you have to play the hand you get dealt, even if you're not the most skilled player you still have a reasonable chance of winning.

We finished with supper, chocolate cake and hot drinks and quite a few people hang around chatting till about 8:00. Lots of families took copies of the game instructions home with them, so a good night, one left to go!

Reflections Workshop Six

Workshop 6 was about connecting maths to literature and the other curriculum strands, and how to access these opportunities at home in our everyday activities. It was also the final workshop and a celebration of what we had explored together as a group. 13 families attended including 34 Parents and children along with the Principal and DP, 3 teachers and myself, making a group of 40 people at the session.

We started the evening with a game that we had run out of time for the previous week. The game was similar to the commercial BLOCKUS game played with two dice and a piece of grid paper. Players take turns to roll the dice and form a multiplication array and cover the number of squares as indicated by the dice, the player that covers the greatest area of the page wins. The game relates to the geometry and measurement (area) part of the maths curriculum and was relevant as the Yr5/6 students are working on a measurement unit at the moment in their classrooms as well.

We then had our weekly Maths in my week reflection time. Reflections included playing paying board games, Monopoly and Game of Life at home, questions about the Fifa world cup and how many goals had the top team scored over the whole competition, which team had had the fewest goals scored against them, Sudoku and baking. Another group shared that they had had 3 dozen oysters to share between 4 people and how many would each person get. They had also unfortunately burnt the bread by baking it for 13 hours instead of 4 and worked out how many hours too many that was in the oven, 9hrs!! Another family had been using Letterboxes for skip counting in 2's, counting up card game scores, paying dad for some crayons, checking the time and playing monopoly. A further family had said they had been using their maths at netball, also playing games, baking, raising money for camp, school homework, and they had used maths in some activities they had been doing at youth group. The green felt pen family said that they had played lots of games from last week's workshop, also maths homework sent from school, they had had a BBQ to raise funds for a church activity selling 230 sausages at $2 each and raising $460 dollars, drinks were a $1 each and 24 of those had also been sold making a total of $484 altogether. My favourite reflection for the evening was from the girls who are learning music and said that they had been counting and using maths in the time values of the notes in their music, two quavers are equivalent to 1 crochet and there for are twice the speed. They had also been talking about the measurement that they had been learning in class.

We then went into our main activity for the evening, which was relating maths to literature, measurement and statistics. The story posed was that a person of giant sized proportions had left a number of footprints around the venue. Police were trying to put together a description of the person and needed help to work out the height. Families picked up the 'footprints' and began exploring and discussing how they could work out the height of the mystery giant. Very quickly people began checking their own foot lengths using tape measures provided and measuring their height at the various stations around the room that had been set up. Feeding back as a whole group it was decided that they giant could be anywhere between 3.5m and 4.5 metres. The difference being that the ratio of foot lengths to height varied depending on the ratio of the person finding the solution. As a whole group

we then put hands up to find out what was the most common ratio, (connecting to Statistics). We had established that the range was between 5 and eight foot lengths. When hands were put up to show individual ratio's it was clear that 6 was the most common ratio. I then shared a description of Roald Dahls BFG who is 24 foot tall, and told people that they could convert this to centimetres/metres by multiplying the number of feet by 30 (30.48 for those who wanted to be exactly accurate). A further question was posed, if we know the height of the BFG, and we know what the average ratio of foot lengths to height is, how we could use this information to work out the foot size of the BFG. One of the dad's showed me his short division method to solve the problem 720cms divided by 6 foot lengths giving a foot length of 120cm or 1.2m I had talked through the problem with his son who didn't understand Dads method, we had solved it by working out that 600÷6 is 100 and then 120÷6 is 20 so the same 120cm, we had a short discussion about the two methods and that yes we still teach and use short division, yes it's ok to show your son how you use this method. Which tool/method is not so important as long as students has a tool that they feel confident to use.

To round everything up, as we were all out of time by now, we then discussed what opportunities there might be to connect to statistics in our everyday experiences, e.g. Black SUV's seem to be really popular at the moment, we could check by counting up 10 oncoming cars that pass us on our next outing, to see if this is true. I also suggested that statistics can be really helpful when your children tell you they need something because 'everyone else has one', (like cell-phones).

The school principal then thanked everyone for the participation and attendance in the workshops and expressed his support for what we had been doing. I reiterated these comments and again affirmed parents as being significant and valuable contributors to their children's education, what they do does make a difference. We then indulged in sticky date pudding, with ice-cream and cream, cupcakes, milo, tea and coffee, and general chit chat with the last people leaving around 8:10pm a good 40mins after we had finished the programme.

Reflecting (very loosely) on the workshops overall, I think that four workshops + the introductory session and survey is enough. Looking at the rate of attendance 14 out of the 18 families that we connected with came four or more times (8 families came 4 times, 2 came 5 and 4 came to all six workshops). In saying that however, two families asked if there was going to be any more at some stage, which was very positive. It has been a great learning experience for me and very successful in terms of building relationships with families and getting to know parents better, some of whom we don't see at school very often at all. In saying that however, only 4 of the families who attended could be described as having a weak/minimal relationship with the school through other activities. The other 14 families are engaged with the school in a variety of other roles which also confirms the value in ensuring that parents have lots of different ways to make those connections. It follows that the more that families are connected to school the more comfortable they feel in getting together to engage with opportunities like workshops and develop skills that can be connected to classroom learning.

It will be interesting to see what comes out of the follow up surveys and interviews! What parents feel has been successful or made a difference for them.

Appendix G: Parent consent to participate

Consent to participate

I have attended an information evening OR read the information sheet and understand what this study is about.

I have had the opportunity to ask questions and know that I can ask further questions at any time.

I agree/disagree to participate in the study and do so on a voluntary basis.

I agree/disagree to the interview being video recorded.

Parent Name: _____

Parent Signature _____

Date: _____

Enquiries: Lisa Haenga lhaenga@yahoo.co.nz or 021367557

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

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Dr Brian Finch, Director (Research Ethics), telephone 06 356 9099, ext86015, email humanethics@massey.ac.nz".