ENHANCING THE INVOLVEMENT OF PARENTS IN THE MATHEMATICS EDUCATION OF THEIR ELEMENTARY SCHOOL CHILDREN

by

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ABSTRACT

An emergent construct in modern education is the recognition by educators and policy makers that involving parents in the education of their children is an important matter. This is clear in the policies of the British Columbia Ministry of Education and the efforts of educational leaders internationally which aim to create conditions, attitudes and supports for parents to become more instrumentally involved in schooling. The object of this study is to clarify how a principal can increase effective parental involvement in learning at home. The curricular area of focus was intermediate level mathematics.

Parents were invited to attend two workshops with the goal of promoting increased parent knowledge and comfort with mathematics as taught in contemporary classrooms in the Lower Mainland of British Columbia. Survey and interview data helped to build the profiles of attitudes, beliefs and practices of four participants selected as case studies. The resulting profiles combined with a comprehensive literature review helped to answer three research questions: What difficulties do parents express with respect to their involvement in mathematics? What is the effect of attending parent workshops about supporting students in mathematics? What gives parents confidence and motivates them to be involved?

Results revealed a greater understanding and acceptance of change and a willingness to engage with their children and their homework at a deeper level than before the workshop experience. There were subtle, yet notable, shifts in understanding of curriculum change and the education system. Since reform-minded educational leaders seek first to prepare the community in a way that facilitates change, these subtle shifts may be significant. The time limitations of this study prohibit comment on long-term effects, which points to the need for further research on the effect of parent attendance at curriculum-related workshops.

Keywords: Parental involvement; elementary mathematics; leadership; role of principal; educational reform; educational change

I dedicate this dissertation to

principals and all educational leaders

working to enhance partnerships with parents

for the good of children.

May these humble findings enhance your endeavours.

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CHAPTER 1.

INTRODUCTION

1.1. Introduction

This dissertation is about principal leadership in the area of parental involvement with curriculum. As an interpretive research study, it seeks to understand the effect of workshops on parents' involvement in their children's mathematics education. It examines the leadership role of the principal with respect to the complex phenomenon of lay involvement in a curricular area that poses challenges for many. It seemed productive and timely to link the research on parental involvement with that of curricular reform in mathematics in an effort to leverage the efforts of both principals and other leaders in education in the area of parental involvement. In this chapter I outline the key terms, context, purpose and significance of the study as well as the research questions, limitations, delimitations, researcher background and plan of the dissertation.

1.2. Definitions

Parent. In this study the term is meant to include all adults who play guardianship roles in a child's life. Epstein prefers the term 'School, family and community partnerships' in lieu of 'parental involvement' to recognize that parents, educators, and others in the community share responsibility for students' learning and development (Epstein, 2001).

Elementary Level in this study means kindergarten to Grade 7.

Intermediate Level in this study means Grades 4 to 7.

Numeracy refers to the application of mathematical understanding in daily activities at school, at home, at work, and in the community. It involves both using mathematical skills and knowing how mathematics can be used to solve problems. Just as there is more to literacy than teaching the rules and

> procedures of language, there is more to numeracy than teaching the rules and procedures of mathematics. Numerate individuals not only "know" mathematics, but also understand it in personally meaningful terms. They feel competent and confident about their ability to draw on the necessary knowledge and apply it in new and relevant ways (British Columbia Ministry of Education, 2010).

Mathematical Literacy. "Mathematical Literacy is an individual's capacity to identify and understand the role that mathematics plays in the world, to use, apply, analyse, process, interpret and communicate mathematical information, and solve problems involving that information in ways that meet the needs of the individual as a constructive, concerned, reflective and involved citizen" (McAskill, Holmes, Francis-Pelton, & Watt, 2006, p. 62).

This study uses the terms numeracy and mathematical literacy interchangeably in an effort to equate the terms and promote a common understanding of their meanings.

Mathematics. The *Princeton Companion to Mathematics* (Gowers, 2008) begins with this statement: "It is notoriously hard to give a satisfactory answer to the question, 'What is mathematics?' The approach of this book is not to try. Rather than giving a definition of mathematics, the intention is to give a good idea of what mathematics is by describing many of its most important concepts, theorems, and applications" (p. 1).

The *Princeton Companion to Mathematics* (Gowers, 2008) contains 1,034 pages not trying to define mathematics but classifying it in various ways for mathematicians. The definitions of numeracy and mathematical literacy above are not the whole of mathematics. Other subsets include: algebra, number theory, geometry, algebraic geometry, analysis, logic, combinatorics, theoretical computer science, probability and mathematical physics (Gowers, 2008). For this study I restrict the definition of mathematics to the one used in the British Columbia curriculum documents. For the purpose of defining mathematics as experienced in a kindergarten through Grade 12 curriculum, it is sufficient to know that mathematics is divided into two aspects: a collection of topics and a set of processes. The topics are number, patterns and relations, shape and space and statistics and probability. The processes are

communication, connections, mental mathematics and estimation, problem solving, reasoning, technology and visualization. These two aspects are woven throughout the curriculum and call for improved numeracy skills.

1.3. Research Context

Admitting a weakness in math may be comparable to saying 'I can't drive a standard car' in that the social stigma is not terribly condemning. Whether this is because, as a society, we do not value mathematics enough is a matter of speculation. However, the experts echo this common reaction towards mathematics in the research:

> Too many Americans seem to believe that it does not really matter whether or not one learns mathematics. Only in America do adults openly proclaim their ignorance of mathematics as if it were some sort of merit badge. Parents and students in other countries know that mathematics matters. (National Research Council [NRC], 1989, p. 76)

The phenomenon seems to afflict North Americans in general. Speaking at a math conference in 2003, university mathematics professor Peter Liljedahl said:

> We live in a society that has infinite tolerance for innumeracy. It is accepted (and even expected) that our children are going to struggle with mathematics. It has become a cultural norm. (Zazkis & Liljedahl, 2003, Conference Programme, Abstract)

Mathematics has generally not received the same public attention as reading with respect to parent involvement. In a study of 234 parents, participants reported that they had chosen to teach their child about reading rather than math (Drummond & De Stipek, 2004). This preference likely has more to do with a belief that parents lack with respect to their own mathematical proficiency rather than a belief that reading is more important than mathematics. Studies have shown that parents' sense of efficacy can affect

involvement (Eccles & Harold, 1996; Hoover-Dempsey & Sandler, 1997). Nonetheless, the result is the same—not enough emphasis placed on mathematics.

From where might these negative beliefs about mathematics originate? Negative beliefs come from the same place as many beliefs. In *The Activities of Teaching,* Green (1971) explains that beliefs always come in groups—in systems. There is a logical organization of beliefs, with some beliefs deriving from other beliefs or attitudes. Vygotsky (1978) also supports this notion that our beliefs and understandings are socio-cultural constructs. In the example of parent-child collaboration, the child may observe and emulate the adult thereby gaining proficiency. When working together, the parent and child will sometimes discover new ways of thinking about a problem that one or both of them might have overlooked had they attempted it alone.

A report by McAskill et al. (2006) reviews Vygotsky's social cognition learning model and asserts that "culture is the prime determinant of individual development…including the culture of family environment" (p. 34). This Vygotskian idea that beliefs are socio-cultural constructs can be illustrated by recalling some of the many components of a learning culture and their impact on the learner. If an individual has experienced a negative learning environment, it stands to reason that their beliefs about learning will be adversely affected. They will perhaps not value the content or the process of the learning and often the two will be so intricately linked in their belief system that the *way* they were taught a certain subject will influence the value they place on the content and the discipline itself. This is, regrettably, the experience of many with mathematics.

Fortunately, belief systems can be altered. Gardner (2006) has identified several factors that aid in mind changing. One of these factors relates to the affective component

of the idea or material to be learned and alludes to the way something is taught and may be strategically leveraged in the parent-child relationship. A child normally has trust and comfort with a parent or other caring adult and this may make learning more palatable or even enjoyable. Principals can strategically foster this in matters of instruction at a time in the child's development when they are more receptive to change and when parents or caring adults are still influential and involved in a 'hands on' way.

1.4. Purpose of the Study

If Canadian students are going to do well in mathematics, a sense of urgency and purpose needs to be directed to changing the pervasive cultural complacency towards learning mathematics. Due to the influence of social contexts, I propose that focusing on the microcosm of culture that is the family is an important vehicle to stimulate such an ideological shift (de Abreu, Bishop, & Pompeu, 1997, p. 233). The sustained intervention of interested and committed parents and educators, who are willing to learn and value the discipline and its processes, can create a positive experience of learning and influence beliefs towards mathematics. If this happens consistently at the family level, societal beliefs towards mathematics will eventually shift. More people are likely to value the learning of mathematics.

Success with involving families in a learning process to build their confidence and give them useful strategies in a particularly challenging area such as mathematics points to its replicability with other subject matter. The aim is for interested parents and care givers to learn and value disciplines and their associated ways of knowing and learning them. Partnerships between school and home invite this sustained effort.

The importance of family and the wider community is underscored by Comiti and Ball (1996), who emphasize that students will only value belonging to a mathematical community if the wider community culture values mathematics. I suggest that promoting a belief such as mathematics is useful, essential, or worthwhile requires an educative effort that is societal in intent yet familial in scope. Having access to students, parents/guardians and teachers affords principals the opportunity to play a crucial role in that effort. Establishing a clear focus on student learning is what successful schools and principals do (Cotton, 2003).

In this climate of accountability, principals are being held responsible for improving academic achievement for all the students they serve. This research contributes to the ways principals might choose to embark upon this challenge. With the myriad of expectations placed on principals today, it is important to be judicious about where one places one's efforts. While we have known for a long time that there is a significant and positive relationship between parents' active participation in their children's learning and the children's academic performance, principals need to know specifically what the involvement consists of, how to effectively facilitate it and the details of what meaningful 'parent outreach' to support academic achievement looks like. This study seeks to illustrate principal leadership as it finds expression in how parents are involved in supporting student learning.

1.5. Research Questions

The overall research motivation posed is: How can elementary school principals design a parent workshop that engages parents to effectively support improved learning at home? The three specific questions that I will answer are: What difficulties and

disagreements do parents express with respect to their involvement in mathematics? What is the effect of attending parent workshops about supporting students in mathematics? What gives parents confidence and motivates them to be involved?

1.6. Significance of the Study

Levin (2008) outlines a practical approach that this study hopes to take with respect to principal leadership:

> School leaders, along with most teachers, work hard for long hours. If we are going to ask them to change what they do, we have a responsibility to help them see *how* they can actually do that, given what they take to be the realities of their jobs. (p. 5)

In practice, principals balance many competing demands and knowing *how* to be most effective and efficient can be a significant challenge. I suggest that one way to be more effective is to harness the powerful influence of parents, which has proven to be a significant factor in student achievement generally and mathematics achievement in particular. One study found that "23% of the variability in student math achievement is explained by the significant variables of parental influence" (Wang, Wildman, & Calhoun, 1996, p. 395). Parental influence is a significant factor in mathematics achievement. However, recent findings have revealed that teachers (and, presumably, principals as well) need more knowledge about how to effectively engage parents:

> The vast potential afforded by this rapport and daily communication is too rarely put to use by involving parents in promoting children's learning and development at home, or even sharing with them much about what the child is learning and doing in the program, in mathematics, for instance. As for promoting children's enthusiastic engagement with math, parents are almost never used as a resource. (Bredekamp quoted in Clements, Sarama, & Di Biase, 2004, p. 77)

This quote seems to be corroborated by Eulina and de Carvalho's (2001) study, which indicates that teachers and parents tend to have negative stereotypes about each other. At the very least, there is often hesitation to address parental involvement in a meaningful manner. The principal, as leader of the school community, has the opportunity to act as a bridge between the teachers and parents and find ways to facilitate and indeed expect more meaningful parental involvement. While many administrators 'talk the talk' of engaging parents as partners in education, they "typically manage parent involvement in conventional ways that support the school agenda and contain parent participation, acting as a buffer rather than a bridge to the community" (Auerbach, 2007, p. 9). We know little about how administrators actually 'walk the walk' of promoting family engagement. A study of parental involvement in intermediate mathematics is important for several reasons. This study contributes both to the scholarly research and literature in the field and may also serve to improve practice. Understanding relationships among educational leaders and parents of students can help to reveal the underlying reasons why parents choose to be involved in the school or not; and what gives parents confidence and motivates them to be involved. Although we have known for a long time about the significant and positive relationship between parents' active participation in their children's learning and the children's academic performance, this in no way attenuates the significance of this study. Principals need to know specifically *what* this involvement consists of, how to effectively facilitate it and the details of what meaningful 'parent outreach' to support academic achievement looks like. Success with this process in a particularly challenging area such as mathematics points to its potential replicability with other subject matter.

In the area of mathematics education, there are few attempts to involve parents in their children's mathematics learning (Epstein & Dauber, 1991; Peressini, 1996,

1998). Other researchers also express this dearth of information regarding supporting parents as learners about reform-oriented mathematics education (Remillard & Patrickson, 2006; Civil, 2001; Civil & Bernier, 2004; Civil, Guevara, & Allexsaht-Snider, 2002; Lubienski, 2004). While this study aims to offer a method for schools to effectively engage parent involvement, it also contributes to an area of academic literature that is under-represented. As such, this study aims to make a contribution to policy, professional practice and academia by illuminating an area of principal leadership related to parental involvement and curriculum.

1.7. Limitations of the Study

This study confined itself to interviewing and observing parent participants in two workshops held at the elementary school at which I am principal. The purposive sampling procedure—the parents chose to attend the workshops and to be involved in the study—decreases the generalizability of findings. However limited in number the case studies, they nonetheless provide insight and valuable information. A study of even one case can provide insight into experience. Since the parents interviewed have children at the school at which the researcher is principal, the collection of data, through surveys, interviews and observations may have been affected by the positional authority of the researcher.

That the principal was the researcher is a limitation of the study insofar as the researcher cannot be construed as objectively neutral and participants are quite likely to have been influenced by the presence of the school leader. The researcher-principal in this study is not a detached observer but a participant in the multiple realities presented by the interaction of participants, workshop facilitator, videographer, materials and

processes. Admittedly, the principal-as-researcher in this study is not an external agent but a supporter of collaborative engagement processes leading towards deeper understanding. While neutrality and objectivity may have been compromised, the design in no way detracted from the fulfillment of the study's purpose.

Though this study included the expertise of a facilitator and math consultant, the varying levels of expertise that can be expected from presenters of workshops on various curricular subjects would also limit the generalizability of findings. It is not expected that findings be generalized to populations, though they may be informative for researchers and educators in similar settings (Merriam, 1988).

The findings from this qualitative study could be subject to other interpretations. As the researcher "filters the data through a personal lens that is situated in a specific socio-political and historical moment, one cannot escape the personal interpretation brought to qualitative data analysis" (Cresswell, 2003, p. 182). The presence of an observer video-recording the workshops may have been intrusive and limited the rapport, responses and interactions among participants and with the presenter. Though there are limitations, the study provided access to issues of more general and enduring interest such as the leadership role of the principal to create opportunities for parent involvement.

1.8. Researcher

Given that Cresswell (2003) emphasizes the impact and inescapable influence of the researcher in a qualitative study, it is useful to explain to readers who I am and from where I approach this topic of leadership in parental involvement in the curricular area of intermediate mathematics.

Mathematics has always been a challenge for me. As a student, I received tutoring in Mathematics 11 and Algebra 12 to enable me to be successful in these requisite courses for university entrance. Later, as a teacher, I taught humanities and French courses. When I began to teach in the area of Learning Assistance, I realized that I could no longer avoid having to deal with mathematics. I soon learned that many of my students struggled in this area. I was open with my students about being only *one step ahead of them* or having to work out problems with them without knowing exactly what I was doing. It was professionally humbling not to be the expert and yet I believe the process helped both my students and me. In meetings with parents, I realized that I could encourage them to engage in mathematics with their children by emphasizing process, suggesting manipulatives and adapted resources.

Ten years into my career, I began working as a consultant at the school district level and one of the groups I facilitated was a secondary school mathematics teachers' network. As I listened to the discussion of teachers who were providing a range of mathematics courses from 'challenge' or advanced courses to 'adapted' and 'modified' ones, I was duly impressed by these educators' willingness to make mathematics both more accessible and enjoyable. Their sincere love for mathematics intrigued me. I remember one teacher speaking about the beauty of patterns and his work with the art teacher at his school to develop a tangram project for his students. Another teacher demonstrated the use of a graphic calculator and discussed how she uses technology in her classroom. This was not how I remembered mathematics as a student and was not how I had ever thought of it until then. It was clear to me that, in the 17 years since I had left high school, much had changed.

Another role I enjoyed as a consultant was giving workshops for parents about how they could help their children do well in school. The workshops focused on study-skills and helpful strategies for parents. I repeatedly heard about parents' insecurities with respect to mathematics. Consequently, I focused the message at the workshops on the importance of process and being patient with themselves and their children. Once again, it was further emphasized how much education had changed since these parents, many of whom were my contemporaries, had been students themselves.

My workshops included a comparison of what they remembered from their own schooling experience to what their children are experiencing in today's classrooms. Parents who had grown up in another country had even more pronounced differences with which to contend. The message I had tried to present to parents at those workshops really struck a personal chord when my daughter, as an intermediate aged student, started bringing home more complex mathematics problems. It was then that I personally realized the importance of my earlier message to parents about process and patience! I was determined not to pass on my 'math phobia' to her and wanted her to enjoy the process while meeting the expectations.

Evidence that I had managed to avoid passing on my phobia and that my daughter actually enjoyed the process came when, in answer to my question "What are you looking forward to today?" she answered, "math class!" This was truly a revelatory moment for me, and one I secretly celebrated with a sense of awe. When I became principal of an elementary school that is focusing on mathematics as an area of school growth, I decided that, whatever topic I chose to research for my doctoral dissertation, it would be mathematics related. I also wanted to integrate my 18 years of varied

experience as an educator and consequently wove elements of my interests in leadership, parental involvement and mathematics into the current study.

1.9. Plan of Dissertation

In this chapter, Chapter 1, I lay the foundation of the study by outlining its context, purpose and significance as well as presenting the research questions and limitations of the study. Chapter 2 is a literature review including related studies from the last 30 years. The review describes how educators can increase effective parental involvement in learning at home, the challenges faced by educators and parents in this regard and what the research says about the effect of parental involvement in general. In Chapter 3, I explain the methodology used in the study and outline the parameters for the collection, analysis and presentation of the data. Also identified in this chapter are strategies to verify the validity and reliability of the findings.

Chapter 4 details the findings of the study. This chapter is organized around the overall research question: How does a principal increase effective parental involvement in learning at home? The analysis of each case is presented in Chapter 5 in response to three questions derived from the overall research question: What difficulties and disagreements do parents express with respect to their involvement in their own child's learning? What is the effect of attending parent workshops? What gives parents confidence and motivates them to be involved? Chapter 5 also presents a discussion and includes conclusions, implications for further research and suggestions and considerations for elementary principals. A reference section of works cited follows chapter 5. Appendices contain the pre and post surveys, interview protocol for case

studies, participant perception of the impact of workshops, sample logic model for a districtwide family engagement strategy and resources for parents.

CHAPTER 2.

LITERATURE REVIEW

2.1. Introduction

In this chapter, a literature review of parental involvement focuses on learning at home and includes related studies covering the last 30 years. The review presents the literature related to five topics that are critical to enhance increased parental involvement in learning at home. The first is a review of the relevant literature concerning parental involvement. The second describes the role of principal as an instructional leader. The third considers ways the principal can overcome the challenges and increase parental involvement with learning at home while the fourth topic addresses what parents and educators need to know about numeracy development. The fifth topic outlines the challenges faced by educators and parents with respect to the involvement of parents in their children's learning at home.

A role of the principal is to facilitate parental engagement and is deeply grounded in society's expectations of the education establishment. This finds expression in the policies and practices of schools pertaining to communication and reporting as well as practices such as 'meet the teacher night', parent-teacher interviews and parent signing of student planners. What can be conceived of as innovative in this arena of parental involvement in 2010? The plethora of literature on the topic is resounding in establishing the importance of parental involvement. There is however, less written on effective procedures and practices for engaging parents and "only 20% of education college deans surveyed considered their administrative graduates well prepared to work with

families (Epstein & Sanders, 2006, p. 81). This research is germane in that it seeks to identify the quality control elements of one aspect of working with families—that is, the parent workshop, and to guide principals in the area of parental engagement with student learning at home.

2.2. Effective Parental Involvement

Parental involvement is a term that has multiple dimensions and, while much has been written related to the topic, two leading theories of parental involvement have shaped the field (Epstein, 1987, 1991, 1995; Hoover-Dempsey & Sandler, 1995, 1997). Epstein (1987, 1991) proposed six major types of family-school involvement that may influence children's educational outcomes (Table 1). Researchers often cite Epstein's work when categorizing different involvement practices and behaviours.

Table 1. Epstein's Six Categories of Parental Involvement

1. Parenting Help families with parenting skills by providing information about children's developmental stages/home environment considerations to support children.
2. Communicating Communicate effectively with families about student progress, school services and programs, and also provide opportunities for parents to communicate with school.
3. Volunteering Find ways to recruit and train volunteers for the school and classroom. Try to accommodate parents' schedules to maximize support for students and programs. This category also includes opportunities for parents to attend events at school in which their children participate.
4. Learning at Home Share ideas with families to improve students' homework strategies and other kinds of at-home learning, and provide information about the kinds of skills students are required to learn.
5. Decision Making Include families as partners in school decisions. Recruit members for school organizations, advisory groups and committees.
6. Collaborating with the Community Create 2-way connections between the school and community that encourage businesses and other groups to take an interest in schools and offer students and their families' ways to contribute to the well-being of the community.

In contrast to Epstein's typology, Hoover-Dempsey and Sandler's theory (1995, 1997) emphasizes psychosocial constructs that are related to parental involvement and student outcomes. Their perspective of parent involvement addresses why parents become involved, how they choose various types of involvement and the positive influence of this involvement. It identifies the importance of parent attitudes, feelings and behaviours thereby demonstrating their own valuing of education. The current study takes a multifaceted approach to parent involvement with their children's learning of mathematics. It draws on both Epstein's (1987, 1991) and Hoover-Dempsey and Sandler's (1995, 1997) understandings of parental involvement in an attempt to look at both behavioural and psychosocial dimensions and how these may be influenced by attending workshops designed for parents.

Why would parents go to the extra effort of being a link between teacher and student in mathematics? The research concerning parental involvement in education is extant in confirming that positive involvement of parents in their own children's learning is well worth the effort. As mentioned earlier, parental involvement in literacy—for example daily reading to and with children—is widely accepted. Why not the equivalent parental involvement in math? And, how can involvement in this important area become as widely accepted? The parental involvement research supports this need.

An abundance of research spanning the last quarter century has shown parental involvement to be correlated to student achievement, lower drop-out rates, positive attitudes toward learning, better parent-child communication, improved behaviour and enhanced community support for schools (Chiu & Xihua, 2008; DePlanty, Coulter-Kerr, & Duchane, 2007; Englund, Luckner, Waley, & Egeland, 2004; Friedel, Cortina, Turner, & Midgley, 2006; Henderson & Berla, 1994; Hill & Tyon, 2009; Hong & Hsiu-Zu, 2005;

Jeynes, 2005; Jung-Sook & Bowen, 2006; Liontos, 1992; McBride, Schoppe-Sullivan, & Moon-Ho, 2004; Renihan & Renihan, 1994; Rich, 1985; Sarason, 1995; Sheldon & Epstein, 2005; Stein, Goldring, & Zottola, 2008; Swap, 1993; Wenfan & Lin, 2005; Wilson, 2009). Parental involvement can significantly contribute to the goals of educators and a combined approach can expedite more positive results.

While there is research on the effects of parental involvement at school, there is less research on parents' home-based involvement. Pomerantz, Moorman, and Litwack (2007) define *home-based involvement* as that which includes parents' practices related to school that take place outside of school, usually, though not always, in the home. The research that has been conducted has conflicting and ambiguous findings, which serve only to confuse even the most well-intentioned educator—be it classroom teacher or principal. Several studies have surprisingly revealed that parents' assistance with homework is associated with *poor* performance in school (Chen & Stevenson, 1989; Cooper, Lindsay, & Nye, 2000; Georgious, 1999). These results did not hold true for students struggling in school. When their parents intervened, they benefited (Pomerantz & Eaton, 2001). Other studies have shown the positive effects of parents' involvement at home with respect to children's academic functioning (Hickman, Greenwood, & Miller, 1995; Hill & Taylor, 2004; Kurdek & Sinclair, 1988). The inconsistency and ambiguity in the literature regarding effects of parental involvement on student achievement seems to imply that it is *how* parents are involved that makes the difference. While the studies looked at results of parent involvement as indicated in student achievement scores and parents self-reports on the amount of time spent and the kinds of interactions, it is difficult to control for process when considering home-based involvement and self-reported behaviours.

Extensive observational research revealed types of *positive involvement* and indicated four characteristics of positive parent involvement at home: autonomy supportive, process focused, affectively positive and accompanied by positive beliefs (Lamborn, Mants, Steinberg, & Dornbusch, 1991; Pomerantz et al., 2007; Pomerantz, Wang, & Ng 2005; Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006). A similar study reported three positive characteristics: autonomy support, direct involvement and elimination of distractions (Cooper, Lindsay, et al., 2000). The Kay, Fitzgerald, Paradee, and Mellencamp (1994) study points to mentoring, or the ability to serve as teachers, as another parenting-style dimension that may be important in homework. This research will incorporate these findings into the interviews and analysis of the selected cases as they are an integral part of understanding the beliefs, attitudes and practices of parents.

According to Pomerantz et al. (2007), "the idea that skill development mediates the link between parents' involvement and children's grades in school has not received direct attention" (p. 6). They recommend further research on the effects of intervention to promote parents' involvement since, about half of the studies reviewed in a meta-analyses examining the effects of such programs, do not support their benefits while the other half do support their benefits (Cooper, Charlton, Valentine, & Muhlenbruck, 2000; Mattingly, Prislin, McKenzie, Rodriguez, & Kaysar, 2002). This might indicate serious methodological problems in the research and differing quality of parents' involvement but it contravenes what one might expect—that is, that more knowledge about how to be supportive with homework would result in improved student performance.

Anesko and O'Leary's (1982) research supports this expectation in that they found that parents trained to identify and monitor homework problem behaviours were more successful in identifying and monitoring homework problem behaviours than

untrained parents. There is a need to further investigate the effects of parent programs that aim to enhance parent and student numeracy since "there has not been enough internally valid research on the effectiveness of interventions designed to promote parents' involvement to draw firm conclusions about the influence of such interventions (Mattingly et al., 2002; White, Taylor, & Moss, 1992).

Research spanning the last decade depicts a cautious, apprehensive approach with respect to teacher communication with families and argues how this hinders parents' involvement (Adams & Christenson, 2000; Becker & Epstein, 1982; Carey, Lewis, & Farris, 1998; Farrell & Collier, 2010; Seitsinger, Felner, Brand, & Burns, 2008). Although 28 years have passed, the reality since Becker and Epstein's (1982) research has not, unfortunately changed. Their work included a survey of 3,700 teachers regarding parental involvement and found that:

> teachers were divided concerning whether teachers can actually influence parents to help their children at home, whether most parents have sufficient skills to teach their children to read and solve math problems, [and] whether it is fair to ask parents to spend an hour each evening working with their children on school-related activities…." (p. 88)

Survey research undertaken 16 years later showed that half of principals believe that inadequate staff preparation posed a significant barrier to teachers' communication with parents (Carey et al., 1998). And, as recently as Farrell and Collier's (2010) study: "All participants [teachers] lacked formal education, training, and support for family-school communications.…As new teachers, they unanimously felt overwhelmed in this arena" (p. 12).

A possible response to this lack of agreement as to the nature of the problem can be found in the work of Cooper, Lindsay, et al. (2000) who caution teachers not to request that parents provide active instruction to their student and to think carefully

about the difficulty of the homework assignment and the educational background of the parent. Epstein (2001) argues that parental involvement is not a burden but a right, a privilege and an imperative for success. She advocates training parents how to help by employing a program like TIPS: Teachers Involve Parents in Schoolwork (Epstein & Dauber, 1989). Educators, parents and child can work together to positively influence beliefs and confidence levels about mathematics. The TIPS program showed that it is often confidence and encouragement, not necessarily skilful helping with mathematics that has positive results on student achievement. Over time, a strong triangle of focused effort among teacher, student and parent may also have lasting cultural significance in reducing the math phobia and anti-intellectualism prevalent in contemporary society.

Much of the research on parental involvement is general in nature and not related to specific subjects. There is a need to examine parental involvement through the lens of specific disciplines so that there is greater potential for meaningful involvement. Predictably, there is a wider body of research on the effect of parental involvement in the area of literacy (Raikes et al., 2002) than there is in the area of mathematics. Parental involvement in the realm of literacy is widely accepted as what responsible parents do. With the appropriate planning and approach, the same could and should be true for numeracy—one of the literacies. However, Graue, and Smith (1996) state that "researchers of school mathematics practice have evidenced little interest in parents"(p. 396). This lack of interest seems to come from a view that diminishes parents as intellectual resources or from a disproportionate emphasis on literacy rather than numeracy.

The belief seems to be that, while parents may be familiar with basic reading instruction practices, they are less able to comfortably engage in mathematics. While

this may be true, research has shown that it is not in skilful application of mathematics where parents can effect the greatest influence (Epstein & Dauber, 1989). It is the affective relationship between parent and child wherein parents' role as encouragers and holders of confident expectations allow them to exert their most powerful influence. Bourdieu (2001) alludes to the power of the affective relationship between parent and child saying "the best hidden and socially most determinant educational investment [is] the domestic transmission of cultural capital" (p. 98).

2.3. Principal's Role in Facilitating Parental Involvement

Since 2000, the Wallace Foundation has been developing a cohesive leadership system of policies and initiatives to improve educational leadership. Its summative document, "Improving School Leadership" (Augustine et al., 2009) represents a decade of focused research and asserts that parent and community engagement is one of the conditions that bolsters effective leadership of the principal. In particular, parent engagement in the area of data use and monitoring of student performance and school improvement are mentioned as important components of building a common vision. The relationship between school personnel and families is a highly consequential dynamic for principals to understand. It is an emotionally charged relationship that warrants the attention of principals who take seriously their obligation to improve student achievement and public perception of schooling efforts.

As Evans (1991) so aptly captures it, "the deep significance of the task of school administration is to be found in the pedagogical ground of its vocation. It is the notion of education that gives the idea of leader its whole purpose" (p. 17). Similar to the shift in teaching and learning described earlier, there has been a shift in the conception of the

school administrator role. The school principal is first an educator not a building manager. In practice however, the role of principal often allows little dedicated time to instructional leadership:

> Insofar as there is any empirical evidence on the frequency of actual instructional leadership in the work of school administrators, it points to a consistent pattern: direct involvement in instruction is among the least frequent activities performed by administrators of any kind at any level, and those who do engage in instructional leadership activities on a consistent basis are a relatively small proportion of the total administrative force. (Elmore, 2000, p. 7)

Perhaps there is a practical way for the elementary school principal to fulfil the purpose of educator, instructional leader and be "a transformational, empowering leader [that] is critical to success" (Davidson & St. John, 1996, p. 169). Part of the role of the elementary school principal is to be an instructional leader for and with parents with the goal of assisting them in the ways they can be more helpful to their children's pursuit of academic, social, emotional and physical goals. This is a potentially powerful way for the elementary school principal to transform and empower—by focusing on parents as possibly the greatest advocates and influencers of students. In his research—and—experience based book on the role of the principal in school reform, Levin (2008) convincingly states that "smart principals and superintendents spend a lot of time building understanding and support from parent groups because that support is vital to any system's ability to sustain itself" (p. 217). This recent injunction has been long-supported in academic publications such as Chavkin and Williams (1987) study that surveyed 9,161 parents of elementary school age children and administrators in six states about learning-at-home parental involvement. The results indicated that:

> More than 93% of administrators agreed most strongly with statements about teachers providing parents with ideas about helping children with school work at home; principals providing teachers with suggestions for

> working with parents; and teachers considering their work with parents as part of their job. (Chavkin & Williams, 1987, p. 171)

Administrators are necessary catalysts and leaders for accomplishing this mission. An overwhelming percentage of the parents who responded to the Chavkin and Williams (1987) survey support and embrace their role in student learning:

> More than 96% of the parents thought teachers should give parents ideas about helping with homework. More than 90% also thought parents have a lot to do with children's success in school. (p. 178)

The results from Chavkin and Williams (1987) survey of administrators and the survey of parents clearly indicate that administrators and parents have a strong interest in parental involvement in education. The leadership research synthesis done by Leithwood, Harris, and Hopkins (2008) corroborates these findings saying, "school leadership is second only to classroom teaching as an influence on pupil learning" (p. 28) and, "leadership accounted for a quite significant 27 percent of all variation in student achievement across the schools (p. 34). In an earlier paper, Leithwood, Seashore, Anderson, and Wahlstrom (2004) emphasizes the role of parents in student learning saying:

> At the school level, evidence is quite strong in identifying, for example, school mission and goals, culture, teachers' participation in decision making, and relationships with parents and the wider community as potentially powerful determinants of student learning. (p. 13)

This role of the principal as instructional leader in the area of parental involvement is further enshrined in important standards for school leaders. Interstate School Leaders Licensure Consortium's 2008 standards for school leaders is based on research in educational leadership and the wisdom of representatives from many state education agencies and professional associations (Council of Chief State School Officers, 2008). The six standards call for:

1. Setting a widely shared vision for learning;
2. Developing a school culture and instructional program conducive to student learning and staff professional growth;
3. Ensuring effective management of the organization, operation, and resources for a safe, efficient, and effective learning environment;
4. Collaborating with faculty and community members, responding to diverse community interests and needs, and mobilizing community resources;
5. Acting with integrity, fairness, and in an ethical manner; and
6. Understanding, responding to, and influencing the political, social, legal, and cultural contexts.

(Council of Chief State School Officers, 2008)

As a result of these standards, consortium members distilled three changes that are redefining leadership skills for school administrators. First, educators are rethinking knowledge, intelligence, assessment and instruction. Second, community-focused conceptions of schooling are becoming more prevalent. Third, and most significant to this study, is that stakeholders external to the school building such as parents are predicted to play a significantly enhanced role in education. The subtext to standard four includes the function "build and sustain positive relationships with families and caregivers." In order to institutionalize this standard, an administrator needs to embrace the importance of collaboration and communication with families as partners in the education of their children.

Similar to the Interstate School Leaders Licensure Consortium's 2008 standards for school leaders, *Leadership Standards for Principals and Vice-Principals in British Columbia* (British Columbia Principals' and Vice-Principals' Association [BCPVPA], 2007) also speaks to the importance of the principal as instructional leader in the area of parental involvement. The standards framework, derived from the Surrey School District (2005) leadership model, is organized around four leadership domains: moral stewardship, instructional leadership, organizational capacity and relationships. The

document highlights the principal's role as "the steward of learning" (p. 7) and defines instructional leadership as:

> improving the quality of teaching and learning processes for students and adults in schools thorough regular dialogue about learning and based on understanding of the body of research on learning and teaching and evidence of student learning. (p. 27)

The British Columbia leadership standards further emphasize the principal's role of providing learning opportunities for students, professionals and *the system.* The document's 16 illustrative actions that describe the expectations for quality leadership practice in the domain of instructional leadership include parents as part of this system. One of these actions entreats principals to "encourage and support positive parental involvement in their child's learning" (p. 14). Under the domain of organizational capacity, the document lists 23 illustrative actions, three of which are pertinent to this study. The actions call for principals to: "build leadership capacity of students, staff, family and community," "involve parents and families as partners in school planning and community development," and "mobilize community resources to support student learning" (p. 18).

Lortie (2009) discusses how 113 suburban elementary school principals perceive expectations with respect to results and their professional performance. Respondents in Lortie's study rated student achievement as the most important result emphasized by central office. Public reaction to the school and the principal was almost equally important. Student performance and progress were mentioned 75 times in Lortie's interviews while public reaction was mentioned 72 times. In effect, "there is a duality here in which student learning and community approval dominate the list" (p. 60) of most important results watched by central office.

The results of some studies seem to suggest that providing parent training activities and resources for parents, to address a combination of organizational and personal interests, is part of the role of the elementary school principal (Chavkin & Williams, 1987; Davidson & St. John, 1996; Elmore, 2000; Evans, 1991; Leithwood et al., 2004; Levin, 2008; Lortie, 2009). This role is emphasized internationally in the qualities and behaviours of successful principals (Moos & Johansson, 2009). Their study looked at successful principals in Australia, Denmark, Norway, Sweden, England and the United States indicating that "the focus on cooperation with parents seems to have grown in several countries" (p. 767), and that "many schools were engaged in developing productive relationships with parents and community" (p. 775) in order to facilitate "a broader learning-area for their students" (p. 776).

Within the context of British Columbia education, a parent guide (Abraham & Gram, 2007) outlines several key requirements for administrators that emphasize the parent-school connection role in school success:

- a clearly expressed vision for success that is widely shared and put into practice,
- leadership in instruction and curriculum,
- better connections with parents and agencies to support students
- a culture that brings students, parents, teachers, and administrators together,
- ways to measure and account for student performance,
- ongoing attention to good quality teaching,
- continual professional development that is linked to curriculum, and
- an approach to change that encourages wide participation.

(p. 3)

An established vehicle for accomplishing these requirements aimed at building parental involvement and general school success, is creating a sustainable learning

community "whereby identity, information and relationships are dynamically connected around the system's larger purpose" (Marshall, 1997, p. 185). A professional learning community is as a group of people that focus its energies on improving the capacity for learning for all. Stakeholders, within the community, confront the problems or barriers facing them, identify the components of a better future, and seek ways to obtain that very future. They continually evaluate and develop their skills in order to attain their goals (Mitchell & Sackney, 2000). Dufour (2004) asserts that the professional learning community model has reached a critical juncture and its "rise and fall depends not on the merits of the concept itself, but on the most important element in the improvement of any school—the commitment and persistence of the educators within it" (p. 6).

Marshall (1997) lists 26 conditions that leaders must create in order to build a learning community. The following conditions relate to the creation of learning communities including parents:

- engage as many people as possible in the system in dialogue to think about itself, to reinforce their interdependence and connectedness and sense of shared intention and purpose
- promote an organizational consciousness and a sense of belongingness,
- create open and multiple pathways for communication,
- infuse the organization with abundant information,
- move information everywhere in the system,
- seek out information that is complex, ambiguous, and paradoxical and encourage people to publicly discuss and use it,
- create networks and webs of dialogue, interaction, and generative communication, and
- establish open access to everyone in the system.

(p. 185)

A study of principals in Saskachewan (Konok, 2006) concerning the process and dynamics of the implementation of professional learning communities corroborates the

above findings and outlines essential steps in the process including "learning before leading, strategic planning and creating the vision, teaching the concept to others and engaging all stakeholders" (p. 109). A professional learning community is a result of a continuous and systematic process.

While the role of principal is extremely important to the successful creation of a learning community, the idea of one person being able to do so unassisted is counter-intuitive to the meaning of community. As Fullan (1999) states, "Principals can make even more long-lasting contributions, by broadening the base of leadership of those with whom they work-teachers, parents, students" (p. 46). For example, in professional learning communities the principal encourages teachers to pursue personal development as part of their job and encourages all stakeholders, including parents, to learn more about current education practices. According to Barth (2002):

> The ability to learn prodigiously from birth to death sets human beings apart from other forms of life. The greatest purpose of school is to unlock, release, and foster this wonderful capacity. Schools exist to promote *learning* in all their inhabitants. Whether we are teachers, principals, professors, or parents our primary responsibility is to promote learning in others and in ourselves. (p. 9)

Principals of learning communities do more than encourage teachers to pursue personal development. Principals are often referred to as *head learners*, *models of life-long learning*, and *instructional leaders* (Hord, 2004; Speck, 1999).

Though administering an elementary school is not an easy task, and parent involvement is sometimes seen as "one more thing," a new perspective based on the data from these studies may have positive lasting effects related to key goals of the principal. The principal's role in facilitating parental involvement with learning at home is shaped by her beliefs and values (Bandura, 1986; Devos & Bouckenooghe, 2009). The

results of these studies indicate that the return on time and effort invested is not only worth the effort for student learning, but also for public relations. Indeed, parental involvement can be a very useful resource for school administrators seeking to implement and gain support for reforms such as changes in mathematics or other curricula. Keeping parents informed and inviting their involvement builds good relationships and a positive perception of the efforts of the school. Both of these are essential to the role of the principal.

The connection between parental involvement, student learning and positive public relations is further supported by the *Principles and Standards for School Mathematics* (National Council of Teachers of Mathematics [NCTM], 2000), which states:

> when parents understand and support the schools' mathematics program they can be invaluable in convincing their daughters and sons of the need to learn mathematics and to take schooling seriously. Families become advocates for education standards when they understand the importance of high-quality mathematics education for their children. (p. 378)

Facilitating parental involvement is one way of helping to realize the goal shared by most principals: to create a challenging and supportive learning community and positive perceptions and support of the school. With respect to the role of the elementary principal in student learning and school improvement, parental involvement with learning at home can be an asset.

2.4. Challenges of Enhancing Effective Parental Involvement

Parental involvement is most often described as participation in curriculum nights or open houses hosted by the school to communicate information about the curriculum or perhaps, volunteering in the classroom. It has also focused on areas of governance—

trying to involve parents in school councils or other committees such as fundraising or site-improvement committees. Izzo, Weissberg, Kasprow and Fendrich (1999) found that, during the elementary school years, parent involvement in school activities such as these increased achievement among students 2 years later. Some parents are interested in governance, however the majority of parents are more interested in doing what they can to assist their children in being successful. While certainly possible to orchestrate, 'meet the teacher' nights and open houses are not usually the forum to delve into the intricacies of parent-child interactions with curricular issues. However, a carefully designed and expertly facilitated parent workshop or series of workshops focusing on one particular subject, such as mathematics, may be a vehicle for enhancing effective parental involvement with learning at home. This approach has been shown effective with literacy initiatives. A review of evidence from New Zealand shows powerful potential effects on achievement from well-crafted literacy programs that are effectively shared between schools and families, particularly when accompanied by appropriate supports for families (Robinson, Lloyd, & Rowe, 2008). I contend that a shared numeracy program could have comparable results. While the scope of this study is limited to two workshops and reaction from parents, it may nonetheless provide the impetus for further development into a home-based parental involvement numeracy program.

Focusing on parent-child collaboration might mean exploring together the materials available—from simple toys and game to software—that take children along interesting mathematical avenues. It may involve designing a workshop on the possibilities of calculator or spreadsheet use. It could also be a meeting to look at children's literature that embeds mathematical concepts. Some children's stories put mathematics in real-life contexts and provide excellent discussion starters. Such

collaborative exploration may initiate what Green (1971) calls "a thirst for learning through patient and calm discovery of the wonders of this world [as related to mathematics or the subject matter in focus] and a corresponding capacity to marvel at them" (p. 203). A sense of wonder and consistent reinforcement of positive core messages with regard to mathematics is important. It is not difficult to imagine the negative result of repeatedly hearing "math is hard." One can conversely imagine the positive influence of experiencing a spirit of inquiry inspired by observations of patterns or math-in-daily-life phenomena.

Parents can play an important role in encouraging appreciation of mathematics with their children. According to Doctorow (2002), the results are well worth the effort: "Students who have a positive attitude about mathematics exert more effort, spend more time on task, and are more effective learners than students with poor attitudes" (p. 16). Indeed, the role of emotion is also part of modification of belief systems and "there is evidence of the central role emotion plays in mathematical and scientific cognition" (Roth, 2007, p. 95). The researcher contends that, if parents' emotions derive from more comfort, confidence and interest in mathematics, this will be infused in the parent-child relationship while engaging with the student in learning at home.

In addition to exploring the hands-on materials, software and literature available, educators can also facilitate parental involvement by sharing print resources such as one from the NCTM called *A Family's Guide: Fostering Your Child's Success in School Mathematics* (Mirra, 2004). This particular resource and others like it are helpful when trying to explain what today's mathematics classroom is like and offers tips on how family members can help their children enjoy math as well as ways to discuss and do math at home.

Egan (1997) elaborates on the importance of mathematical context and application saying:

> We need to embed the sequence of skills and algorithms to be learned into an historical and human context. We need to see the human purposes for what different forms of mathematics were developed and, as far as is known, who invented or discovered each theorem, algorithm, technique, or advance in mathematical understanding. (p. 223)

Many parents will acknowledge that they value critical thinking, communication skills, interpersonal skills and collaboration. These are cultural tools that can become cognitive tools to be used in mathematics if their relevance is explored and made sufficiently evident. Therefore, if principals are aiming for an ideological shift in the way parents perceive the teaching and learning of mathematics, it is necessary to show parents ways to address the acquisition of these processes in mathematical contexts. An overview of the critical processes in the Common Curricular Framework for K-9 mathematics (McAskill et al., 2006) reveals how critical thinking, communication skills as well as positive interpersonal skills can be addressed through learning mathematics. The mathematical processes include communication, connection-building, mental mathematics and estimation, problem-solving, reasoning, selecting and using technologies as tools, and developing visualization skills (2006, p. 6).

Parents need to understand and be convinced of the reality that doing mathematics involves listening, discussing, finding ways to solve problems, sharing ideas, taking turns, working together, generating options and strategies and decision making. The research seems to indicate that, when parents embrace the importance of these mathematical processes and foster this in their children's mathematics journey, mathematical literacy may be enhanced (Chavkin & Williams, 1987; Hart, Smyth, Vetter,

& Hart, 1996; Mirra, 2004; McDougall, Ross, & Jaafar, 2006; Morrison 2008; NCTM, 2000).

Many parents know about reading development—that it is important to teach letter and sound correspondence, blends and diphthongs for example—even if they do not know the pedagogical jargon. It seems reasonable to conclude, however, that very few parents are knowledgeable about the components and sequence of mathematical concepts. In addition, many elementary educators are generalists (i.e., they do not have a specialty in mathematics) and are therefore also encouraged to learn from current research in mathematics about what to teach and how to teach it effectively. In fact, many educators find themselves in a similar position to that of their students' parents in their lack of knowledge about the components and sequence of mathematical concepts.

Obviously educators who are contemporaries of their students' parents were in elementary school at the same time and therefore experienced the same methods and curricula. Many teachers experience the same math *anxiety* and are under-prepared for curricular change in mathematics. A combined effort in the exploration of numeracy development is therefore both necessary and at the same time, demanding of a certain amount of professional humility. Many of us must admit our *gaps* and that, particularly in the area of the pedagogy of mathematics; we have much to learn.

Sharing knowledge about current mathematics curriculum and methods can happen in the context of workshops for parents as has been explored in this study. In such workshops, following an adult-education approach is essential. This approach specifically integrates what Mezirow (1991) and Hart (1983) report about adult learners. These authors argue that adults who are learning are challenged to input greater energy, require more time, critical reflection and testing of new behaviours in *safe situations*.

Therefore, adults learning about the mathematics their children are experiencing a need to focus primarily on modifying, transforming, and reintegrating knowledge and skills into what they had formed and accumulated in childhood. These adult-learning principles imply that the workshop is not a *one shot* experience but rather an effort of ongoing support in a non-threatening, invitational and supportive environment that facilitates critical reflection and helps to embed the new learning into the life experience of the adult learner. The ongoing support is meant to empower parents.

As each school context is different, it is important for the principal to be able to differentiate the type of family involvement that will be successful in that particular setting. According to Seefeldt, Denton, Galper, and Younoszai (1998) and Fine (1993), the sociodemographic makeup of the school should influence the behaviour of the principal and the appropriate type of family involvement envisaged. Their research shows that, among schools in which parents already show high levels of involvement, parents more likely want principals who emphasize school curriculum and instruction and support process of student learning, and student test scores. The schools participating in my current study are from the middle sociodemographic range and fit this description of high levels of involvement. It is certainly helpful for principals to be aware of family expectations of the school in order to emphasize different sets of imperatives. In this way, principals can strategically adjust their efforts and approach so that the needs and expectations of families are addressed.

While being context-responsive and considering the situation of parents, a principal also needs to consider the realities of students and their learning. If students need more parent support with homework, the principal can establish "programs for parents that apply covert pressure to support their children's learning at home" (Day &

Leithwood, 2007). For example, Griffith (2001) found that, in the context of socially advantaged students, a principal who emphasizes her role as master teacher is more effective in empowering parents and having parents help their children with homework. Among schools with more disadvantaged students, "the instructionally-oriented role of master teacher and the outward, interpersonally-oriented role of missionary appeared more effective in involving parents" (Griffith, 2001, p. 182). These studies show that the emphasis on effective teaching and reaching out to parents is significant in both contexts (Day & Leithwood, 2007; Griffith, 2001).

2.5. Numeracy Development

In order to create a sense of urgency around the need for a focus on mathematics (or another curricular area), it is helpful to engage parents in discussion about the shift in teaching and learning in general and in mathematics in particular. An article by Barr and Tagg (1995) that created much discussion in the academic world compares this paradigm shift. The following table (Table 2) is my summary of the main ideas of their article. The shift in teaching and learning is described globally by Nobel laureate Herb Simon who wisely stated: the meaning of *knowing* has shifted from being able to remember and repeat information to being able to find and use it (Simon, 1996).

Table 2. Teaching Paradigm Compared to Learning Paradigm

Teaching Paradigm	Learning Paradigm
1. Knowledge is "out there" and dispersed or delivered by an instructor.	Knowledge is in each person's mind and consists of frameworks constructed by the learner.
2. The teacher is the chief agent.	The learner is the chief agent.
3. Students are basically passive.	Students are active discoverers.
4. Students demonstrate learning by recalling information on tests.	Students reveal their learning by using frameworks to understand and act.
5. The teacher often uses a lecture-approach and controls the learning activities.	The learner is actively involved, in the learning activities designed by the teacher.
6. Individualistic, competitive	Team-oriented, collaborative, supportive
7. Learning is presumed to be cumulative and linear	Learning consists of interactive and nested frameworks.
8. Only some students can learn to high levels.	All students can learn to higher levels.
9. The goal is to cover material.	The goal is for students to accomplish learning outcomes.

For many contemporary practitioners, the journey in education is toward a view of learning that people construct new knowledge and understanding based on what they already know and believe (Cobb, 1994; Piaget, 1952, 1973a, 1973b, 1977, 1978; Vygotsky, 1962, 1978; Wood, Bruner, & Ross, 1976). Realizing that this ideal is not entirely embraced and practiced consistently in all classrooms, the British Columbia Principal and Vice Principal Association identify four principles of learning to which we are encouraged to aspire:

- Learning requires the active participation of the student,
- Learning is both an individual and a social process,
- Learning takes place in different ways and at different rates for each student, and
- Learning is encouraged when students are involved in their own assessment and evaluation and reporting; when assessment and evaluation is ongoing; and when assessment and evaluation and reporting are clear and supportive.

(BCPVPA, 2007, p. 29)

This qualitative change over time in teaching and learning is embodied in the simultaneous call for numeracy improvement. Numeracy refers to the application of mathematical understanding in daily activities at school, at home, at work, and in the community. It involves both using mathematical skills and knowing how mathematics is used to solve problems. Discussion of more global transformations espoused in education today may enhance parents' understanding of changes in mathematics in general and numeracy in particular by providing the context in which calls for reform occur. In an informal conversation with researcher and scholar Dominic Peressini, Joyce Epstein emphasized the importance of giving parents the "lay of the land" in specific content areas and "examining parental involvement through the lens of specific disciplines" (Peressini, 1998, p. 558).

In keeping with this theoretical, though admittedly not entirely practiced, shift in teaching and learning, the National Research Council (2001) document, *Adding It Up: Helping Children Learn Mathematics*, describes a mathematically literate person as one who demonstrates:

- Conceptual understanding: understanding mathematical concepts, operations, and relations
- Procedural Fluency: skill in carrying out procedures flexibly, accurately, efficiently, and appropriately
- Strategic Competence: the ability to formulate, represent, and solve mathematical problems
- Adaptive Reasoning; the capacity for logical thought, reflection, explanation, and justification
- Productive Disposition; habitual inclination to see mathematics as sensible, useful, and worthwhile, combined with a belief in diligence and one's own efficiency.

(p. 4)

Fostering and developing these characteristics relies on a certain learning environment. While they are outlined in Table 2 in a general sense, the National Research Council describes the ideal mathematics learning environment:

> The learning environment should value and respect all students' experiences and ways of thinking so that learners are comfortable taking intellectual risks, asking questions and posing conjectures. Students need to explore problem-solving situations in order to develop personal strategies and become mathematically literate. Learners must realize that it is acceptable to solve problems in different ways and that solutions may vary. Positive learning experiences build self-confidence and develop attitudes that value learning mathematics. (National Research Council, 2001, p. 11)

That is the kind of environment educators are encouraged to foster for children's learning of mathematics. This type of environment is further explored by Clements et al. (2004), Comiti and Ball (1996), de Abreau et al. (1997), Goldin (2002), Jensen (2005, 2006, 2008), Jones (2003), Lubienski (2004), McAskill (2007), McDougall (2004), and Sousa (2005). According to these researchers and mathematicians, the ideal environment in which to learn mathematics is where discussion is encouraged and various tools are employed. A collaborative environment is desired. Children are encouraged to reason, communicate their ideas and build on their thinking and prior experience. Adult guides (whether teachers or parents) refrain from *telling* students what is needed and focus instead on listening to students and getting them to do the talking. The environment allows for exploration and discovery resulting in a delayed, rather than immediate response. The ideal learning environment includes materials for drawing, making and using pictures and diagrams. Students are actively engaged in their learning.

For mathematics, children may also have access to a calculator and develop the ability to decide which method, mental, written or calculator assisted, is appropriate in

particular circumstances. Some researchers have found that an environment that allows calculators and access to math-related websites is one imbued with the understanding that technology can stimulate thinking. It can also promote experimenting with numbers in a non-threatening way with immediate feedback on number patterns and calculations. For example, Forrester (2003) showed that children will often try much harder examples when using calculators, and are particularly interested in exploring large numbers. In addition to calculators, Perks and Prestage (2003) show how computer spreadsheets are an excellent tool for exploring numbers and displaying results.

When students engage with a task, Anghileri (2006) suggests that teacher or parent guides refocus their attention and give them opportunities to develop their own understanding. More specifically, she suggests:

- Getting students to look, touch and verbalise what they see and think;
- Interpreting students' actions and talk;
- Using prompting and probing questions;
- Parallel modelling where a problem with similar structure is solved
- Getting students to explain and justify what they have done
- Providing meaningful contexts to abstract situations;
- Simplifying the problem by constraining and limiting the degrees of freedom;
- Rephrasing students' talk; and
- Negotiating meanings.

(p. 9)

While it is understandable that not all parents and educators will be able to enact the above with equal effectiveness, these guidelines provide helpful advice regarding the kind of environment we need to aim to foster for children learning mathematics.

A collaborative environment including student discussion, exploration and various tools can be described as having a problem solving focus. "Problem solving is central to

most current definitions of mathematics literacy and to the curricula and policies that underpin mathematics education in Canada" (Doctorow, 2002, p. 11). This by no means devalues the role of basic facts and mental math in mathematics instruction. On the contrary, procedural fluency with basic facts and doing mental math are considered necessary skills so that students are able to more confidently think about tasks that are more complex.

The theoretical shift in the literature (and in some educators' practice) from teaching to learning is also evident in the transformation of the way learning is assessed. It would also be helpful for parents to be aware of the various methods and types of assessments that can take place to evaluate and develop numeracy in students. Assessment is a frequently debated and compelling topic in contemporary education. The BCPVPA (2007) defines assessment as:

> the process of collecting, synthesizing and interpreting information to aid in decision making. In an educational context, assessment is the process of observing learning; describing, collecting, recording, scoring, and interpreting information about a student's or one's own learning. Different types of assessment instruments include achievement tests, observation instruments, performance tasks, and authentic assessments. (p. 24)

When parents think of assessment, their context might be how they were assessed in schools a decade or more ago. The predominant type of assessment at that time is referred to as *assessment of learning*. This type of assessment has a summative purpose, "usually signalling students' relative position compared to other students … [and is] expressed symbolically, generally as marks or letter grades" (p. 24). An example of this type of assessment is the unit test that requires students to synthesize their learning at the end of a unit or a chapter. Though this type of assessment still plays an important role in today's classrooms, assessment in kindergarten to Grade 12 has evolved to include *assessment for learning* as well as *assessment as learning*.

Assessment for learning is "designed to promote learning and shifts the emphasis from summative to formative assessment, from making judgments to creating descriptions that can be used in the service of the next stage of learning" (BCPVPA, 2007, p. 24). In mathematics, examples may include diagnostic assessments, observational notes taken while students are expressing their problem-solving process, and activities based on real-life situations where students work in small groups to present a solution to a problem. Assessments for learning provide information to teachers during the learning process that assist them in modifying instruction according to what students already know and what they need to learn. Black and William (1998) reviewed 580 studies and concluded that formative assessment is one of the most significant contributors to improved learning.

Assessment as learning emphasizes the role of the student and "occurs when students personally monitor what they are learning and use the feedback from this monitoring to make adjustments, adaptations, and even major changes in what they understand" (BCPVPA, 2007, p. 24). Examples include having students work together with the teacher on developing criteria in rubrics, or by helping them use metacognitive questions for reflecting on their work.

One of the reasons that assessment is often debated may be the presence of large-scale provincial assessments administered currently at the Grades 4 and 7 levels in British Columbia (Foundation Skills Assessment, British Columbia Ministry of Education, n.d.a). There is also national testing of 13- and 16-year-olds (School Achievement Indicators Program, British Columbia Ministry of Education, n.d.b). While this latter assessment only affects elementary schools that include Grade 8, it essentially assesses learning that was begun during the elementary years. These large-scale

assessments combined with differentiated classroom assessment practices create complex conditions for parents to navigate. The results of these assessments are often misinterpreted and misused. Parents, and others, who use them as a single means of evaluation without taking into account the assessment *for* and *as* learning may be mislead in their understanding of their child and their school's progress. Assessment is an essential topic of discussion among parents who seek to understand contemporary education.

In order to effectively support learning of mathematics it is helpful for parents and educators to embrace a common definition of numeracy and understand the type of environment that is fostered in contemporary mathematics teaching and learning. Peressini (1998) argues that the literature about mathematics education reform has distanced parents from schools and led to conflict between parents and mathematics educators and that to reconcile this conflict, ways in which parents can be included in mathematics education must be considered. In addition to communicating the essential tenets of mathematics reform to parents, it would also be helpful to include discussion of the role of change—the changes in society, in technology and in schools since these changes affect mathematics and other curricular programs.

2.6. Challenges to Parental Involvement

Underscoring all efforts directed toward increasing parental involvement in learning at home must be an understanding of the many reasons why certain school subjects, present issues for parents. McDougall (2004) explains that "parents' issues tend to be shaped by past and personal experiences with mathematics and by what is valued in mathematics" (p. 60). He posits that "most adults experienced a mathematics

curriculum that emphasized facts and procedures for computing. The homework expectations of parents for their children frequently reflect those experiences" (p. 66). Parents who experienced mathematics in classrooms characterized by drill and practice of basic mathematical skills may therefore find themselves in a conflict of dispositions with their child's teacher or generally confused by what is going on in today's mathematics classroom unless of course their child has a *traditional* teacher who emphasizes drill and practice over problem solving. Mathematician Anghileri (2007) concurs:

> There have been many changes in mathematics teaching over the last few decades and children in the mathematics classroom today will be involved in many more thinking activities and much less 'drill and practice'…There have been fundamental changes to the curriculum with the word 'numeracy' introduced to convey a meaning of not only proficiency with numbers, but confidence and inclination to use numbers in practical problem solving, in familiar and in novel contexts. (p. 1)

These changes in curriculum and educational practice have evolved as the bodies of research in cognitive psychology and neuroscience have provided insights relevant to education. The research in cognitive psychology and the brain over the last 30 years has provided strong support for a view of knowledge that is actively constructed rather than received (Caine & Caine, 1994; Gardner, 1983; Hanna, 2005; Hart, 1983; Innes, 2004; Jensen, 2005, 2006, 2008; Posner & Klevjord Rothbart, 2006; Sousa, 2005, von Glasserfield, 1991; Vygotsky, 1978). Education has been influenced by brain research to such a degree that it has been said brain-based learning is "a significant educational paradigm of the twenty-first century" (Jensen, 2009). In contemporary classrooms, including mathematics classrooms, any of the following principles derived from constructivist theory (Brooks & Brooks 1999; Wiggins & McTighe, 2005) may be observable:

- Encouragement and acceptance of student autonomy and initiative.
- Utilization of raw data and primary sources along with manipulative, interactive, and physical materials.
- When planning, teachers use cognitive terminology such as "classify," "analyze," and "create."
- Allowance of student responses to drive lessons, shift instructional strategies, and alter content.
- Inquiry concerning students' understanding of concepts before sharing their own understanding of those concepts.
- Encouragement of students to engage in dialogue, both with the teacher and with one another.
- Encouragement of student inquiry by asking thoughtful, open-ended questions and encouraging students to ask questions of each other.
- Pursuit of elaboration of students' initial responses.
- Engagement of students in experiences that might engender contradictions to their initial hypotheses and then encourage discussion.
- Allowances for wait time after posing questions.
- Providing time for students to construct relationships and create metaphors.
- Nurturing students' natural curiosity through frequent use of the learning cycle model.

While one could argue that good teaching has always occurred, the growing acceptance of the above principles as *good teaching* to be striven for is evidence of a significant educational paradigm of the 21st Century (Jensen, 2009). It can be said that, in general, many parents of children in school today were educated in a behaviourist approach (Lapan & Houghton, 1995; Skinner, 1974). This approach emphasized the idea that children can be *trained* to learn by observing and memorizing the desired outcome demonstrated by the teacher and then repeating this practice with many exercises. However, many contemporary psychologists and researchers have shown that children learn better and develop a range of skills when they are actively involved in constructing meaning (Caine & Caine, 1994; Gardner, 1983; Hanna, 2005; Hart, 1983;

Innes, 2004; Jensen, 2005, 2006, 2008; Posner & Klevjord Rothbart, 2006; Sousa, 2005, von Glasserfield, 1991; Vygotsky, 1978).

The constructivist approach, which is observable in many of today's classrooms, encourages students to know and understand processes so that they can transfer them to different contexts. There is normally less memorization and more discussion and negotiation. The idea is to increase the students' confidence to take risks of approaching other problems and in this way to work within their capabilities. This theoretical shift from a behaviourist orientation to a constructivist orientation has influenced the role of teacher. In general it may be said that today's teacher is less of a demonstrator and transmitter of knowledge with the goal of training students, and more of a promoter of thinking and individual coach with the goal of helping students make connections and construct meaning.

This is a significant shift in theories of learning and is highly consequential for educational leaders to acknowledge and grapple with as they plan to engage curricular support for learning at home. Anghileri (2007) quotes from a 1937 mathematics book for teachers to underline how much theories of learning have changed. This would, hopefully be shocking reading for today's teachers. The author of the now over 70-year-old textbook asked teachers, "Why then should we burden children with unnecessary explanation in arithmetic?" (p. 5). The reality is that many parents experienced a more behaviourist education than what we promote in today's classrooms. It should not be a revelation that education, like other disciplines such as medicine, law, psychology and others, has evolved! With this evolution comes the challenge of bridging this ideological divide to improve support for student learning at home.

While principals may well embrace in theory the importance of bridging this ideological divide, it seems that the process of engaging parents poses a challenge to educators. Fullan quotes Bryk et al. (1999) challenging the education system as a whole:

> There is a need for significant advances in the knowledge, skill and dispositions of local school professionals in their ability to effectively engage parents and the local community. (p. 52)

He also quotes Coleman (1998) who similarly emphasizes the need to facilitate parental involvement: "The most important task facing the school in the immediate future is collaboration with parents in building active communities of learners" (Fullan, 1999, p. 61). Furthermore, the British Columbia Integrated Resource Package (British Columbia Ministry of Education, 2007) reiterates this challenge by guiding educators in this way: "As facilitators of learning, educators are encouraged to highlight mathematics concepts as they occur within the K to 7 school environment and within home environments" (p. 11).

Even if parents and interested adults agree that mathematical literacy is essential, they may be less inclined to be practically involved. The specialized content of mathematics and the vast differences in methods employed as compared with when they learned mathematics, are seemingly prohibitive to even the most well-intentioned parents. As such, parents reported that they feel somewhat disenfranchised in the face of the educational establishment. Remillard and Patrickson (2006) found that, although African American parents in a low-income neighbourhood viewed themselves as "critical players in their children's learning," the implementation of reform-oriented curriculum tended to dis-empower them with regard to school mathematics. It would follow that the parents' limited understanding of the reform-based approaches in any curricular area would mean their access to the discourse of reform was also limited.

Yet, parents can be an important link in the communication between teacher and student. With their unique knowledge about their children, they may be able to help translate and reinforce the content and, perhaps more importantly, help students persevere and develop the work habits necessary for success in mathematics. Parents may be able to make homework more interactive by focusing on life-skills math around the home and community and playing math-related games. However, just *doing math* with their children will not necessarily engage them experientially as Dewey (1916/1966) noted: "mere activity does not constitute experience" (p. 146) and the "educative value of …activities…depends upon the extent in which they aid in bringing about a sensing of the meaning of what is going on" (p. 246). To this end, Egan (1997) asserts that it is important to engage not just the manual or *hands on* depiction of concepts, but the intellectual inquiry, wonder and imagination that the study of mathematics (or other subjects) can engender. A parent workshop may be a way for an elementary school principal to facilitate this intellectual inquiry by equipping parents with the tools, the words, the questions and the attitudes that may foster greater success in their children's academic endeavours.

An example of potential content of such a workshop is a facilitated discussion of the term *mathematizing*. This term describes how teachers and, by extension parents, can "find frequent opportunities to help children reflect on and extend the mathematics that arises in their everyday activities, conversations, and play, as well as structure environments that support such activities" (Clements et al., 2004, p. 59). Much research has shown that an emphasis on applying mathematics to real-life problems as well as abstract problems leads to better student achievement than if students are uniquely working on problems in the context of typical school problems. Homes are replete with opportunities for exploring real-life problems and thus engaging in mathematizing.

Parents can be shown how to recognize these opportunities and how to use them to engender mathematical thinking processes in their children. In the classroom, there should be a balance between basic skills and problem solving in both real-life and abstract contexts (Nunes, Schlieman, & Carraher, 1993; Saxe, 1991; Schlieman & Carraher, 1996). The classroom can more readily focus on the abstract and with some effort facilitate exploration of *real life* mathematics. Enlisting the support of families and providing families with the means to successfully engage with the real life aspects of mathematics is a potentially significant way to enhance a school's program.

In order to effectively engage with their children in the pursuit of mathematical understanding, parents will therefore require a perspective and basic understanding about what is going on in contemporary classrooms as related to mathematics. We need to find ways to enliven what Egan (2002) calls "inert knowledge" (p. 148).

How can adults with self-reported weak math skills or *math anxiety* support the skill and conceptual development of students of mathematics? There is evidence that says parents feel ill-equipped to get involved with the school's mathematics program. According to a large-scale survey done in 2006 by Statistics Canada and the Canadian Council on Learning, "two of every three parents (65%) don't have the knowledge needed to help their children with homework" (Canadian Council on Learning, 2006). This study corroborates previous research findings that parents experience themselves as lacking the skills to constructively assist children with homework—especially considering the reforms in mathematics since they were in school (Hoover-Dempsey, Bassler, & Brissie, 1992; Kay et al., 1994; Levin et al., 1997). Indeed, parents are susceptible to the influence of personal experiences in their own education.

2.7. Summary

The principal's role is undeniably complex. Student learning and public relations are cited by several studies to be two central aspects of this role. Recent research finds that the quality of the principal is, among school-based factors, second only to the quality of the teacher in contributing to what students learn in the classroom (Leithwood, Jantzi & Hopkins, 2006). Given the potential impact of parental involvement on their students' motivation and attitude as well as skills and the potentially significant impact on public relations, parent engagement would seem to be a sensible area to which to devote time and energy. It is not only a sensible role, but a role of principal that is deeply grounded in society's expectations of the education establishment.

Whether the lens is one of equipping parents with the tools to be instrumentally involved with their own children's learning or a view to the attitudes, beliefs and motivations of parents towards this end; parent engagement is an important topic that effective principals address in various ways. The literature reveals four characteristics of positive parent involvement: autonomy supportive, process focused, affectively positive and accompanied by positive beliefs (Lamborn, Mants, Steinberg, & Dornbusch, 1991; Pomerantz et al., 2007; Pomerantz, Wang, & Ng 2005; Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006). Others include additional positive characteristics such as direct involvement and elimination of distractions (Cooper, Lindsay, et al, 2000). Finally, mentoring, or the ability to serve as teachers is reported to be another parenting-style dimension that may be important in parent engagement with learning at home (Kay, Fitzgerald, Paradee, and Mellencamp, 1994).

However, it is frequently difficult for schools to reach parents and invitations to parent meetings often result in the same, already involved and informed parents

attending. Levin (2008) offers hope in the face of this challenge saying "we have more and more evidence that patience, persistence, and respect for parents' situations can improve school-home connections, often dramatically" (p. 112). Through workshops, websites, newsletters or other means, principals can facilitate increased knowledge about current curricular processes including collaborative learning that allow children to construct meaning. Notwithstanding the importance of the effort, the research depicts a cautious, apprehensive approach with respect to teacher communication which may hinder parents' involvement (Adams & Christenson, 2000; Becker & Epstein, 1982; Carey, Lewis, & Farris, 1998; Farrell & Collier, 2010; Seitsinger, Felner, Brand, & Burns, 2008).

Much of the research or parental involvement is general in nature and not related to specific subjects. There is a need to examine parental involvement through the lens of specific disciplines so that there is greater potential for meaningful involvement. Since subjects such as mathematics are more commonly construed by families as challenging, facilitating a certain comfort level with the material and processes is an intrinsically worthy and strategic goal for principals to embrace. A principal who gives attention to parent and community engagement may also bolster their leadership through their instructional leadership. Principals who embrace their role as a steward of learning are well poised for this challenge and responsibility. An established vehicle for embarking on this journey is creation of a sustainable learning community with the principal as *head learner*. Auerbach (2009) neatly encapsulates leadership for family engagement saying it "begins with a belief, 'a natural feeling' for the role of parents in education and a sense of collective responsibility for children" (p. 24).

CHAPTER 3.

METHODOLOGY

3.1. Introduction

In Chapter 3, I describe the methodology and delineate the data collection, analysis and presentation of the data. I also identify the strategies used to check the accuracy of the findings.

This is a qualitative study using survey and interview data. It studies the experience of workshop participants. The process was an attempt to make parents welcome and give them information about the subject of mathematics through the vehicle of parent workshops and interviews. Cresswell (2003) prefers Rossman and Rallis' (1998) characteristics of qualitative inquiry and I will outline those that are represented in this particular study. In qualitative research, the researcher is involved in the actual experiences of the participants, which "enables the researcher to develop a level of detail about the individual or place" (Cresswell, 2003, p. 181).

The actual methods of data collection are based on open-ended observations, interviews and documents but may also include emails, scrapbooks and other forms. As happened in this study, "the research questions may…be refined as the inquirer learns what to ask and to whom it should be asked" (Cresswell, 2003, p. 181). In this way, qualitative studies are based on an unfolding and evolving research model. Qualitative research is interpretive. The researcher observes the participants and evaluates the data through his own experiences and through his reading of the literature. As such "one cannot escape the personal interpretation brought to qualitative data analysis" (p. 182).

The design of the study is pro-active in that it "intentionally engages in qualitative research while pro-actively working toward transformation" (Meyers, 2000, p. 25). The transformation I hoped for was that parent participants would become more aware and grow in confidence in their ability to assist their own children in intermediate mathematics. This method is well suited to the researcher who is intimately involved in the participating community.

3.1.1. Sample

The sample of subjects was selected from within the school population and four neighbouring schools in a western Canadian province. The subjects sampled included parents of intermediate age children. Parents were from the middle socio-economic range, varied in age from 33 to 49, had their children in independent schools and represented a variety of cultural backgrounds. Nineteen participants out of 23 total workshop participants completed the first survey in October 2008. Seventeen of those participants completed the second survey in late November and eight completed a follow-up survey in January 2009. From those eight, four were chosen as case studies to be interviewed in January and February 2009.

3.2. Data Collection

3.2.1. Procedure

In mid-October, 2008, there were two parent workshops given by a mathematics consultant at an independent elementary school in a western Canadian province. Participants who agreed to participate in the research study completed consent forms. They also completed a pre-survey designed to elicit information about their beliefs, attitudes, emotions and practices concerning their home-based interaction with their

child and learning mathematics whether for the purpose of homework completion or general understanding. The workshops were videotaped by a research assistant for subsequent review and analysis.

During the workshops, the researcher was an observer and also took the role of introducing the guest speaker and providing hospitality to participants. The field notes include behaviour and activities of individuals, traits of the participants, a description of the physical setting, demographic information and the researcher's personal thoughts, such as "speculation, feelings, problems, ideas, hunches, impressions, and prejudices" (Bogdan & Biklen, 2006, p. 121). My collection of thick description (Stake, 1995, 2005) was important to my understanding of parents' experience of the workshops.

At the end of November 2008, a second survey was mailed to participants. This survey was designed to elicit information regarding any interventions attempted as well as any changes in beliefs, attitudes, emotions and practices that may have been prompted by participation in the workshops. A follow-up survey was sent in January 2009 and based on the data from this third survey, which eight of the original 23 participants completed, four cases were selected for in-depth analysis and interviewing. Interviews took place in January and February 2009 with follow-up conversations, as necessary to clarify statements, occurring during the subsequent 5 months of data verification and analysis.

Semi structured interviews followed an interview protocol aimed at gathering more detailed information about the responses that participants had given in the first three surveys. The interview protocol consisted of an outline of topics and issues to be covered. They were focused interviews, meaning that there were guiding questions and additional probing questions when an interesting issue was raised by the interviewee.

The tone of the interviews was conversational and informal while probing for more in-depth responses. While this procedure was systematic and comprehensive, it was difficult to compare or analyze data due to the fluidity of the discussions. Extensive verbatim notes were taken during the interviews which lasted 40 minutes to 1 hour. The quality of the findings was confirmed by reviewing the written material with the interview participants for verification. The interviews yielded thick description of parents' cognitions and perceptions of their role, their conception of mathematics and also identified what they found useful and motivating in a parent workshop.

3.2.2. Instruments

As mentioned, a self-report questionnaire administered in three parts over a period of 4 months was used as one of the main data-gathering instruments in this study. Analysis of the data from these surveys led to the selection of four participants as case studies. The surveys were structured to reveal how parents are involved with their children in mathematics. The inconsistency and ambiguity in the literature regarding effects of parental involvement on student achievement seems to imply that *how* parents are involved makes the difference. Using data from the National Education Longitudinal Study, Ho and Willms (1996) reported that parental involvement contains four dimensions: home discussion, school communication, home supervision and school participation. The instruments designed for this study take into account each of these components. I will now describe the three surveys and interview protocol.

The first survey was given prior to the parent workshops and contained 16 general attitude statements about mathematics and their involvement with their intermediate child's education (Appendix A). Several questions sought information about their understanding of problem solving methods and a couple of questions asked them

to rank attributes of a numerate student. The final two questions asked how much time they spend with their child doing mathematics homework and why they decided to attend the math workshops for parents.

The second survey given 6 weeks after the second parent workshop included all the questions of the first survey so that comparisons could be drawn (Appendix B). The second survey also included 10 questions designed to glean information about how the workshops may or may not have impacted them.

The follow-up survey given 3 months after the workshops was intended to get further information about the impact of the workshops and also to get a profile of the parent participants (Appendix C). The items on this survey included more general questions about the parents' opinions and attitudes about curriculum-related workshops, their interactions with teachers as well as their child's current and projected achievement. It asked if they wanted more information about the topics covered in the workshops and gave four hypothetical scenarios regarding the teaching and assessment of students in mathematics. Several questions pertained to general parenting style, boundaries and expectations.

Reigadas (2006) found that parents' setting rules regarding doing homework, doing chores, television watching and maintaining certain grades, could be used as a composite measure of more general academic expectations and that these practices predicted higher test scores in elementary students (though they have a negative effect in high school students). A more recent study also supports this notion concluding that:

> perceived parental involvement through socialization of educational values, such as having high achievement and attainment expectations, had the strongest association with students' GPAs and classroom engagement. (Chen & Gregory, 2010, p. 53)

Remillard and Patrickson (2006) also cite evidence that children whose parents are involved in their education tend to perform at higher levels on standardized tests when compared to children with less involved parents (Henderson & Berla, 1994; Jeynes, 2005; Sheldon, 2003).

The interview protocol was tailored to each of the selected participants in that they were asked to explain and elaborate previous responses from the first three surveys (Appendix D). Initial questions asked about changes since the parent's school days. Next, there were questions concerning the impact of the workshops particularly focusing around why their idea of what constitutes a numerate student changed. Also included were questions about the value of parent workshops in general, involvement with child and homework, the profile of the parent and their tolerance for change. It is important to note that my approach in the interviews was not only to collect objective data but also to enliven the interview process by encouraging the participants to tell stories and share experiences.

I felt it was important to stimulate participants' sharing of their values, experience, history and wishes for the future. In many ways, this was a mutual learning process. I believe that the interviewees learned by reflecting and verbalizing about their experiences and ideas. As the interviewer, I learned by listening and asking relevant questions to probe deeper and follow the conversation along its natural path, while at the same time directing it to the topics of research inquiry. The interviews were purposeful conversations (Bogdan & Biklen, 2006) that proved to be powerful techniques to understand human interaction (Fontana & Frey, 2005).

3.2.3. Description of Workshops

The workshops were open to parents in six independent schools in a western Canadian province. Parents from four of the six invited schools attended. The majority of participants were from the researcher's own school. The presenter was a teacher educator and contributor to a widely used mathematics program (Pearson Education Canada, 2007). One of his general objectives in the workshops was to create a better understanding of the curriculum and ways mathematics is currently taught. With this in mind, he began the workshops with an introduction to the principles of a contemporary mathematics program. These principles are not the purview of any particular program but of contemporary mathematics programs in general. These are the principles he explained for participants and upon which the two workshops were based:

- All students need opportunities to learn mathematics in ways that are meaningful to them. A responsible mathematics program recognizes many learning styles.
- Students best develop conceptual mathematical understanding when they have opportunities to *do* math, to engage in hands-on experiences in which they explore concepts using a variety of tools and strategies in a rich mathematical context.
- Students demonstrate conceptual understanding by communicating and modeling their reasoning, and connecting a new concept or strategy to other contexts and concepts they have seen before.
- Learning through problem solving helps students make sense of the math. Students develop new knowledge and skills through meaningful problems.
- Mathematics understanding is deepened and enhanced when students have opportunities to make connections between mathematical concepts and other mathematics strands, other disciplines, and the real world.
- Procedural fluency with number is an essential skill for life. When students practice mental and written computational strategies effectively, they learn to use them accurately, efficiently, flexibly, and appropriately.
- Parents have a significant role to play in student learning. A mathematics program should help parents and teachers collaborate to

reinforce what is learned in the classroom each day, promoting a positive attitude towards mathematics in the home.

- The purposeful use of technology in the mathematics classroom can enrich learning experiences for students, allowing them to explore and develop concepts, and extend critical thinking and problem-solving skills.
- A mathematics program should support curriculum implementation and assessment with 100% curriculum fit and practical teacher support-pacing guidelines; combined grades strategies; models for independent and group learning; performance-based assessment suggestions.
- Effective use of assessment is an integral part of mathematical teaching and learning. Teachers need to balance assessment purposes and methods with practical assessment tools that support teacher decision-making and feedback, student reflection, and reporting to parents.

(Pearson Education Canada, 2007)

The parents were particularly interested in their role in the contemporary mathematics program. The presenter focused on developing their confidence through better understanding. The workshops were hands-on and parents worked on tasks that one would see in intermediate grade level mathematics classrooms that have adopted current curriculum and methods. Working in groups, sharing ideas, using manipulative materials, encouraging different representations and solution approaches and focusing on conceptual understanding were common characteristics of these workshops. The presenter drew on household and community knowledge as strategic resources for how parents could assist their intermediate child in mathematics. This instilled confidence in the participants due to familiarity of the resources. Parents shared ideas and strategies they have tried and found successful with their own children. The presenter anecdotally explained that we learn a lot from studying what has gone well in the past and inquiring into the conditions that allow for success to occur rather than focusing on what's not working.

In order to emphasize changes in mathematics, the presenter engaged parents in a discussion about how mathematics has evolved since they were in the classroom. He explained, with examples, how current methods foster knowledge building and understanding. The presenter later emphasized to me the importance of this part of the workshop—eliciting from parents their own experiences of mathematics and then contrasting to how mathematics has since evolved. He suggested to me a children's book called *Fish Is Fish* (Lionni, 1970) as an illustration of the problem of presenting new information without regard to the learner's existing conceptions. It is notable that he used a lot of encouragement throughout the workshops. When I spoke with him about this afterwards, he said that this was deliberate and intended to model for parents the importance of encouragement and demonstrating confidence regarding their children's achievement. He confirmed that these two variables, encouragement and demonstrating confidence, are important factors towards the improvement of student achievement.

The presenter used adult education facilitation practices while engaging participants with intermediate grade level mathematics tasks. This approach respected the participants' life experience and facilitated a learning experience that comfortably helped participants push the boundaries of their comfort zone. The tasks presented were enjoyable and engaging and there was a lot of laughter and creative tension as parents grappled with the challenges, negotiated and collaborated with one another. He discussed the significance of the tasks and various approaches used to arrive at solutions by asking questions about why and how solutions resulted. He circulated around the room and interacted with the participants while giving feedback and asking thought-provoking questions. He created a safe environment for exploration by taking care not to evaluate or comment on progress. Though he clarified process and methods when asked, he did not answer questions regarding whether participants were *doing it*

right, preferring instead to let parents work out the solutions the best they could. During the workshops, parents were challenged to think differently about mathematics. They were presented with information and took part in experiences that may have contributed to modifying previous conceptions formed in childhood.

3.3. Data Analysis

Once the data was collected, it was input into tables so that it could be carefully considered and interpreted. An inductive approach was followed in two phases that moved back and forth throughout the duration of the study. A vertical analysis was done according to each of the respondent's interviews and a comparative, horizontal analysis to look for common patterns and differences across respondents. The data also informed the scope of the literature review which continually evolved as I sought explanations and similar studies.

The analytic technique of ordering the data prior to actual analysis proved to be very useful. Ordering it in various ways—vertically and horizontally increased the type of information I was able to glean from it. Ordering the data helped to make evident subtle changes in attitude from before to after the workshops and indicated to me which participants might be interesting to interview. On the first survey, for example, all of the respondents reported to being comfortable or very comfortable with helping with math homework before and after the survey and there was little to no noticeable change in their responses to many questions. The data with a story came in their answers to Questions 3 to 9 of the survey (Appendix A).

The analysis included consideration of participants' perception, thought, imagination, emotion and action in an effort to make evident the conscious experience of

workshop participants. Inevitably, my identity influenced what I chose to consider and interpret as well as my interaction with participants. Rather than present my interpretations of participants' experiences at the workshops and during the interviews as objective, I acknowledge that I have been *reflexive* (Hammersley & Atkinson, 1995). That is, just as the participants are actively making sense of their experience and of my presence, I too am making sense of them and their interpretations.

Some researchers conduct qualitative data analysis using theoretical propositions to test their data while others generate themes or categories out of the data (Yin, 2003). For this study, data analysis was an iterative process, which consisted in examining all of the qualitative data for categories, patterns, connections and themes. This process required continual movement between the parental involvement literature, data collected from various participants, and observation notes. The end result of this process was the identification of three factors that impact parents' home-based involvement. These factors are: (a) difficulties and disagreements; (b) workshop effect; and (c) confidence, motivation and change. In chapter 4, these themes are discussed in detail for each of the selected case studies.

Participants were selected as case studies because their surveys were information-rich and may have included curious ambiguities, contradictions or otherwise notable statements in their responses that warranted further probing and investigation. Patton (1990) asserts that this method "becomes particularly useful when one needs to understand some people, a particular problem, or unique situation in great depth" (p. 54). Furthermore, a variety of data collection procedures are often used in case study to examine the phenomenon in depth. The sheer volume of data generated by the surveys necessitated use of some guiding filters to sieve through and organize the data. In order

to discuss difficulties and disagreements, workshop effect and confidence, motivation and change, it was first necessary to evaluate the data and how it contributes to these themes. Several appropriate filters or frameworks, discussed previously in the literature review, were found to be helpful. One was the study by Pomerantz et al. (2005), which identified four characteristics of effective parental support: autonomy supportive, process focused, affectively positive, and accompanied by positive beliefs regarding the achievement of the student.

The second relevant study by Cooper, Lindsay, et al. (2000) identified direct involvement and elimination of distractions as key components. Finally, a large-scale family commitment study (Wang et al., 1996) in which approximately 3,000 Grade 7 students were randomly selected and tracked provided additional filters since a powerful predictive framework resulted from this study. The framework includes two dozen variables that reliably predict (p =.05 level) the effect of parental involvement on student achievement.

While my study does not track student achievement, it is supported by findings from the Wang et al. (1996) study that around 23% of the variance in student math achievement has been explained by the selected family commitment variables. Family commitment remains a significant factor of student mathematics achievement. Wang et al. (1996), stress the need to focus on the positive variables: parents' education and confidence in student performance as well as the negative variables: the ways parents help students with their homework and how they reward students for good grades. Based on the significant predictive nature of the variables identified by the Wang et al. study (1996), regarding family commitment and student achievement as well as the contributions from the extensive observational study by Pomerantz et al. (2005), and

Cooper, Lindsay, et al. (2000) study, a couple of considerations for school leaders emerge as significant. Principals interested in school reform in any curricular domain first know what these variables are and then seek every opportunity within school-home relationships to enhance the positive factors and control the influence of negative factors.

To validate the accuracy of findings, I triangulated different data sources by examining surveys, observational field notes and interviews. Multiple techniques help to ensure the credibility of the data (Gulka, 1992). I used member-checking to determine the accuracy of my interpretations. I have clarified the bias that I bring to the study (see Researcher Personal Background in Section 1.7). I also include negative information that runs counter to expected outcomes in an effort to present an open and honest narrative. I asked several colleagues to review the account for clarity and resonance. Their questions and comments helped in my rewriting of drafts. Finally, I used an external auditor to review the entire project. This person was new to the project and provided an assessment at the conclusion of the study, which was used to further clarify certain sections, as required.

3.4. Ethical Considerations

This is an *insider* or *backyard* study conducted by myself as the principal of the school where the majority of study participants had children enrolled. This can be a concern because the researcher is acting as both researcher and, to some extent, change agent—even if this role is not explicitly the purpose of the study. The dual role of practitioner-researcher can be seen to be in conflict. However, this type of research is also possible and beneficial expressly *because* the researcher is the principal with

established knowledge, working relationships, access and credibility within the school. The data is potentially rich for the school, similar schools, as well as the academic community.

In this study, the participants were respected and experienced no harm as a result of their participation. Individuals were not coerced into participating in the study and were simply invited with no pressure attached. There was no penalty for refusing to join the study and parents could still attend and participate fully in the workshops. This is in accordance with the National Research Council (2003) principle that the "individuals [be treated] as autonomous agents whose decisions on whether or not to participate in research are to be respected and not overridden by a researcher" (p. 81). Confidentiality was assured to all participants and they chose pseudonyms from the beginning. The data is maintained securely in a locked file cabinet to which only the researcher has access. Since the data collection only involved adults directly and not students, ethics approval was readily granted by the university.

3.5. Summary

Chapter 3 conveys the methodology used in this study, which helped to realize my hope that parents would become more aware and grow in confidence in their ability to assist their own children in intermediate mathematics. The survey data and interviews yielded information of parents' perceptions of their role, their conception of mathematics and what they found useful and motivating in a parent workshop. The workshops challenged parents to think differently about mathematics. Participants were presented with information and were active participants in engaging activities. The process contributed to answering the overall research question: "How can elementary school

principals design a parent workshop that engages parents to effectively support improved learning at home?" and also revealed to me an important motivation for why principals should be concerned about this in the first place.

The methodology of the study—the workshop experience and self-reflection required to answer surveys introduced many ideas to parents about models of learning that are research-based. This experience helped to address preconceptions regarding how children learn and likely influenced the criteria that parents use to judge classroom practice.

The chapter begins by explaining the characteristics of a qualitative research approach. Next, the sample of subjects is described. The procedure followed during data collection is outlined: there is a description of the instruments and the content and process of the two workshops and interviews is delineated. This chapter explains how the data was analyzed including the steps taken to organize, filter and then interpret vast amounts of information. The final section of the methodology chapter considers the ethics of the study. Chapter 4 presents findings.

CHAPTER 4.

FINDINGS

4.1. Introduction

Chapter 4 details the findings and results of the study. It is organized around the overall research question: How does a principal increase effective parental or family involvement in learning at home? First I will describe the survey results and then a description of the four cases is presented.

4.2. Survey Results

In October 2008, participants were each given a survey (Appendix A) before attending two workshops. As mentioned, this pre-survey included 16 questions designed to gauge beliefs, attitude and emotions since mathematics is not just a cognitive process but also an affective process. Specifically, the questions asked about their experience with mathematics both as a child and adult, ideas about how to solve problems, preferred area of mathematics and opinion about the attributes of a numerate student. Finally, the survey asked parents to identify their feelings about helping their child and why they decided to attend the workshops. The second survey was given to participants in November 2008, 3 weeks after the workshops.

This second survey included the same 16 questions from the pre-survey as well as 15 additional questions. These additional questions focused on the experience and impact of the workshops. Participants were asked if they had tried any of the recommended practices, if the sessions gave them ideas, if they had spoken with their

child about the workshops and if they felt more able to help. Further questions asked participants if there were specific behavioural changes in themselves or their child and if they would participate in similar workshops with a different subject focus. Some demographic data was gathered regarding their child's grade. An opportunity to complete the phrase, "I didn't realize that….," as well as provide additional comments yielded some interesting responses.

This section reports the responses of the 19 workshop participants who completed the first survey and the 17 participants who completed the second survey. As such, it gives a glimpse into *what is* regarding parent involvement at home with intermediate level mathematics. Knowing the current reality of this group of middle class, racially mixed, suburban parents may be important for principals to understand as they think about and plan for school improvement in their school context. The discussion of results is presented in thematic groupings of the questions. Feelings, attitudes and beliefs are discussed first and then skill level and processes are addressed. Questions 1 to 4 and 8 to 9 relate to participants feelings, attitudes and beliefs and are therefore discussed together. The data for these questions is presented in Tables 3 to 8 in the following pages. As a group, Questions 5 to 7 have to do with skill level and processes. The data from these questions is presented in Tables 9 to 11.

Questions 1 and 2 focused on participant feelings and attitude towards mathematics and level of comfort helping. The results presented in Tables 3 and 4 indicate little to no noticeable change. Pre- and post-workshop responses were all comfortable or very comfortable with respect to helping their child with mathematics homework.

Table 3. Parent Comfort Level Helping with Mathematics Homework

Question 1. Of all the subjects at school, how comfortable are you with helping your child with math homework?

Participant	Pre-workshop Survey Response	Post-survey[a] Response	Change
Sarah	Comfortable	Comfortable	O
Franco	Comfortable	Comfortable	O
Mary	Very comfortable	Very comfortable	O
Camila	Comfortable	Comfortable	O
Patrick	Very comfortable	Very Comfortable	O
Michael	Very comfortable	Very Comfortable	O
Gabrielle	Comfortable	Comfortable	O
Pierre	Comfortable	Comfortable	O
Milagros	Comfortable	Comfortable	O
Paul	Comfortable	Comfortable	O
Dan	Comfortable	Comfortable	O
Andrew	Comfortable	Very Comfortable	Δ
Juan	Comfortable	Comfortable	O
Julia	A little	A little	O
Bill	Very comfortable	Very comfortable	O
Manjit	Comfortable	Comfortable	O
Maria	Very comfortable	Very Comfortable	O
Mark	Comfortable	No response	n/a
Lelei	A little	No response	n/a

[a] 3 weeks after workshop; Δ = change; O = no change.

As can be seen in Table 3, there was little change in the pre- and post-workshop survey responses of participants. Participants indicated that, before and after the workshops, they were comfortable or very comfortable helping their child with mathematics homework. In Table 4 responses indicate that parents also had consistent pre and post responses regarding whether they look forward to helping with mathematics homework.

Table 4. Parent Feelings Anticipating Helping with Mathematics Homework

Question 2. Do you look forward to helping your child with Math homework?

Participant	Pre-workshop Survey Response	Post-survey[a] Response	Change
Sarah	Sometimes	Sometimes	O
Franco	Sometimes	Sometimes	O
Mary	Sometimes	Sometimes	O
Camila	Often	Often	O
Patrick	Always	Always	O
Michael	Often	Often	O
Gabrielle	Always	Often	Δ
Pierre	Often	Often	O
Milagros	Often	Often	O
Paul	Sometimes	Sometimes	O
Dan	Often	Sometimes	Δ
Andrew	Always	Always	O
Juan	Often	Often	O
Julia	Sometimes	Sometimes	O
Bill	Always	Often	Δ
Manjit	Often	Often	O
Maria	Often	Often	O
Mark	Sometimes	No response	n/a
Lelei	Never	No response	n/a

[a] 3 weeks after workshop; Δ = change; O = no change.

Tables 5 and 6 present the data from survey Questions 3 and 4 concerning beliefs about mathematics. The questions essentially ask the same thing. Consistent data results when the response to one of these questions is affirmative and the other response is negative. One respondent indicated a change in beliefs. In the pre-survey. Pierre said he was "unsure" about whether he believed there is one way to solve mathematics problems. In the post survey, however, he changed his mind and said "no"—he did not believe there is one best way to solve mathematics problems. After the workshops, all respondents unanimously agreed with the current best practice view that there is not one *best way* to solve a problem and there are multiple ways to reach a

solution. Except for four participants: Patrick, Pierre, Mark, and Lelei, the remaining 15 participants held this belief before and after the workshops. There was no change in the majority of respondents' beliefs.

Table 5. Parent Belief Regarding Ways to Solve Mathematics Problems A

Question 3. Do you believe there is one best way to solve mathematics problems?

Participant	Pre-workshop Survey Response	Post-survey[a] Response
Sarah	No	No
Franco	No	No
Mary	No	No
Camila	No	No
Patrick	Unsure	No
Michael	No	No
Gabrielle	No	No
Pierre	Unsure	No
Milagros	No	No
Paul	No	No
Dan	No	No
Andrew	No	No
Juan	No	No
Julia	No	No
Bill	No	No
Manjit	No	No
Maria	No	No
Mark	Unsure	No response
Lelei	Unsure	No response

[a] 3 weeks after workshop.

Table 6. Parent Belief Regarding Ways to Solve Mathematics Problems B

Question 4. Do you believe that there are different ways to solve mathematics problems which are equally good?

Participant	Pre-workshop Survey Response	Post-survey[a] Response
Sarah	Yes	Yes
Franco	Yes	Yes
Mary	Yes	Yes
Camila	Unsure	Yes
Patrick	Yes	Yes
Michael	Yes	Yes
Gabrielle	Yes	Yes
Pierre	Yes	Yes
Milagros	Yes	Yes
Paul	Yes	Yes
Dan	Yes	Yes
Andrew	Yes	Yes
Juan	Yes	Yes
Julia	Yes	Yes
Bill	Yes	yes
Manjit	Yes	Yes
Maria	Yes	Yes
Mark	Yes	No response
Lelei	Unsure	No response

[a] 3 weeks after workshop.

While there is not much of a story to tell from the data in Questions 1 to 4, the story comes in responses to Questions 8 and 9, which are the final questions to do with attitudes, beliefs and feelings. The data from these survey questions is presented in Tables 7 and 8. In all but two cases, individuals changed what they identified as the three most important qualities of a numerate student or changed the order of importance of these qualities. For example, while Sarah did not change the top three qualities, she changed their order of importance. First she said the most important quality of a numerate student is being able to communicate ideas and/or understandings. After the workshops, she said basic skills were most important.

Franco changed some of the qualities as well as their order of importance. Before and after the workshops the most important quality for him was being able to communicate ideas and/or understandings. The second most important quality changed from good basic mathematics skills to willingness to engage with mathematics. The third quality changed from good mathematical understanding to perseverance. Of the 19 participants who consented to be in the study, 17 completed both the pre and post surveys. Of these 17, 15 participants experienced a change in their conception of a numerate student from before to after the workshops. Nuances as to why these types of changes may be significant for the participant are explained in the case study interview data profiled in Sections 4.3 to 4.6.

Table 7. Parent Belief Regarding Important Attributes of a Numerate Student

Question 8. The following is a list of possible attributes of a numerate student. Which ones do you think are important?

	# sense	Arith	Prob solving	persev	comm	algeb	Basic skills	proced	enthu	willing	Math under
Sarah	*			+	*+		*+		*	*+	
Franco	*+	*+	*+	*+	*+	+	*+	+	*+	*+	*+
Mary	*+	*+	*+	*+	*+		*			*+	*+
Camila	*+		*	*+	+		*+			*+	*
Patrick	*+	*	*+	*+		*	*+			*+	*+
Michael			*+	*+		*+	*+	*+	*+		
Gabrielle	**	*	*+		*+	*	*+	*+		+	+
Pierre	+	*	*+	+	*+		*+	*		*+	*+
Milagros	+		*	*+	+		*+		+	*+	
Paul	+	+	+	*+	*+		*+	+	*+	*+	+
Dan	+		*+	*+	*+		+	+	*+	*+	*+
Andrew	*+			*+	+				*+	*+	
Juan	* +			* +	*		*		* +	+	*+
Julia	+	*+	+	*+	*	+	*+		*+	*+	*
Bill	*		*+	*+	*+				*	*+	
Manjit	*+	*	*+	*+	*+		*+		*+	*	*+
Maria		+	*+	*+	*+		*+			*+	*+
Mark	*	*	*		*	*	*		*	*	*
Lelei	*	*	*		*		*		*	*	*

Note. Pre *, Post +.

Table 8. Parent Belief Regarding Three Most Important Attributes of a Numerate Student

Question 9. What are the three most important aspects?

	# sense	Arith	Prob solving	persev	comm	algeb	Basic skills	proced	enthu	willing	Math under
Sarah	*3			+	*1+3		*1+1		*	*2+2	
Franco	*+	*+	*+	*+3	*1+1	+	*2+	+	*+	*+2	*3+
Mary	*+	*+	*+	*+	*+1		*			*1+2	*3+
Camila	*1,2,3 +2		*1,2,3	*+	+		*1,2,3 +1			*+3	*
Patrick	*+	*	*+3	*3+2		*	*1+1			*+	*2+
Michael			*1+1	*+		*2+2	*3+3	*+	*+		
Gabrielle	** 2	*	*1,2,3 +3		*1,2,3 +	*	*1,2,3 +1	* +		+	+
Pierre	+1	*	*3+2	+3	*+		*+	*		*1+	*2+
Milagros	+		*	*2+2	+		*3+3		+	*1+1	
Paul	+	+	+	*+3	*+2		*3+	+	*1+1	*2+	+
Dan	+		*3+	*+3	*+2		+	2+	*+	*1+1	*+
Andrew	*+2			*3+3	+				*1+1	*2+	
Juan	*1 +2			*2 +3	*		*3		* +1	+	*+
Julia	+	*+	+	*2+	*	+	*+2		*+3	*1+1	*3
Bill	*		*+	*2+2	*+3				*3	*1+1	
Manjit	*+	*	*3+1	*+3	*2+2		*+		*+	*	*1+
Maria		+	*1+1	*2+2	*+		*3+			*+	*+3
Mark	*	*	*		*	*	*3		*1	*2	*
Lelei	*	*	*		*1		*		*3	*	*2

Note. Pre *, Post +;
The numbers indicate ranking of the attributes before and after the workshops.

The data from survey Questions 5 to 7 are presented since as a group, they have to do with skill level and processes. Tables 9 to 11 present the data that will now be discussed. As can be seen in Table 9, after the workshops, five people changed the types of homework they prefer. Three study participants added types of homework they prefer. Sarah added geometry; Gabrielle added drill; and Dan added drill, word problems and geometry. Could it be that the workshops showed them the value of these other types of mathematics homework? Was it that the workshop facilitator was able to show them how to be more successful with these types of homework? Of some curiosity are

study participants Juan and Manjit. Each of these individuals dropped one type of preference in favour of others. For example, Juan dropped his preference for word problems and indicated after the workshops that he now preferred geometry. Manjit dropped drill and added basic facts and geometry. Juan and Manjit are 2 of the 4 case studies and more information is in the description of their interviews in 4.4 and 4.6 respectively.

Table 9. Parent Preferred Type of Mathematics Homework

Question 5. Given a choice, which type of mathematics homework do you prefer?

	Basic Facts	Drill	Word Problems	Geometry	Algebra	Change
Sarah	*+	*+		*	*+	Δ
Franco	*+	*+	*+			O
Mary	*+		*+		*+	O
Camila	*+	*+				O
Patrick	*+	*+			*+	O
Michael			*+	*+	*+	O
Gabrielle	*+	*	*+	*+	*+	Δ
Pierre		*	*+			Δ
Milagros			*+	*+	*+	O
Paul	*+	*+	*+			O
Dan	*+	*	*	*		Δ
Andrew	*+		*+			O
Juan	* +	* +	*	+		O
Julia	*+	*+	*		*+	O
Bill			*+	*+	*+	O
Manjit	+	*	*+	+		Δ
Maria			*+	*+	*+	O
Mark			*			n/a
Lelei	*					n/a

Note. Pre *, Post +; Δ = change; O = no change.

The data for survey Questions 6 and 7 are presented in Tables 10 and 11. It is of interest that four people changed the way they provided examples when helping with mathematics and five changed the way they reacted when a problem was too difficult to

solve. While it was not possible to capture all these changes in the case studies, some of the individual interviews allowed for more probing into the reasons for these changes and shed more light generally into why people may change their approach to working with their child. Since this is not a controlled experiment, a causal relationship between the workshops and a change in behaviour is not possible to make. Nonetheless, it may be inferred that the workshops were a possible contributing factor influencing a change in behaviour.

Table 10. Parent Provision of Other Examples

Question 6. Do you think of other examples to share with your child?					
	Never	Sometimes	Often	Always	Change
Sarah		*+			O
Franco			*+		O
Mary			*+		O
Camila		+	*		Δ
Patrick			*+		O
Michael			*+		O
Gabrielle			*+		O
Pierre			*+		O
Milagros			*+		O
Paul		*+			O
Dan			*+		O
Andrew			*	+	Δ
Juan	*	+			Δ
Julia		*	+		Δ
Bill			*+		O
Manjit			*+		O
Maria		*+			O
Mark		*			n/a
Lelei		*			n/a

Note. Pre *, Post +; Δ = change; O = no change.

Table 11. Recourse Taken when Having Difficulty

Question 7. If you find a problem too difficult and you can't answer it, what of the three possibilities are you more likely to do?

	Try Different Ways	Note to Teacher to Excuse	Encourage Teacher Help	Change
Sarah	+		*	Δ
Franco			*+	O
Mary			*+	O
Camila	+		*+	Δ
Patrick	*+			O
Michael			*+	O
Gabrielle	+		*+	Δ
Pierre	*+			O
Milagros			*+	O
Paul			*+	O
Dan			*+	O
Andrew	*+			O
Juan			*+	O
Julia	*+			O
Bill	*		+	Δ
Manjit	*		*+	O
Maria			*+	O
Mark			*	n/a
Lelei			*	n/a

Note. Pre *, Post +; Δ = change; O = no change.

Questions 10 to 14 are open-ended questions asking participants about their attitudes and emotions towards mathematics. Question 10 asked "How do you feel when your son/daughter is really struggling with their homework and you don't know how to help?" Both before and after the workshops many of the emotions included frustration, helplessness, stress, anxiety and confusion. Some of the comments were indicative of the group response. Pre-workshop comments included:

- "I feel like engaging a tutor"
- "I need to find out how to help them"
- "disappointed"
- "upset because I want them to feel successful"

- "curious—I want to find out how to do the particular problem"
- "concerned that the math from that point on will build on the misunderstood concept and will continue to be a problem"
- "determined to get the help needed."

Post-workshop comments included:

- "I feel like I need to help them see the options"
- "I feel calmer"
- "I try to encourage calmness over the situation"
- "frustrated but now willing to re-look at the homework"
- "interest in figuring out how to do the homework"
- "challenged."

Question 11 asked "How do you feel when your son/daughter is doing well on all their homework; only missing one or two questions?" Not surprisingly, responses depicted feelings of relief, satisfaction, accomplishment, confidence, pride, and happiness. A few participants more reservedly responded "ok, but want to confirm questions in another way," "we can do better" and "ensure kids need to practice more and ensure kids double-check their work every time." There was no change in the pre-survey and post-survey responses regarding how people felt when their child was doing well.

Questions 12 (Table 12) asked "How do you feel when your son/daughter is doing well on the exercises but struggling on the word problems?" The responses mirrored many of the comments to Question 10, that is: frustration, anxiety, overwhelm and a lack of confidence. However, the comments after the workshops were sometimes nuanced with a willingness to try, help the child understand and make connections as well as more of an interest in finding out why the child experienced difficulty.

Table 12. Parent Feelings when Child Doing Well on Exercises, but Not on Word Problems (Question 12)

	Pre-workshop Response	Post-workshop Response
Sarah	Feel frustrated as I try to understand and make a connection for them	Somewhat frustrated as they appear to have the concept but are not able to understand when phrased differently.
Franco	Worried. Is it a comprehension issue? I had this problem and had him see a speech therapist.	Worried they may have comprehension issues.
Mary	Hopeful, but aware that they have not made the crucial link to how the concept is adapted to real life	I feel like they are memorizing the math concept and not truly understanding it.
Camila	No response	No response
Patrick	Sympathy—word problems can always be tricky. The only way is to keep practising repeatedly.	sympathy
Michael	I feel challenged to have them understand the question	Concerned, worried
Gabrielle	Need to find an example of real life. Put into the problem	Need to find out where the struggling is ex. Terminology, or the wording
Pierre	Frustrated	I feel I can help them with that, figure it out
Milagros	I feel challenged to help them find a way, like I want to draw a picture for them	I feel like this is normal and I feel challenged to find ways (e.g. Diagrams, examples) to help.
Paul	I think it will come with further work.	Frustrated.
Dan	Ok, but want to confirm questions in another way.	Need to find out why
Andrew	No response	We will need to continue working on the word problems.
Juan	That it should be more clear, easier, why doesn't he get it, he just did it without the words and got it so why not now?	That I can help.
Julia	Feel confident he/she will work it out	hopeful
Bill	No response	No response
Manjit	I feel tempted to help	Ok and I can help them to understand
Maria	I feel a challenge to explain the problem in a way they can relate to	Excited to explain how the exercises can be applied to the word problems.
Mark	Ok	No response
Lelei	Concerned	No response

There seemed to be an increased understanding by several participants of the comprehension demands required of word problems. For example, in the pre-workshop survey, Pierre indicated frustration and in his post-workshop survey he showed more

willingness to engage saying "I feel I can help them with that and figure it out." There were subtle changes in the perceptions of several parents. Juan expressed frustration before the workshop saying "it should be more clear, easier, why doesn't he get it, he just did it without the words and got it so why not now?" After the workshop, he greatly tempered his response and showed increased confidence simply saying "I can help."

Maria showed little emotion in response to the pre-workshop question and more in the second. Before the workshop, Maria said "I feel a challenge to explain the problem in a way they can relate to." After the workshop, she said "I feel excited to explain how the exercises can be applied to the word problems." There were no trends of significant conversions or lives changed by the workshop experience; any reported changes were subtle.

An open-ended question, Question 13 (data in Table 13) asked "What do you do when you know your son/daughter is getting many of the answers wrong on his/her homework?" It is similar to Question 7 (Table 11), which states: "If you find a problem too difficult and you can't answer it, what of the three possibilities are you more likely to do?" The three possibilities given are "try different ways, write a note to the teacher to excuse, encourage the child to get help from the teacher." Juan answered Question 7 (Table 11) in the same way before and after the workshop, but he answered Question 13 (Table 13) differently before and after the workshop.

Table 13. Parent Response When Child Is Getting Answers Wrong

	Pre-Workshop Response	Post-Workshop Response
Sarah	Source out others to help—Teachers, older students	Consult text or notes from teacher to gain an understanding of how the lesson was taught
Franco	Write a note to the teacher. Obviously, he does not understand something.	Try to help—if I'm unsuccessful, I write a note to teacher requesting help.
Mary	Try to take a step backward with them to find what concept is not being understood	Ask them to explain to me their reasoning and find where the problem lies.
Camila	No response	I do my best to help by explaining or using different strategies—or, I get a tutor
Patrick	Add more time at home to spend on math problems, workbooks, computer programs and drills until they find it easier	Re-do, drills, further resources and practice books out of school time
Michael	Review concepts, lesson, text. Review math facts/calculations.	Review concepts introduced in the lesson, then use sample questions that I make up.
Gabrielle	Explain again, use different ways	To review and ask the kid how she/he comes up with the answer
Pierre	Like I want to help, they need extra help	Figure out what they understand and go from there
Milagros	I try to sit down with them and help them.	Sit down with them and assess where problem is
Paul	If I can't help I would speak to a teacher	Tell them to seek help from the teacher
Dan	Sometimes request to move on and return to problem area later on	Doesn't happen —so far
Andrew	I figure out if they know the basic number concepts first.	Sit down together and try to go slowly over the reasons why he/she is having difficulty. And we look at attacking the question from different angles.
Juan	Try to show him where he went wrong so he can get them correct before handing it in	Set up appointment with teacher to discuss solutions
Julia	Review the homework with my child and talk to the teacher for extra work	Help more with the homework and talk to the teacher
Bill	Help them by asking them questions that make him look at the problem from a different perspective	Explain to him/her what they are doing wrong. Explain how to answer the questions and help them learn short cuts.
Manjit	Explain a different way	Explain in a different way. Contact teacher.
Maria	I will explain it in a different way and do a few with them, making sure they re confident before leaving them to complete it on their own.	Work with them to help them understand the steps.
Mark	Ok	No response
Lelei	Concerned	No response

Before he said he would "try to show him where he went wrong so he can get them correct before handing it in" and after he said "set up appointment with teacher to discuss solutions." I noticed that Bill also had a subtle change in his responses. Before the workshop, he said he would "try different ways" and after the workshop, he would "encourage teacher help." Perhaps Juan and Bill could now see the value in having a partnership in order for the child to be successful? Perhaps they now felt more comfortable asking for the teacher's help and initiating a partnership for the benefit of their child? Either possibility is supported in the literature concerning models of role construction. Hoover-Dempsey and Sandler (1997) theorize that the strongest predictor of parent involvement is how parents conceptualize and construct their role, that is, what they think and do regarding their responsibility to support education. The fact that, after the workshops, some parents felt more comfortable asking for the teacher's help is corroborated by Auerbach's (2009) study of parent engagement when she reported that "parents told us they felt more comfortable after the meetings approaching teachers with questions" (p. 21).

In contrast, both Gabrielle and Sarah changed their response to Question 13 (Table 13) from asking the teacher for help (pre-workshop response) to trying other methods to solve questions (post-workshop response). Perhaps the workshops gave them new methods and ideas that encouraged them and made them feel more confident in their own ability to help their children? Gabrielle's pre-workshop response focuses on her own abilities. She said she would "explain again and use different ways." Her post-workshop response is nuanced in that it focuses more on working with the child by eliciting from them information regarding process and knowledge they have. Her post-workshop response was that she would "review and ask the kid how she/he comes up with the answer." While Pierre's pre and post responses to Question 7 (Table 11), were

the same in that he would "try different ways" when faced with difficulties, his responses to Question 13 (Table 13), were slightly different. Before the workshop he said he feels "like I want to help" when his child is getting answers wrong and then after the workshop he said he feels like "figur[ing] out what they understand and go[ing] from there." Could this indicate increased understanding of the role of process and building on prior knowledge? This possibility is supported by the literature pertaining to how caregivers build on what children know and how to extend their competencies by providing supporting structures or scaffolds for the child's performance (Bielaczyc, Pirolli, & Brown, 1995; Cobb, 1994; Piaget, 1952, 1973a, 1973b, 1977, 1978; Saxe, Gearhart, & Guberman, 1984; Scardamalia, Bereiter, & Steinbach, 1984; Schoenfeld, 1983, 1985, 1991; Vygotsky, 1962, 1978; White & Frederickson, 1998; Wood et al., 1976).

Most parents were congruent in their pre and post responses to Questions 7 and 13 (data in Tables 11 and 13 respectively). For example, in answer to what they do when their child is having difficulties, Camila, Andrew and Manjit all mentioned trying different methods to solve questions and Camila and Manjit added that they would seek expert help whether from a tutor or teacher. Given the choice of several options, only Camila answered Question 7 in the same manner as Question 13. Sarah answered the open-ended Question 13 (Table 13) and the multiple choice Question 7 (Table 11) differently but this was likely more a case of how the question was posed. A multiple choice question *forces* a choice of predetermined responses by its nature while an open-ended question invites personal examples and explanations. While the answers were *different*, in their essence they are actually similar since "encouraging teacher help" can be compared to "sourc[ing] out others to help—teachers, older students." The combined data shows that more respondents would try different approaches after the workshop. Can this possibly be attributed to the influence of the workshop experience and the

presenter? Did parents gain confidence in the importance of multiple approaches by learning about them?

Question 14 asked parents "How do you feel about mathematics?" This question was answered variously depending on whether parents interpreted it to mean their own emotions towards the subject or the value of the subject itself. For example, parents who interpreted the question in light of emotion said: "uncomfortable," "comfortable," "positive," "I like it," "good," "confident," "I'm curious about it," "I enjoy it," "I feel pretty stupid about math," "ok," "fine" and "love it." Alternatively, parents who interpreted the question having to do with the value of mathematics said: "I think it's very important," "It's fun," "It's part of our life everyday," "very interesting" and "challenging," "crucial to later success in life." There were several notable changes in parents' reported feelings about mathematics.

Julia was a parent who in the pre-workshop survey said "Beyond the basics, I feel pretty stupid about math! Therefore I become very frustrated with the higher levels of math." In the second survey, however, Julia said "I feel okay." Another change is evident in the responses of Juan. In the pre-survey, he said "[I feel] so—so [about mathematics]" and in the post-survey, "[I feel] good [about mathematics]." A significant change is noticeable in a couple of parent participants. One example is Andrew's level of confidence from before to after the workshops. In the pre-survey, he said he felt "very anxious" and in the post-survey he felt "great." Another example is that Milagros reported in the pre-survey that she was "easily confused" with mathematics yet in the post-workshop survey she felt "good [about mathematics]." While there were significant differences in the pre and post comments, caution must be used in attributing cause to the workshops. The workshop may have influenced the participants and these findings

can be considered a tentative foundation for future work with a larger, more diverse population.

Question 15 (Table 14) asked about how much time participants spend helping with math. The pre-survey and post-survey results do not indicate any trend pointing to a possible workshop effect. Sometimes the participants indicated doing more or less homework in the pre-survey and post-survey. Though the results were inconsistent, they did reveal some of the significant variables indicating family commitment to mathematics. For example, most of the parents surveyed took the time daily to talk with their children about mathematics and some bought extra workbooks to supplement their resources. Most indicated that they wanted to help their children understand their homework. Comments were made that showed that the amount of time spent doing mathematics homework was very much school-driven. That is, when the teacher assigned homework this dictated the amount of time spent. If the goal is more parent involvement with the child and the subject area, this may point to the benefit of teachers regularly planning mathematics activities for parents and children to do together as part of their program.

Question 16 asked about what motivated the parent to attend the workshops. Most of the responses indicated that the prime motivation was to help their child more efficiently and increase their child's success with mathematics. A few parents were more specific in their responses: "My son is coming to math (algebra) that I may find difficult. I don't want us to get frustrated if I need to explain a concept." Another answered: "I want to try to be more open in thinking patterns." A third parent said "I would like them to be able to choose any career they would like." Yet another responded "There are always new techniques coming out and in order to explain homework I need to be up to date."

Table 14. Parent-child Time Spent on Homework

	Pre-workshop Response	Post-workshop Response
Sarah	2 hours per week	1 hour per week
Franco	Only when needed. Once a week.	Average of 1 hour a week. Hard to gauge—I have 3 kids and all are very different.
Mary	The time varies enormously from grade-to-grade. Grade 3 to 4 drills about 10 minutes an evening. Older grades may require a whole evening but then not again for a month.	1-2 hours per week.
Camila	A lot of time, it takes constant supervision and help to get the task accomplished	It differs with the amount of homework sent—up to 1 hour or more
Patrick	At this stage, not much comes home so only about 15 minutes unless we do outside workbooks and computer work.	1 hour a week—most is done in class, very little comes home.
Michael	Grades 3 to 5 10 minutes a day doing math sheets and math facts; Grades 7 and 9 as required—10 minutes a week	30 minutes a week
Gabrielle	30 minutes to 1 hour	As much time as it takes until she/he understands the problem
Pierre	Depends, but as needed; 10 minutes a day	1 hour a week
Milagros	Very little, about half an hour a week	Very little, about 15 minutes a week
Paul	I have two children—first one, very little; 2nd one—I help him daily.	Depends
Dan	Little, not much help usually required so far	Little
Andrew	4 days a week	5 days a week
Juan	1.5 hours a week	30 min a week
Julia	About 30-60 minutes a night—during the week nights	Depends—but I would say 1-2 hours a week
Bill	1 hour per week. My wife spends more time helping my son.	Not a lot. My wife helps more than I do. When there are math problems they are having problems doing, I help.
Manjit	10-20 minutes	20-30 minutes a week
Maria	Not much right now since they are not having difficulty. If they have problems, about 1-2 hours a week.	1-2 hours per week.
Mark	1 hour per week	No response
Lelei	None, my husband does it	No response

Questions 17 to 24 of the second survey asked participants how the workshops influenced them, particularly about what they may have done with the information and

how their beliefs and feelings about mathematics may have changed. Their responses, some of which I amalgamated due to redundancy, can be found in Table 13, Table 14, and Appendix E. My analysis of participant responses to these eight questions follows.

The data suggests that parents in the study often implemented the learning support strategies. From the 19 parents, 65% implemented some of the recommended ideas as presented in the workshops. These results suggest that the recommended practices can be implemented by parents with high levels of fidelity. Findings do not show sustained implementation due to the limited length of the study and further research is warranted to determine if implementation is sustained over time.

Nonetheless, the workshops provided the initial impetus for participants to try new strategies with their children and suggested a change in their understanding about learning mathematics. For example, participants said that the workshops encouraged them to acquire new resources, to use manipulatives and to talk about various processes in mathematics. Participants also indicated changes in beliefs about learning mathematics: there is more than one way to solve problems, the significance of a positive attitude and "open mind," and the benefits of working in groups. In the literature review, I summarized nine practices that mathematics educator Anghileri (2006) reports as significant in developing student understanding. Though not using the same language, parents in the current study alluded to five of these: getting students to look, touch and verbalise what they see and think; getting students to explain and justify what they have done, providing meaningful contexts to abstract situations, rephrasing students' talk and negotiating meanings. Participants were able to shift their thinking and change their practice after only two workshops describing and experiencing contemporary approaches in the subject area. This suggests that there is potential for

similar workshops to increase engagement and understanding of the education system. If parents' beliefs are misaligned with the ideas behind reform efforts, there can be negative consequences. Ideally, we need a shared vision of the goals of mathematics and other curricula. This study suggests that carefully constructed parent workshops can be an effective vehicle for creating a shared vision of educational goals.

4.3. The Case of Pierre

4.3.1. Introduction

Pierre has two children in Grades 5 and 7 enrolled in the school at which the researcher is principal. With respect to homework completion, he motivates them by giving timeframes for tasks to be done. He laughed and said "sometimes I have to threaten or cajole them but 'motivation' is a much nicer way of putting it." He rewards the children with privileges like taking a break to play outside but not with material rewards.

Pierre and his wife set rules about bedtime, chores and computer use. They don't have a television in their home but sometimes need to limit the amount of reading in the interests of getting homework and chores done and sufficient sleep. Both parents volunteer at the school by driving for fieldtrips, helping with fundraising initiatives, and monthly work-bees to deal with ongoing maintenance of the school. Pierre has his own landscaping business and personally knows the importance of mathematics in budgeting as well as for figuring out the amount of material needed for a certain area. He wants his children to do well in mathematics because:

> you never know what the future holds. We're training kids today for jobs that don't even exist yet. A positive attitude is everything. My wife and I want them to go on to post secondary without making them

> feel like they have failed if they don't. We tell them that you need education to do well and we've got education savings for them.

As a student, Pierre did well in mathematics and especially enjoyed practical applications. He often communicates with teachers when there is a school related issue he is trying to resolve with his children. The form of communication is usually a note in the student's agenda asking for more examples to work through at home and sometimes asking for discretion regarding the time needed to complete the assignment.

The reason Pierre was chosen as a case study was because he had different responses in the pre-survey and post-survey. For example, he initially identified number sense as the most important characteristic of a numerate student but, after experiencing the workshop, he changed his number one characteristic to "willingness to engage in mathematics." During the interview, he explained that he was influenced by the workshop leader's emphasis of the importance of attitude and staying positive. He knows it is important to make math fun and that, even if you don't really know how to do a certain question, you can work through it and clarify part or all of it out. He further explained that, rather than telling his children how to do a problem, he now stops himself and asks them what they understand. He confessed that, although this is hard for him and takes a lot of patience, it is worth it.

Another discrepancy in his pre-survey and post survey responses had to do with whether he believed that there is one best way to solve problems. Before the workshop, he was "unsure" but afterwards he responded "no, there isn't just one way. We learned through games that there are many different ways to get there." He further explained that he has found math websites useful for finding other examples.

4.3.2. Difficulties and Disagreements

In Pierre's account of how he assisted with mathematics at home, several differences that were framed as challenges between home and school became apparent during the interview and follow-up conversations. His disagreements have to do with content and methods as well as the language in which mathematics is learned most comfortably.

Pierre said that the content taught in today's mathematics classroom poses a difficulty for him. "The curriculum is very different today as compared to what I learned in school. It is presented differently too, technology and the metric system have modernized it." When asked more about this, Pierre explained that he often felt unable to keep up with technology and not able to help his kids with today's curriculum. Additionally, with the teachers' focus on problem solving, Pierre expressed a concern that "the basics" would be lost: "drills are important repetition that help to understand process. I hesitate to take away the need for regular drills and believe that memorization has a place in mathematics." During the interview, I learned that Pierre's two children are enrolled in weekly drill and practice sessions at a local learning centre because he feels the contemporary curriculum is deficit in this area.

The second area of disagreement has to do with methods used in today's classroom. Pierre remembers being taught with a lot of flashcards and repetition, which he found boring and unmotivating and which, he concluded, didn't enable him to understand the concepts behind subtraction and division and how they relate. Although he didn't enjoy these processes as a student, and appreciates the emphasis on critical thinking, Pierre thinks that contemporary mathematics has compromised too much in this area and does not emphasize drill and practice enough. He gave an example to do

with calculator use. He does not support his daughter using a calculator and took issue with the workshop leader's acceptance of them after a certain point in a child's learning.

Another method used in today's classroom that Pierre has difficulty with is the use of group projects. He explained that "you are only as strong as your weakest link and the division of work is an issue. I do not agree that my child's grade depends on someone else." By saying this, Pierre betrays a belief that mathematics is basically an individual activity. This was how he learned mathematics and possibly reveals that he does not see the value in group processes.

A third and final difficulty is the language of instruction. It is sometimes difficult for Pierre to explain mathematics in English as this was not his first language. Although this poses a difficulty with helping his children, particularly with terminology, it is not an insurmountable difficulty. Pierre is fluent in English but specialized terminology sometimes requires the aid of a dictionary.

4.3.3. Workshop Effect

Pierre attended the workshops without any preconceived expectations and noted that as a result "I do feel I can help them more." Before the workshop, he indicated frustration and a hesitancy engaging with his children in mathematics. After the workshop, he said that he was more willing to engage. He was relieved to learn that a positive attitude and just being part of the process were significant variables in student success (Pomerantz et al., 2005) because this made him feel that even when he doesn't understand, he can help through encouragement, getting his children to show their work and focusing on their autonomy and tenacity. "It is not okay for me or them to just give up!" he laughed.

Pierre's interview revealed his sincere interest and commitment to supporting his children in learning mathematics. He mentioned several of the significant family commitment variables, which are part of the powerful predictive framework of Wang et al. (1996) with respect to family involvement qualities that influence student achievement. For example, he makes time to talk to his kids, encourages them to work hard on mathematics, provides them with extra resources and communicates the belief that mathematics is important. Furthermore, he insists his children do their homework and expects them to complete college.

4.3.4. Confidence, Motivation and Change

Pierre's surveys and interview reveal a confident and motivated individual in relation to family and career. Although he said he was "unsure" when asked in the survey if he felt more able to help his children as a result of participation in the workshops, he retracted this saying that he did in fact feel more able to help. He said he had gained confidence and an understanding of the importance of a positive attitude. He further explained that the way he helps his children has changed in that he is more patient and tries to make learning fun. He specifically mentioned that the workshops motivated him to explore useful mathematics websites and to learn more ways to help his children.

4.3.5. Summary

Perhaps the most telling information gleaned from the case study of Pierre relates to the research process itself. Had I not interviewed him, I would have had an incomplete and somewhat inaccurate portrait of this father of two and his involvement in their learning. Rather than expecting to clarify and deepen understanding of the survey

data, I sometimes got conflicting information through speaking with him. Time to reflect and try some of the recommended practices as well as the time to mentally prepare for the interview resulted in new data and a richer description of Pierre's experience of the workshops. Pierre's concluding remarks may be important reasons in themselves for leaders to provide curriculum-related workshops. He said "I didn't realize that math can be fun. I enjoyed the workshops and found them positive and fun—a good refresher on the importance of positive attitude and patience." His emphasis on how the workshops impacted in the affective domain is perhaps the strongest leverage parents can use to influence their children's learning.

4.4. The Case of Juan

4.4.1. Introduction

Juan is the single father of two boys enrolled at the school at which the researcher is principal. To motivate them to complete their homework, he finds himself saying "you are not playing…before you do anything else you have to finish your homework." He describes his children as easily distracted and homework gets done more efficiently when he has time to sit beside them, prompting them to stay on task and ask probing questions. Sometimes he needs to find additional examples or reword questions. He has a rule of 30 minutes home study whether or not they have assigned homework so sometimes his children do practice sheets, flashcards or play approved computer-learning games.

Juan also has rules about bedtime, chores and the amount and content of television watched. He has no time to volunteer at the school. He is able to drop his kids off on Wednesday mornings so communicates with the teachers then. He has found this

communication with his sons' teachers to be essential since his sons tend not to tell him when they are struggling.

As a corporate trainer, Juan often needs to collect, analyze and represent data visually so he is well aware of the value of mathematics. Although he did well in high school mathematics, he found a university course in calculus difficult and chose not to take further courses. He attributes his general facility with mathematics to his ability to learn languages (he speaks five). He studied linguistics and has developed his analytic thinking skills which also serve him in his career. He views being able to do mathematics as an important life skill. Juan is concerned about his children's ability to do well in mathematics because "they have trouble with the basic fundamentals. For example, they don't understand how division and multiplication are related and they are in Grades 5 and 6!" Juan frequently discusses future plans with his two sons and helps his children explore their interests by taking them to visit the workplaces of clients so that they can see for themselves what is involved in different careers.

The reason Juan was chosen as a case study for this research is because his ideas about what describes a numerate student changed from before to after the workshops. Initially, he said "number sense" was most important and then he changed to "enthusiasm." When asked about this change, he said:

> I realized that if you are enthusiastic, you can tackle anything. This is a general principle in life and certainly in my work as well. The presenter really impressed this upon me and it made sense. He made the tasks fun and helped me to look at mathematics differently—in a better light.

Another reason Juan was chosen was because I found it interesting that, before the workshops, he said he preferred drill of basic facts and afterwards he said he preferred

geometry. When asked about this change from an arguably less cognitively demanding activity to a more demanding and spatially-oriented activity, he said it was the workshop presentation that was "fun and peaked my interest." The workshops helped him feel motivated and encouraged to learn more about this area of mathematics.

4.4.2. Difficulties and Disagreements

Difficulties for Juan revolved around childhood memories of drill and practice with the multiplication tables. Every Friday at his elementary school, the intermediate classes had to take a timed test of the tables and since this was the exact same sheet every week, he remembers just memorizing the answers sequentially. Remarkably, he stills feels guilt about cheating and remembers the competition, pressure and anxiety surrounding these weekly tests. He hated being singled out for not knowing the answers. He also remembered the influence of his mother: "I remember my mom always saying how bad she was at math, which made me feel like there was nothing I could do to get it." He explained that he felt like he was trapped in a world where math would never make sense and he felt powerless to overcome his deficiencies. As an adult, Juan's biggest obstacle is time—he finds that the mathematics his children bring home is quite involved and remarked that "this isn't fair because not all families can measure up to that." At the same time, Juan acknowledges that "mathematics education is far superior today. It is more hands-on, manipulative-based than when I was in school and we tended to focus mainly on rote drills." Juan explained that another difficulty is thinking of other examples in order to "make it real for them." Word problems and the times tables are both "huge hurdles for me to overcome with my sons and I try not to get frustrated but I usually do."

4.4.3. Workshop Effect

Juan found the workshops personally motivating and that they gave him ideas for how to help his children. "Because of the workshops, I want to make more effort to make it real for my kids. I have more confidence and feel good about being able to help even when I don't know the answers." He also said that the workshops "gave me a boost because I am not a math-inclined person." This indicates to me that the research into self-concept with respect to mathematics and view of what constitutes mathematics needs to be better disseminated. Contrary to his self-evaluation, I would consider Juan to be *math-inclined* since at work he collects and analyzes data. Although he enjoyed the workshops and benefitted in increased confidence, Juan did not find the workshops directly helpful in the matter of his sons' difficulty with multiplication saying "I was not satisfied with the answers of the presenter about multiplication." Juan summarized the workshop's overall effect saying "the workshops were time well spent."

4.4.4. Confidence, Motivation and Change

Juan indicated that the workshops gave him new ideas, coping strategies and increased confidence. They prompted him to take various perspectives when doing problems and made him feel more able and inclined to help and encourage his children. After the workshops, he said he feels motivated to make more of an effort and to learn more about how to help his children with schoolwork. Juan is planning to change the way he communicates with his children's teachers. Instead of just asking how they're doing in general, "now I will be more on the ball—especially when my kids are anxious about math. I will be more assertive and ask for extra help for them when I know they need it."

4.4.5. Summary

Juan is a thoughtful individual who has high, yet supportive expectations of his children. A continual learner himself, Juan values mathematics and education in general. His responses highlighted areas that could be explored and developed, such as self-concept of learners, understanding of what constitutes mathematics, and provision of a resource bank of *real examples*. This case study demonstrated the lived reality of several significant family commitment variables that contribute to student success. For example, including interactions that are affectively positive, positive beliefs (Pomerantz et al., 2005) as well as direct involvement (Cooper, Lindsay, et al., 2000) and enjoyment doing things with kids (Wang et al., 1996).

Asked about the value of workshops for parents, Juan said:

> I think they are very valuable and I thank you for doing this because I think a lot of parents are too proud and unwilling to say I need help with this. Word will get around and more people will come if you do this again.

4.5. The Case of Mary

4.5.1. Introduction

Mary is a parent who establishes structures and routines for her three children. She described for me the area set aside for her children to complete homework where she has assembled the necessary supplies and calm music playing. She often makes the kids a cup of hot chocolate to soothe them and tries to make them comfortable so that they don't mind doing homework. All three children sit together at the homework table and she is in the same room available to help as needed. She uses a kitchen timer to help keep them on track and to give regularly scheduled breaks as a reward for

consistent effort. Mary frequently volunteers at the school and communicates regularly with teachers. She has a career as a scientist involved in molecular genetics and while she doesn't use mathematics in her work (culturing bone marrow and analyzing chromosomes), she realizes the importance of mathematics saying "it opens so many doors, if they don't do well they are limited in careers later." The future of her children is a high priority for Mary and her husband. They communicate high expectations and are actively involved in saving and investing for their education.

The reason Mary was chosen as a case study was because some of her responses to the pre-workshop survey differed in perplexing ways to her responses in the post-workshop survey and I wanted to explore this further. For example, in the pre-workshop survey, Mary said the most important quality of a numerate student is willingness to engage in mathematics. However, in the post-workshop survey, she said that communication is the most important quality of a numerate student. The opportunity to discuss this discrepancy during the one-on-one interview allowed her to explain that "both are important to me, I just have a lot of fear surrounding mathematics and thought that communication would help me get over my fear and allow me to engage."

I found it puzzling that she identified a fear of mathematics since in the interview I also learned that as a student she loved mathematics, especially calculus! She also loves analytical thinking. What causes fear and hesitation regarding her ability to help her children is not knowing contemporary methods of learning mathematics. She feels "out of touch" and that's one of the reasons she was excited about attending the workshops.

There was also a difference in her pre-and post survey responses regarding what she does when her children have difficulty getting an answer to a problem. In the pre-

survey, she said "I try to take a step backward with them to find what concept is not being understood" and in the post-survey she said "I ask them to explain to me their reasoning and find where the problem lies." This post-workshop response is congruent with her post-workshop emphasis on communication and perhaps points to a deeper understanding of teaching and learning mathematics. For example, she also said that "mathematics education today is much superior to when I was in school. It is more relevant to life and there isn't the same focus on rote memory. There is a better balance."

4.5.2. Difficulties and Disagreements

Mary openly admitted her fear of mathematics and sometimes her avoidance dealing with problems her children encounter. She said she has to draw it out of them because she thinks they sense her hesitation to engage in mathematics and she realized "I need to get more information to overcome my fear so I don't limit my children's success by passing on a math phobia." Mary expressed another difficulty in that she sometimes feels isolated and does not know how to help her kids. She didn't know where to go for assistance or how to overcome her difficulties.

4.5.3. Workshop Effect

Mary seemed to take away quite a few practical strategies from the workshop. First of all, she learned that it is fine to do things different ways. Growing up, she often had a different way of solving mathematics problems because her parents would teach her a different way at home. She always represented her answers in the manner that the teacher expected however and did not reveal that her process was different from what the teacher had taught and required. One of the strategies she enjoyed as a child was

visually depicting the solution to a problem. Although she rarely included her drawings in the work she submitted, she relied heavily on them. She specifically mentioned: "The presenter said it is a good idea to draw a picture, even if the question doesn't require this as part of the answer. I will encourage my children to do this."

Before the workshops, Mary indicated that she felt frustrated doing mathematics with her child and made no mention of contacting the teacher for help. After the workshops, however, she said she experienced increased confidence saying "I can help. I need more time to make this judgment but I probably feel less alarmed if the understanding isn't there." When asked why she no longer felt as frustrated or alarmed she said she now realized that making mistakes is part of the learning process. "Because I sometimes have difficulty with the material it is difficult to help my kids and I don't have a firm grasp." She said in these instances she will now contact the teacher for help. Both responses may point to a change in her understanding of the role of the teacher and the process of learning mathematics.

The workshops also impressed upon Mary that other parents experience the same challenges. "It is just that parents don't tend to talk about difficulties," she said and "the workshops gave me confidence and comfort knowing that other parents have similar difficulties." She gave an example saying that the workshops improved her understanding of the approach to teaching and learning mathematics and now she knows what questions to ask her kids, gets less irritated, thinks of different ways of approaching problems and gets her children to explain their process. Furthermore, knowing more about teaching and learning mathematics in today's classroom, she feels better equipped to converse appropriately with teachers.

4.5.4. Confidence, Motivation and Change

Mary indicated her level of confidence and enthusiasm for mathematics not only by attending the mathematics workshops, but by her open critique of the school's lack of inclusion of parents in the instructional program. She felt strongly that some parents have practical experience of mathematics applications that they could speak about and demonstrate to students. As the principal of the school where Mary's children attend, I eagerly embraced her suggestion of seeking parents as guest presenters. Mary also felt it would be a good idea to have more workshops about curriculum for parents, so that they could share ideas and continue to learn. She specifically suggested a workshop on essay writing saying, "I would love ideas on how to encourage growth in writing skills." Of the 19 participants who completed the second survey, 16 or 84% echoed this request for more curriculum-related workshops.

4.5.5. Summary

The workshops seemed to impact Mary in a couple of significant ways. Firstly, she said, "I didn't realize that the philosophy of teaching math had changed so much. I didn't realize our kids do not do repetitive questions to emphasize a concept and that problem solving is the focus now." Mary remembers that, when she was in school, it "used to be the other way around and the new way is more interesting because the kids now know why they are learning." Secondly, she said, "I appreciate gaining insight into the modern teaching process. I am better able to understand my kids' daily experience and work through problems with them." Mary's participation in the workshops supports the notion that carefully constructed parent workshops can be an effective vehicle for creating a shared vision of educational goals.

4.6. The Case of Mangit

4.6.1. Introduction

Manjit is a mother of four children aged 9 to 16. Her younger children are enrolled at the school at which the researcher is principal. She is involved in their home learning through provision of a quiet study area and being available to help as needed. Manjit and her husband communicate high expectations that their children do their best and complete assignments. As a Special Education Assistant, Manjit has skills that easily transfer to homework help. Her husband, who operates a financial management firm, also has a facility with inquiry, data and mathematics. Manjit remembers doing well in math as a student though she didn't really enjoy it. She particularly mentioned her father's assistance, and motivating encouragement as a contributing factor to her success. The family has rules about bedtime and chores and rarely watches television. They find time to volunteer at school and communicate regularly with teachers.

Manjit was chosen as a case study for this research because her ideas about what constitutes a numerate student changed from before to after the workshops. She identified *ability to do basic facts* before the workshop and added *word problems* and *geometry* following the workshops. When asked about this shift she said that the presenter focused on problem solving and that there are multiple ways to the answer. She mentioned that provision of visuals was instrumental in her understanding of the problems he presented and that, without them, she would not have had access in the process.

4.6.2. Difficulties and Disagreements

For Mangit, difficulties stemmed mostly from what she remembered and felt about her experiences as a student of mathematics. She explained that she was great with procedures but not as good with abstract concepts. She said, "I felt like I was faking it in class a lot of the time" and then further elaborated with an example. She could recite the times tables by heart but did not know how multiplication and addition were related. She didn't really understand what the times tables meant so that when obvious errors were made, she didn't understand why the answer didn't make sense. She said that another difficulty was that the way she remembers being taught was that there was one correct way of solving a problem and she was not permitted to deviate from this procedure. Upon reflection, now as an adult, she realizes that this limited her conceptual understanding of mathematics, as she put it, "I felt I couldn't think outside of the box so I didn't challenge myself; I just wanted to get it right."

With some material in mathematics, Manjit admits "I feel frustrated, helpless and tempted to give up because I doubt my abilities." For example, she encounters difficulties when working with her children on mathematics at home when there are no visual supports or extra examples. In the follow-up questionnaire, she said "I often get confused with word problems and see my child shut down before their complexity."

4.6.3. Workshop Effect

Manjit really enjoyed the practical examples and strategies provided by Dr. Neel in the workshop. She had noted several of the recommended books and has already purchased and explored one of them with her youngest son. She also said that instead of telling her children how to approach a problem, she will "let my kids explore the materials before diving into the lesson." Although she was less enthralled with the

suggested online math sites, she did recognize the potential value of online math games because she said she would encourage her son to look into them. Manjit emphasized how much fun she had at the workshops and that she found the presentation of problem solving empowering. She appreciated the presenter's comparison of Canadian and American monetary values and promotion of group processes saying, "these examples and ways of doing math are relevant, encourage questions and are fun." She elaborated by saying that adults and students all benefit from knowing why we are learning a certain topic. The *why* often puts it in context provides added motivation to learn and adds value to the lesson.

Before the workshops, Mangit indicated that she preferred to engage in practice of drill and rote mathematics with her child. After the workshop, however, she said she still enjoyed basic facts and drill but added an interest in problem solving and geometry. Also, before the workshops Mangit said she would never contact the teacher but afterwards she felt she would feel more comfortable doing so and will ask more specific questions. Manjit said that the workshops helped to increase her confidence and improve her attitude towards mathematics saying that "through interaction in small groups we could bounce ideas around and understand it better."

4.6.4. Confidence, Motivation and Change

Manjit enjoyed participating in the workshops and said she would be interested in similar curriculum-related workshops about reading comprehension strategies. The workshops increased her confidence and motivation as well as gave her practical strategies she can use with her children. She appreciated the way the workshop was organized saying that talking with other parents about their challenges and strategies working with their children was helpful. Manjit's overall knowledge about changes in

teaching and learning was enhanced by the discussion about changes in mathematics education since she was a student.

4.6.5. Summary

Manjit summarized her opinion about mathematics in the follow-up questionnaire saying:

> being fluent in math is as necessary as being fluent in English. Many things in life can be made easy with mathematical understanding … Practice, perseverance and practical application are the most important skills.

Even though she sometimes gets overwhelmed herself, Manjit emphasized the importance of social, collaborative skills when learning math and letting students enjoy the struggle of challenging problems. When asked to elaborate on this she returned to the example of her father who tried to make learning math fun by fostering inquisitiveness and exploration and by providing visuals to support her understanding. She chuckled adding "even blind squirrels can occasionally find a nut!"

This case study demonstrated the lived reality of several significant family commitment variables that contribute to student success. These variables are: providing meaningful contexts to abstract situations (Anghileri, 2006); autonomy supportive and process focused (Pomerantz et al., 2005); direct involvement and elimination of distractions (Cooper, Lindsay, et al., 2000).

CHAPTER 5.

DISCUSSION

5.1. Introduction

The current educational climate calls for parental involvement and school leaders need to take the initiative in facilitating this involvement. This study looked at parental involvement with a focus supporting the learning of mathematics at home. A group of parents chose to attend two workshops with the goal of learning more about the content and methods of mathematics in today's classrooms and how they can support their children at home. Participants completed pre- and post-workshop surveys as well as a follow-up survey about the impact of this experience and four parents were chosen as case studies to be interviewed. The resulting report of this study tells a story about how these parents are involved in their children's learning of mathematics, the difficulties they encounter and what they found helpful, motivating and confidence-inspiring as a result of the workshops they attended. Though limited in scope, the case studies are enlightening and provide potentially helpful and practical implications for educators, particularly for district leaders and school principals.

5.2. Research Questions

The overall research motivation was: "How can elementary school principals design a parent workshop that engages parents to effectively support improved learning at home?" This will be addressed in Section 5.5, Suggestions and Considerations for

District Leaders and Principals. The three underlying questions derived from this overall research question will be answered first.

5.2.1. What difficulties do parents express with respect to their involvement in mathematics?

Participants expressed five difficulties related to their involvement in mathematics:

- Bridging their own experience of mathematics with their child's experience,
- Negative childhood memories of mathematics,
- Increasing cognitive demands of the intermediate curriculum,
- Communicating with teachers, and
- Children's lack of perseverance.

Each of these difficulties will be explained below.

Parents have difficulties bridging their own experience and conceptions of mathematics grounded in computational proficiency with the teaching and learning in contemporary mathematics classrooms, which tends to be more oriented towards problem solving. Mary said "I didn't realize that the philosophy of teaching math has changed so much. I didn't realize our kids do not do repetitive questions…and that problem solving is the focus now." The parents showed a lack of understanding of the rationale for the ways mathematics has changed and a realization that this lack of information has disempowered them. Pierre expressed confusion, frustration and disagreement over the use of calculators and technology and the method of collaborative processes and group projects.

Sometimes it is not just bridging the gap that poses the difficulty, but the childhood experiences themselves. A few participants shared negative childhood

memories like the anxiety caused by timed tests or a parent who was negative towards mathematics. These experiences have had the effect of imprisoning the participants in the fear and anxiety of the past.

Another difficulty expressed by participants was the increasing cognitive demands of curriculum in the intermediate grades. Several participants elaborated saying that they encounter frustration, stress, anxiety, and confusion, when faced with mathematics problems. They identified thinking of real examples and grappling with specialized terminology particularly challenging. Michael related that "parent participation [should be] expected only when the student needs help/clarification. Parent participation should not be required everyday." Paul expressed his frustration in the follow-up questionnaire saying "I am not a teacher and I feel the expectation to help children is greater than when I went to school. I think problem solving seems to be very difficult for both the child and adult."

Some participants shared that contacting the teacher is a difficulty because, although they know their child is having problems, they cannot identify the exact area of difficulty and therefore did not know what questions to ask. This makes them too uncomfortable to ask the teacher for help. This contributes to a sense of isolation and helplessness. A quote from Juan's case study provides a possible cause of this isolation as well as motivation for educators to organize parent workshops: "I think a lot of parents are too proud and unwilling to say I need help…word will get around and more people will come if you do this again."

The final difficulty expressed had to do with dealing with easily distracted children who lack perseverance faced with a challenge. The resulting tension and arguments in the parent-child relationship is a struggle that some participants face daily.

5.2.2. What is the effect of attending parent workshops about supporting students in mathematics?

In their evaluation of the workshop experience, parents expressed that both content and process were important in the workshops. Of 17 respondents, 76% commented that the workshops gave them good information about how mathematics has changed as well as fun strategies to try with their children. Juan's comment illustrates this well:

> I realized that if you are enthusiastic you can tackle anything. This is a general principle in life and certainly in my work as well. The presenter really impressed this upon me and it made sense. He made the tasks fun and helped me to look at mathematics differently—in a better light.

Paul identified his key learning from the workshop saying: "What I mainly learned from the course was there are many different ways to get to the answer and that is what I focus on."

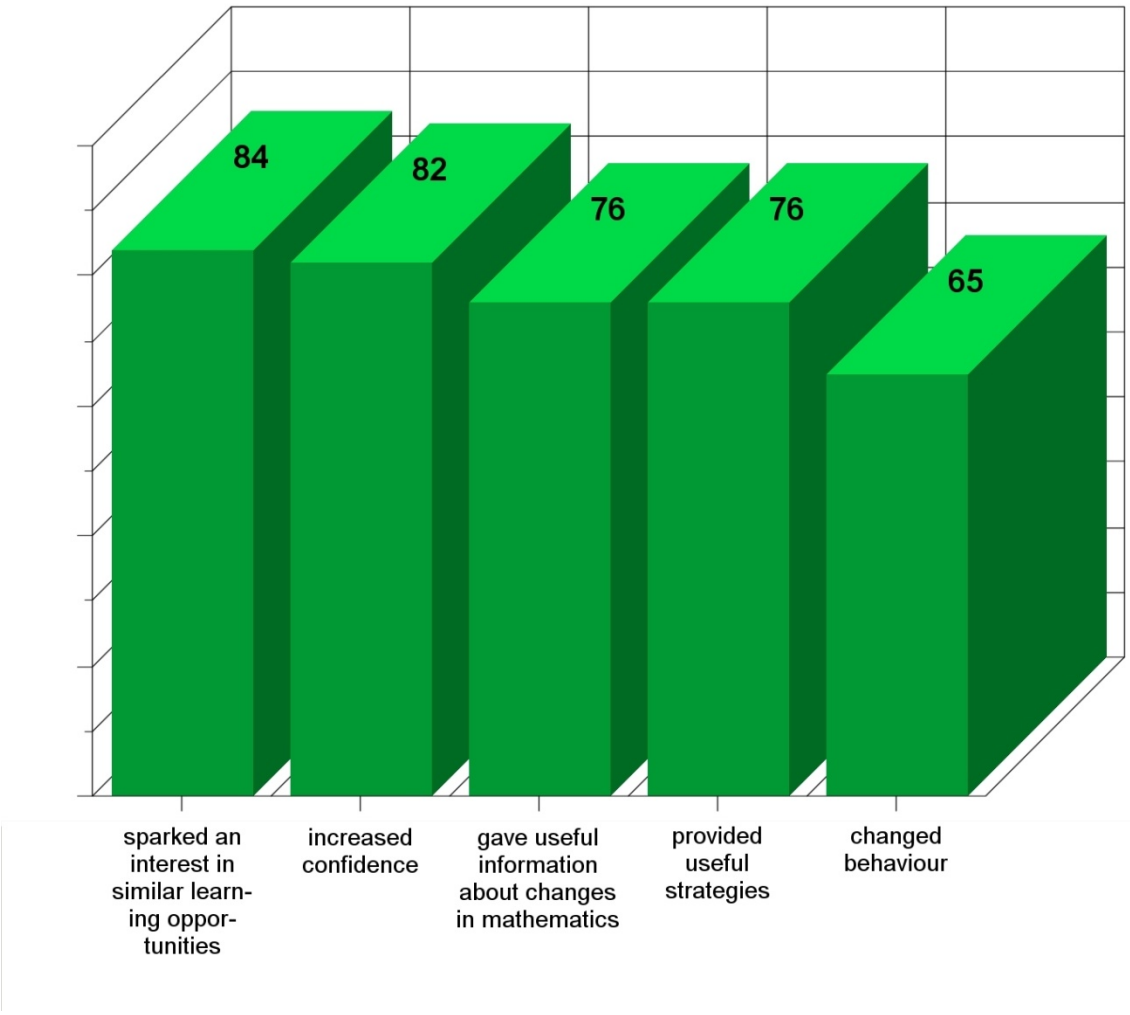
Eighty-two percent of participants commented that the workshop helped them feel more able to help and provoked changes in their behaviour. Instead of telling their children how to do a problem, they now ask more questions and let them struggle with it longer. The workshop's effect on getting participants to think of other examples when doing mathematics with their children was negligible. Sixty-five percent of participants said they have implemented some of the strategies recommended at the workshops. For example, in their responses to the post-workshop and follow-up surveys and during the interviews, participants mentioned having tried the following strategies that were presented at the workshops:

- facilitating hands-on experiences, i.e., using manipulatives
- promoting different representations and solution approaches

- playing games, i.e., logic puzzles, card games like War, probability games with multi-coloured candy, using blocks and shapes to create patterns
- encouraging, demonstrating confidence and positive attitude
- asking thought-provoking questions to ascertain what the child already knows
- exploring literature that connects numeracy and literacy, and
- getting children to *talk through*; communicate their understanding aloud.

Affective changes were also evident in the survey responses of participants but this change pertained to the adults and not to their children. Two parents who had felt negative about mathematics before the workshops said that they felt more positive about mathematics after the workshop. There was no change in how the majority of respondents felt about mathematics before and after the workshops. In the estimation of the parents shortly after the workshops, the workshop did not appear to indirectly influence the self-concept of their children. Anecdotal data indicated that, for some participants, communication with teachers was affected by attending the workshop. They expressed greater comfort contacting teachers and that they would be more specific and assertive in asking for help. Finally, attending the parent workshop sparked an interest in most participants (84%) for similar learning opportunities about different curricular domains.

Figure 1. Workshop Effect



5.2.3. What gives parents confidence and motivates them to be involved?

When I probed into how the participants gained confidence and motivation as a result of participating in the workshops, there were four themes that emerged from their responses:

- the content of the workshops relating to changes in mathematics
- the interactive, fun ambiance during the workshops
- the emphasis on affect, and
- provision of helpful resources.

Several parents appreciated the content of the workshops related to how mathematics has changed. They mentioned a greater appreciation for the differences between their ways of doing mathematics and those that their child was being taught at school. For example, it was liberating for some to hear that making mistakes is part of the learning process. As a child, Mary was not encouraged to draw in her mathematics classes yet used this technique almost clandestinely at home. The likelihood of her encouraging her own children to explore drawing as a strategy in mathematics problems increased because, her experience was affirmed and validated. She said "the presenter said it is a good idea to draw a picture, even if the question does not require this as part of the answer. I will encourage my children to do this."

Most participants made some mention of their appreciation for the way they were invited and welcomed at the workshops and how they were facilitated. It was significant to many participants that they found the workshops interactive and enjoyable. Several quotes from the case studies illustrate this:

> "I did not realize that math can be fun. I enjoyed the workshops and found them positive and fun."
>
> "The presentation was fun and peaked my interest in geometry."
>
> "Through interaction in small groups, we could bounce ideas around and understand it better."
>
> "Talking with other parents about their challenges and strategies for working with their children was helpful."

The emphasis on the importance of positive attitude, patience and perseverance also fostered confidence and motivation among the participants and encouraged them to be involved in their children's learning of mathematics. Juan volunteered that the workshop experience had lead to more sensitive interactions during homework time where he tries to adjust his strategies to fit with the child's rather than simply show how to do a

problem. He specifically referred to the workshop presenter's emphasis on encouragement and perseverance even when you do not know how to solve a problem, saying that it helped shift his attitude towards more understanding and encouragement and less frustration and struggle. He also said that "because of the workshop, I want to make more effort to make it real for my kids. I have more confidence and feel good about being able to help even when I do not know the answers."

Many parents gained in confidence as a result of learning about the importance of the role a positive attitude plays in student achievement. When asked to identify the most important skills they would like to see their child learn in mathematics, five of the eight respondents to the follow-up questionnaire referred to affective skills such as having fun, practice, perseverance and enjoying the challenge.

Finally, participants gained in confidence and motivation to be involved because of the provision of recommended mathematics resources accessible through the web or in print. This gave them an increased sense of self-efficacy and empowerment "knowing where to find resources to help solve math problems or concepts." Several participants mentioned that they felt they were better equipped and felt more capable to address future challenges as a result of attending the workshops.

5.2.4. Conclusions

Much research rightly focuses on lower socioeconomic families and strategies to assist them in helping their children be more successful academically. An extensive literature review process accessing hundreds of studies has led me to believe that there is less literature describing similar efforts with middle to upper socioeconomic families. Since the education enterprise is for all and practitioners must serve a range of families with diverse needs, it stands to reason that studies with all stakeholder groups are

required to inform evidence-based practice. This study shows that adults with post-secondary education, middle to upper socioeconomic parents can be intimidated by mathematics and not know how to help their children. It also shows a sincere interest among this group of parents in learning more about what and how mathematics is taught in today's classrooms. In this study, attending the parent workshops sparked an interest in most (84%) participants for similar learning opportunities about different curricular domains. The sentiment expressed by Julia was similar to that expressed by several participants:

> It is important for my child to do well in mathematics because it greatly affects other skills and areas of life such as music, science, shopping, budgeting etc. Also I do not want him to struggle with math as I did in high school.

In the surveys, but more obviously in the interviews, the differences in the parents' experience of another school system and changes in the curriculum over time seemed to be a remarkable discovery for many participants. Although it was not initially an impetus for them to attend the workshops, the discovery may have led parents to more of an awareness of how diversity and reforms impact their ability to assist with learning at home. Several of the participants reported that they realized education has changed significantly and that if they are to support their child at home, they have to learn how to make the transition between their own mathematical practices and experience and the ones their child is experiencing at school.

There is a strong body of research that shows students make more progress when the family is supportive of the work of the school and involved in its activities and, reciprocally, when the school is receptive and respectful of the experiences and knowledge of parents. This study, though limited in scope and time, points to the effects

of regular, permanent programs of partnerships with families. While partnering with families is not a new idea, this study adds to the concept by further illuminating specific ways in which educators can support parents through the vehicle of the workshop. It also demonstrates how, as a result of increased understanding, parents can become supporters of curricular reforms.

5.3. Implications for Further Research

Spillane (2004) shows that sustained engagement with an idea is critical for deep conceptual change and that such understanding takes years rather than months to acquire. With this in mind, future research could attempt a longitudinal study of parents, perhaps in comparative sociodemographic groups, as their children go through the school system to see how their engagement changes as their children grow and as they receive more learning opportunities themselves. It would be interesting to further explore the potential impact on children's self-concept when their parents attend workshops meant to help the parent-child relationship. In this limited study, parents indicated that the workshop did not appear to indirectly influence the self-concept of their children. A longitudinal study could be designed to investigate this further.

As far as educational policy is concerned, in situations where home backgrounds differ markedly from school backgrounds, children might ultimately benefit from research about how educators can assist parents in bridging gaps (de Abreu, Bishop, & Presmeg, 2002). This is not how curricular reforms are generally implemented however. Although parental involvement is encouraged, the research largely does not focus integrating home and school approaches. It is instead presented as parents supporting school practices and may therefore neglect the actual experiences of the child at home (de

Abreu & Cline, 2005). The current study highlights the need to examine the impact of curriculum reforms on parents and how to effectively bridge gaps and cross boundaries between home and school.

Further research might also focus on principal leadership in the area of motivating and guiding teachers in improving home-school communication or learning at home. This is recommended in the parent involvement literature (Epstein et al., 2002; Epstein & Sanders, 2006; Shartrand, Weiss, Kreider, & Lopez, 1997) yet is "conspicuously absent from most [principals'] … visions of family engagement" (Auerbach, 2009, p. 13). In the area of research methodology, it would be important for future researchers to pretest any surveys used. I found that, in a question on one of the surveys, participants interpreted the survey item differently than I had intended. Consequently, the resulting data from that question was less useful to me. Therefore, future researchers should thoroughly pilot the surveys and analyze the responses of a small sample of individuals before starting the main study. Results of the pilot should be used to refine the surveys so that the data collected is most beneficial.

5.4. Suggestions and Considerations for District Leaders and Principals

"For schools to be effective, it is not enough to establish links with the home: what are needed are comprehensive and permanent programs of partnerships with families and communities" (Fullan, Hill, & Crevola, 2006, p. 94). Bryk, Sebring, Kerbow, Rollow, and Easton (1998) similarly highlight the importance of schools pursuing systemic change saying:

> Schools pursuing a systemic agenda have a 'client orientation'. They maintain a sustained focus on strengthening the involvement of parents

> with the school and their children's schooling. They also actively seek to strengthen the ties with the local community and especially those resources that bear on the caring of children. As these personal interactions expand and become institutionalized in the life of the school, the quality of the relationships between local professionals and their community changes. Greater trust and mutual engagement begins to characterize these encounters. (p. 127)

These comprehensive, permanent, systemic programs are a result of reciprocal roles among and between schools and parents. Sergiovanni (2005) illustrates this reciprocity when he refers metaphorically to leadership as "bubbling up and trickling down." Survey Question 12 (Table 12) asked "How do you feel when your son/daughter is doing well on the exercises but struggling on the word problems?" and is a good example of how a carefully constructed parent workshop can assist educators in building trust and engagement. The responses to the question after the workshops were often nuanced with a willingness to try, help the child understand and make connections as well as more of an interest in finding out why the child experienced difficulty. Effects were subtle, yet significant and indicative of the promise of permanent, systemic programs.

A very helpful resource for principals seeking to create systematic family engagement is *Beyond the bake sale: The essential guide to family-school partnerships* (Henderson, Mapp, Johnson, & Davies, 2007). This resource promotes the work of the Harvard Family Research Project which reports data from six districts in the United States that all have a systematic family engagement strategy. In total, the data represent 677 schools and 333, 192 students. These data reveal core components of successful systems, best practices and recommendations for policy.

The three core components are:

- creating districtwide strategies,
- building school capacity, and

- reaching out to and engaging families.

The five best practices are:

- a shared vision of family engagement including parents' support at school and with learning at home;
- purposeful connections to learning as evident in the district's strategic plan, school improvement plans and parent-teacher conferences;
- investments in high quality programming and staff that is based on organizational, rather than individual approaches;
- robust communication systems between district offices, school staffs, families and community members who share information in reciprocal and meaningful ways, and
- evaluation for accountability and continuous learning based on collection and use of data.

Recommended policies to build stronger family engagement are those that:

- create the infrastructure for districtwide leadership—for example, the districts profiled have a senior level employee responsible for family engagement;
- build capacity across districts to reduce duplication and maximize efficiency;
- ensure reporting, learning and accountability—for example, integrating family engagement into performance evaluations, and
- help districts understand, design and implement strong evaluation strategies.

(Harvard Graduate School of Education, 2010)

The Harvard Family Research Project has developed a logic model that can be used for strategic planning of family engagement programs (Westmoreland, Rosenberg, Lopez, & Weiss, 2009). Graphically displaying the plan as opposed to listing steps is useful because visually depicting a concept is an effective learning instrument

The first and most important suggestion for district leaders and principals is to allocate resources, engage in conceptual design and implementation of a parent involvement initiative. This capacity-building, beginning with awareness, creates

intellectual capital by emphasizing the development of knowledge, competence and skill (Serviovanni, 2005). The commitment of school leaders is vital to school-community connections, yet is "insufficiently addressed in training for administrators" (Auerbach, 2009, p. 9). It is however, widely documented in the literature that leadership is fundamentally a moral activity (Culbertson, 1963; Greenfield, 1995; Foster, 1984, 1986; Harlow, 1960; Kidder, 2005) that "requires a distinctive value framework" (Graff & Street, 1957, p. 120). I contend that district leaders can strategically influence this value framework and subsequent activity so that family involvement becomes part of principals' beliefs and values and is recognized as constitutive of the role.

Devos and Bouckenooghe (2009) posit, "the explicit and tacit knowledge of principals shapes both their role conceptions as school leaders and their vision. Role conception, in turn, directs actions, strategies, and routine behaviors" (p. 177). What is needed is for principals to be aware of their role conceptions and build a knowledge base about parent involvement in education that becomes integral to their value framework and role conception.

Taken together, this enhanced knowledge base, value framework and role conception creates fertile ground in which school-parent partnerships may germinate and flourish. Parent involvement is not dependent on the leadership of a principal who is charismatic and outgoing. Rather, it depends on cognitive leadership that focuses on the message, the purposes, the values, and the underpinning ideas. "It is cognitive leadership that counts the most, not personality-based leadership and not bureaucratic leadership" (Sergiovanni, 2005, p. 159). Therefore, for parental involvement to be seen as a priority, I argue that more attention could be paid by school district leaders to principals' values and beliefs about the role of parents in education.

How might district leadership enhance the knowledge based, value framework and role conception of principals with respect to parent involvement? While getting principals together to share local problems and practices is undoubtedly useful, educators also need to consider the value of national-level descriptive data about problems and practices. Therefore, school district leaders might establish discussion and research groups in the context of a learning community model to explore the research on the effects of parent involvement, the studies that show how parents act as resources for their children and the ways that they might be supported in doing so. The district would also include parents in the learning community and invite them to curriculum-related workshops. As my study suggests, parents would benefit from learning about the rationale behind the approach to mathematics instruction. In discussing the difficulties with the contemporary approach to the teaching of mathematics, Pierre, one of the case studies in this study revealed several potential topics for discussion and explanation with parents. Pierre indicated that he feels current practices have compromised too much and de-emphasized drill and practice to the detriment of students. He has difficulty with group projects and the use of calculators. Other parents may benefit from learning about the rationale behind such instructional approaches. In general, participants in this study expressed five difficulties related to their involvement in mathematics:

- Bridging their own experience of mathematics with their child's experience,
- Negative childhood memories of mathematics,
- Increasing cognitive demands of the intermediate curriculum,
- Communicating with teachers, and
- Children's lack of perseverance.

Providing parents opportunities to develop knowledge and strategies aligned with the curricular approach used in the school system gives them access to the cognitive and

affective processes of contemporary teaching and learning as experienced by their children. Additionally, school district leaders could offer professional development for teachers on the topic of how we teach students to be aware of their beliefs about mathematics and how to facilitate parent involvement through interactive homework.

At the local school level, educators might also offer opportunities for parents to review course outcomes and strategies for helping their children achieve success in school. These might include recommendations of relevant print and other resources to support student success in mathematics (Appendix F). Home communication and school websites could include strategies for parents when learning in various curricular domains. If communication in English is a barrier, perhaps volunteers could be sought from the community to translate these strategies as well as assist with parent-teacher conferences and other school functions such as family math nights. Parents could be invited to spend time in the classrooms to enhance their understanding of the child's learning experience. Finally, a reasonable amount of homework should be interactive and provide the necessary tools, materials and information for parents to be involved. Parents should receive clear guidelines, should not be expected to teach the content and should ask questions that help students clarify and summarize what they have learned (Epstein, 2001; Epstein & Becker, 1982; Van Voorhis, 2003). The potential results of such efforts to engage parents with learning at home are illustrated well in the current study in the case of Pierre. Pierre attended the workshops without any preconceived expectations and noted that as a result "I do feel I can help them more." Before the workshop, he indicated frustration and a hesitancy engaging with his children in mathematics. After the workshop, he said that he was more willing to engage. He was relieved to learn that a positive attitude and just being part of the process were significant variables in student success (Pomerantz et al., 2005) because this made him

feel that even when he doesn't understand, he can help through encouragement, getting his children to show their work and focusing on their autonomy and tenacity. "It is not okay for me or them to just give up!" he laughed.

This study focused on the vehicle of the parent workshop as a tool for principals to facilitate greater understanding of strategies that enhance learning both inside and outside school. The data suggests that parents in the study often implemented the learning support strategies. From the 19 parents, 65% implemented some of the recommended ideas as presented in the workshops. These results suggest that the recommended practices can be implemented by parents with high levels of fidelity. Eighty-two percent of participants commented that the workshop helped them feel more able to help and provoked changes in their behaviour. Instead of telling their children how to do a problem, they now ask more questions and let them struggle with it longer. The results of the study also suggest that such gatherings include a component where parents discuss their past lived reality of the topic, particularly when they were in school. The facilitator should spend time bridging any gaps and explaining the rationale behind reforms. The study also suggests that workshops need to be enjoyable, hands-on and include practical applications. Pierre's concluding remarks at my interview with him may be important reasons in themselves for leaders to provide curriculum-related workshops. He said "I didn't realize that math can be fun. I enjoyed the workshops and found them positive and fun—a good refresher on the importance of positive attitude and patience." His emphasis on how the workshops impacted in the affective domain is perhaps the strongest leverage parents can use to influence their children's learning. Juan also mentioned the importance of the affective when he said:

> I realized that if you are enthusiastic, you can tackle anything. This is a general principle in life and certainly in my work as well. The

> presenter really impressed this upon me and it made sense. He made the tasks fun and helped me to look at mathematics differently—in a better light.

With this in mind, selection of the presenter is very important since:

> mathematics educators who set out to modify existing, strongly-held belief structures … are not likely to be successful addressing only the content of their beliefs, or only the warrants for their beliefs. It will be important to provide experiences that are sufficiently rich, varied, and powerful in their emotional content to foster the construction of new meta-affect. (Goldin, 2002, p. 60)

Integrated into the workshop could be exemplars of activities that support learning such as homework assignments that require students and parents to interact and talk about the subject as well as materials and resources provided for families to use at home. The relationships between implementation of these activities and achievement were strong and positive, even after the researchers accounted for the influential variable of schools' prior achievement or level of schooling (Sheldon & Epstein, 2005).

In addition to a relevant and engaging topic, principals can use the information gleaned from this study regarding how participants gained confidence and motivation as a result of participating in the workshops. What inspired confidence and what they found motivating related to:

- the content of the workshops relating to changes in mathematics
- the interactive, fun ambiance during the workshops
- the emphasis on affect, and
- the provision of helpful resources.

When scheduling parent workshops, principals would do well to consider one of the results of Sheldon and Epstein's (2005) study of 18, highly diverse schools. They found that "evening workshops for parents were rated more effective than daytime

workshops, perhaps because many parents worked and could not easily go to the schools during the day" (p. 201).

When considering topics, principals may find it helpful to consider Jones (2003) suggested workshop topics for parents:

- Asking the right questions,
- Building a partnership with teachers to support learning,
- Sustaining important dialogue with teachers about curriculum, homework and meeting standards,
- Using community resources to enhance learning, and
- Utilizing computer technology to expand parents' knowledge as well as support their children's learning.

This study provides principals greater certainty regarding what is useful to consider when organizing a parent workshop. We need good educational leaders who, as part of the public sphere, accept the challenge to truly engage educators and parents in collaborative discourse with the goal of negotiating and co-creating an institution of school that is acceptable to both. When faced with this seemingly daunting task, it is beneficial to remember that "the ideal manner in which the public sphere operates is not for a social order free from conflictual debate…[but for a] debate free from social conflict" (Taylor, 2005, p. 91).

5.5. Growth as a Researcher and Principal

Not many moments in a person's life can be captured in memory but I remember when the topic for my doctoral research crystallized in my mind. It was in the spring of 2007 when I was appointed the principal of a school whose growth plan included mathematics. My professional journey until that point had included teaching high school humanities courses, student learning assistance, facilitating professional development

for teachers, and occasionally giving workshops for parents. The possibility of somehow blending those domains both intrigued me and filled me with apprehension. If I could find a way to help demystify mathematics for parents. I felt that this would contribute to educators' knowledge about how to effectively enhance the parent-school relationship.

But, in order to demystify mathematics for others, I would have to face my own math anxiety. I began my personal journey against math avoidance. The effort has led me to invite a university researcher to conduct research for a national study of mathematics in the classroom; to investigate math curricula and arrange professional development of teachers in the subject area. I have conferred with mathematicians about how students best learn mathematics and I have tried the methods with my own daughter. The journey has catapulted me out of my comfort zone, helped to recapture my curiosity and encouraged me to take risks and try again, and again.

Doing research has increased my capacity and disposition for critical thinking as well as increased my ability in disciplined inquiry and exploration as I explore possible solutions based on the work and research of others. I have grown in my ability to search the educational literature for relevant research articles and other publications. This is of particular note since highly efficient electronic methods for accessing research have evolved since my undergraduate studies in the late-1980s and early-1990s and even since my graduate studies in the mid-1990s. I have improved my comprehension of technical research reports and the practical significance of statistical results, which has contributed to my ability to draw appropriate conclusions from their findings. Doing my own research has opened my eyes to the worldwide network of educational researchers studying the educational enterprise.

I have grown in my ability to engage in the process of doing a research study, from preparing an initial proposal, collecting and analyzing data, to writing a final report of the completed study. This process has required careful, detailed observations and systematic data management processes. My skills in accessing focused, authoritative information were definitely enhanced over the course of my doctoral research. With regard to methodology, I learned the importance of pretesting surveys when I discovered that participants had interpreted a question on one of the surveys differently than I had intended. Although the resulting data was less useful to me, it did not detract in any significant way from the overall findings.

The impetus for pursuing doctoral study was to learn how to be a better practitioner and to contribute to the field of principal leadership. This process has fostered much growth in my professional role as a principal. Not only have I learned from my own study the characteristics of effective workshops for parents, but doing my own research has developed my intellectual curiosity and encouraged me to look beyond my daily routine to ask questions about why problems of practice occur and how to solve them. While I have always had an appreciation for the value of the research community as a rich resource of more effective practices, I can now more comfortably and confidently enter the dialogue with researches and policymakers.

As a result of this process, my approach to professional decision making has become more sophisticated. I have been more conscious about engaging staff with the research behind the efficacy of certain programs and methods when we are considering program changes or purchase of resources. Ultimately, this bridge between education research and education practice better serves students. My level of discourse with staff has been elevated to the extent that when I see problems of practice reported in the

media or in our school, I ask, "what does the research say" and, depending on the topic, this may lead to some basic research to shed light on the issue. For example, there have been advances in the area of what causes autism and promising interventions. Parents of children with autism read this information and sometimes ask us to try new approaches at school. It is imperative that we then take the time to productively address the concepts of the reported advances so that we can engage in widely accepted evidence-based practice rather than relying on personal experience or intuition and possibly be distracted by *fads*. Another example is the issue of homework and parent involvement. By looking at a research synthesis, I was able to acknowledge the discrepancy in the research and also point to studies identifying the conditions under which parental involvement enhances homework. These balanced presentations of research support my belief that the education profession has a moral imperative to access and examine evidence-based programs and procedures in the process of professional decision-making.

The research process has increased my enthusiasm for having researchers conduct research in the school as well as for inviting student teacher placements. Not only do I believe that furthering evidence-based practice improves education, I also want to foster growth by nurturing teachers' professional development and continuous school improvement. Having researchers and student teachers in the school has afforded teachers the opportunity of participating in an ongoing dialogue with both professional researchers and practitioners.

At the same time as I began my doctoral research, I became a principal. In retrospect, I suppose I could have been easily overwhelmed by the challenges both these roles posed. Happily, I found instead that engaging in the research process and

staying connected to the university was, though admittedly very busy and demanding, also exceptionally enriching, thought provoking and supportive of my practice. Dialogues with researchers, supervisors, professors and program coordinators have helped me to clarify, consolidate and inspire my efforts in both domains.

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APPENDICES

Appendix A.

Pre-Workshop Survey

Survey for the start of the 1st Parent Workshop

1. Of all the subjects at school, how comfortable are you with helping your child with Math homework?
   Not at all A little Comfortable Very comfortable

2. Do you look forward to helping your child with Math homework?
   Never Sometimes Often Always

3. Do you believe there is one best way to solve mathematics problems?
   Yes No Unsure

4. Do you believe that there are different ways to solve mathematics problems which are equally good?
   Yes No Unsure

5. Given a choice, which type of mathematics homework do you prefer? Check your preferences (as many or as few as you want):
   Basic facts Drill Word Problems Geometry Algebra

6. Do you think of other examples to share with your child? For example, other applications of the same concept as they might appear in real life math?
   Never Sometimes Often Always

7. If you find a problem too difficult and you can't answer it, what of the following three possibilities are you more likely to do?

   Help my child to keep trying the problem in different ways and submit the various attempts
   OR
   Write a note to the teacher to excuse my child
   OR
   Do you encourage your child to seek help from his/her teacher?

8. The following is a list of possible attributes of a numerate student. Which ones do you think are important? Check all that apply.
   Good number sense
   Good at arithmetic
   Good at problem solving
   Perseverance
   Able to communicate ideas and/or understandings
   Good at algebra
   Good basic mathematics skills
   Good with procedures/algorithms
   Enthusiastic
   Willing to engage with mathematics
   Good mathematical understanding

9. The following is a list of possible attributes of a numerate student. Number the three most important aspects (1 is most important).
   Good number sense
   Good at arithmetic
   Good at problem solving
   Perseverance
   Able to communicate ideas and/or understandings
   Good at algebra
   Good basic mathematics skills
   Good with procedures/algorithms
   Enthusiastic
   Willing to engage with mathematics
   Good mathematical understanding

10. How do you feel when your son/daughter is really struggling with their homework and you don't know how to help?

    _____

    _____

11. How do you feel when your son/daughter is doing well on all their homework, for example, only missing one or two questions?

_____

_____

12. How do you feel when your son/daughter is doing well on the exercises but struggling on the word problems?

_____

_____

13. What do you do when you know your son/daughter is getting many of the answers wrong on their homework?

_____

_____

14. How do you feel about mathematics?

_____

_____

15. How much time, on average, do you spend with your child doing mathematics homework?

_____

_____

16. Why did you decide to attend these math workshops for parents?

_____

_____

Appendix B.

Post-Workshop Survey

Survey for the end of the 2nd Parent Workshop

1. Of all the subjects at school, how comfortable are you with helping your child with Math homework?
   Not at all A little Comfortable Very comfortable

2. Do you look forward to helping your child with Math homework?
   Never Sometimes Often Always

3. Do you believe there is one best way to solve mathematics problems?
   Yes No Unsure

4. Do you believe that there are different ways to solve mathematics problems which are equally good?
   Yes No Unsure

5. Given a choice, which type of mathematics homework do you prefer? Circle your preferences (as many or as few as you want):
   Basic facts Drill Word Problems Geometry Algebra

6. Do you think of other examples to share with your child? For example, other applications of the same concept as they might appear in real life math?
   Never Sometimes Often Always

7. If you find a problem too difficult and you can't answer it, what are you more likely to do?

   Help my child to keep trying the problem in different ways and submit the various attempts
   OR
   Write a note to the teacher to excuse my child
   OR
   Do you encourage your child to seek help from his/her teacher?

8. The following is a list of possible attributes of a numerate student. Which ones do you think are important? Check all that apply.
   Good number sense
   Good at arithmetic
   Good at problem solving
   Perseverance
   Able to communicate ideas and/or understandings
   Good at algebra
   Good basic mathematics skills
   Good with procedures/algorithms
   Enthusiastic
   Willing to engage with mathematics
   Good mathematical understanding

9. The following is a list of possible attributes of a numerate student. Number the three most important aspects (1 is most important).
   Good number sense
   Good at arithmetic
   Good at problem solving
   Perseverance
   Able to communicate ideas and/or understandings/
   Good at algebra
   Good basic mathematics skills
   Good with procedures/algorithms
   Enthusiastic
   Willing to engage with mathematics
   Good mathematical understanding

10. How do you feel when your son/daughter is really struggling with their homework and you don't know how to help?

    _____

    _____

11. How do you fell when your son/daughter is doing well on all their homework. for example, only missing one or two questions?

_____

_____

12. How do you feel when your son/daughter is doing well on the exercises but struggling on the word problems?

_____

_____

13. What do you do when you know your son/daughter is getting many of the answers wrong on their homework?

_____

_____

14. How do you feel about mathematics?

_____

_____

15. How much time, on average, do you spend with your child doing mathematics homework?

_____

_____

16. Why did you decide to attend these math workshops for parents?

_____

_____

17. Have you tried any of the recommended practices from the session or materials provided? Explain.

_____

_____

18. Do you think the sessions have given you ideas for how to help your child?

_____

_____

19. Have you discussed anything from the workshop with your son/daughter?
Yes No If you answered yes, what did you talk about?

_____

_____

20. Do you feel more able to help your child as a result of participation in these workshops?
Yes No Unsure

21. Are you more inclined to help your child as a result of your participation in the workshops?
Yes No Unsure

22. Are you more inclined to:
Give encouragement
OR
Jump in and *save* your son/daughter when the struggle with a question?

23. Do you think your child's self-concept, enthusiasm and understanding has improved as a result of your participation in these workshops?
Yes No Unsure

24. Do you use the skills and information from the workshops with younger children/siblings at home?
Yes No

25. How likely are you to participate in such a program—perhaps with a different subject-specific focus?
Not Likely Likely Very Likely

26. GENERAL COMMENTS

Appendix C.

Follow-up Questionnaire

Code name: _____ Follow-up Questionnaire

1. What is your intermediate student currently achieving (letter grade in mathematics? Did this have any influence on your decision to attend the mathematics workshops for parents?

   _____

   _____

2. What generally did you expect to gain from attending the workshops?

   _____

   _____

3. You said you would consider attending workshops about _____. Why this topic?

   _____

   _____

4. Would you like more information on any of the recommended practices or ways to help your child in school?
   Yes No

5. If yes, which ones? (If no, leave answer blank.)

   _____

   _____

6. Have you tried any of the recommended practices from the session or materials provided?
   Yes No

7. If you answered yes to the above question, what has worked for you? What hasn't worked for you? Why? (If no, leave answer blank.)

_____

_____

8. Do you think your child will continue to do well in mathematics next year?
Yes No

What makes you believe this?

_____

_____

9. Do you think your child will continue to do well in mathematics in high school?
Yes No

What makes you believe this?

_____

_____

10. How often do you discuss school progress with your child?
Never Sometimes Often Always

11. How often do you discuss future plans with your child?
Never Sometimes Often Always

12. How often do you discuss school problems with your child?
Never Sometimes Often Always

13. Do you set rules about bedtime?
Yes No

14. Do you set rules about chores?
Yes No

15. Do you set rules about the amount of TV your child can watch?
Yes No

16. Do you set rules about the types of programs they are allowed to watch?
Yes No

17. During the school year do you volunteer at the school?
Yes No

How often do you communicate with teachers?
Never Sometimes Often Always

19. What situation(s) would lead you to contact the teacher?

_____

_____

20. If next week your child came home with a project in mathematics that was a *group project (*for example, building a budget for life after high school*)* and the resulting grade would figure significantly in their term grade, what would your attitude towards this project be?

_____

_____

21. This is a hypothetical scenario—next year we are thinking of hiring a teacher who is an expert in mathematics and is deeply involved in mathematics reform. She doesn't spend a lot of time explicitly doing drills. Most lessons focus on problem solving. There is one daily question for homework that requires your participation. What would you think of this?

_____

_____

22. If your child came home with a graded assignment on which he got 50%—and the teacher wrote "the final answer was correct but the process followed was not correct," what would your response be? What do you think about this grading practice?

_____

_____

23. If your child came home with a graded assignment on which he got 50%—and the teacher wrote "the final answer was correct but you did not explain your thinking well enough," what would your response be? What do you think about this grading practice?

_____

_____

24. How did you do in high school mathematics?

_____

_____

25. Did you enjoy mathematics?
Yes No

26. Have you benefited/or been hindered from your achievement in mathematics?

_____

_____

27. Why do you think it is important for your child to do well in mathematics?

_____

_____

28. What are the most important skills that you would like to see your child learn in mathematics?

_____

_____

Appendix D.

Interview Protocol for Case Studies

Code Name: _____ Guiding questions for the four case studies:

**Prior to the interviews, see what they responded re interest in other workshops. Tailor the questions to the individuals.*

Change Since Parent's School Days

- What do you think about mathematics education today as compared to when you learned it in school?
- How are the textbooks different now? How are teachers' methods different?

Impact of Workshops

- You were chosen to be interviewed because your ideas about what describes a numerate student changed from before the workshops to afterward the workshops.

  Before you said: _____

  After you said: _____

  Can you explain this change? _____

  _____
- Have you seen any change in your child's attitudes and confidence in mathematics since October?
- How is your son/daughter currently achieving in mathematics? Did this have any influence on your decision to attend the mathematics workshops for parents?
- What do you see as the value of workshops for parents? What's the point?
- What did you expect to gain from attending the workshops?
- You said you would consider attending workshops about (ex. multiplication tables)—why this topic?
- Would you like more information on any of the recommended practices or ways to help your child in school? If so, which ones specifically?
- Have you communicated with you child's teacher more/less or differently since October?
- Has the way you have worked with your child changed in any way that you can see since October?
- Do you use the skills and information from the study with younger children/siblings at home?

Involvement with Child and Homework

- How do you motivate your son/daughter during home work sessions?
- Have you tried any of the recommended practices from the session or materials provided?
- What has worked for you? What hasn't worked for you? Why?
- Describe what you do most to help your son/daughter with their school work.

Profile of Parent

- Do you think your child will continue to do well in mathematics next year, in high school? What makes you believe this?
- What do you see for the future of your children academically?
- How often do you discuss school progress with your child?
- How often do you discuss future plans with your child?
- How often do you discuss school problems with your child?
- Do you set rules about bedtime? Chores? Amount of TV? Types of programs on TV?
- During the school year do you volunteer at the school?
- How often do you communicate with teachers?
- Why would you decide to contact the teacher to discuss something?
- Do you try to encourage a positive attitude towards school/ mathematics in particular?

Acceptance of Change

- If next week your child came home with a project in mathematics that was a group project involving problem solving—say building a budget for after high school, what would your attitude towards this project be? Do you think you would have answered this question the same or differently before experiencing the workshops with Dr. Neal?
- This is a hypothetical scenario—next year we are thinking of hiring a teacher who is an expert in mathematics and is deeply involved in mathematics reform. He aims to get students thinking. He doesn't spend a lot of time teaching the drills or basic math. Most lessons focus on problem solving and there is always one question for homework that requires your help and involvement. What would you think of this? Do you think you would have answered this question the same or differently before experiencing the workshops with Dr. Neal?
- If your child came home with a graded assignment on which she got 50%—and the teacher wrote "the final answer was correct but the process followed was not correct," what would your response be? Would you see this as a fair grading practice? Do you think you would have answered this question the same or differently before experiencing the workshops with Dr. Neal?

Appendix E.

Participant Perception of the Impact of Workshops

	Tried Any Recommended Practices	Have New Ideas	Discussed with Child	Feel More Able to Help	More Inclined to Encourage or *Save*	Noticed Child's Self-Concept Improved
Sarah	Yes—picked up the book on *matherpieces*	Yes	Yes—various strategies to solve a problem	Yes—understand that there is more than one way to solve a problem	encourage	yes
Franco	Yes—talking through math problems—having my child talk through equations so we know where he may have gone wrong or how he's thinking	Yes	Yes-talking math problems through; benefits of working in small groups	Unsure	No response	unsure
Mary	Yes—reinforcing the concept of adding and subtracting fractions while cooking—converting fractions to percentages and probability	Yes	No	Unsure	encourage	No change—there wasn't a problem
Camila	Yes—I have ordered a couple of the books. But lately no math that the explained practices would be useful for have come home.	Yes, some great ideas	no	Yes—I have some more strategies and resources	Encourage	unsure
Patrick	Yes some books and practical applications for everyday math	yes	Yes—techniques for problem solving	Yes, more resources and alternative ideas	Jump in and save	yes
Michael	Yes we found a good Tangram website	Somewhat but I missed the 2nd session	Yes, tangrams	Unsure	Encourage	unsure

	Tried Any Recommended Practices	Have New Ideas	Discussed with Child	Feel More Able to Help	More Inclined to Encourage or *Save*	Noticed Child's Self-Concept Improved
Gabrielle	No	Yes	Yes—more than one way to solve a math problem	Yes, a little	Encourage	Too early to know maybe
Pierre	Not many yet but I hope to in the near future	Yes	Yes—we discussed what we did in the workshop	unsure	encourage	unsure
Milagros	No	Yes, using real life examples	No	Yes, I am encouraged that there are many ways to solve a problem. I am more aware of my mental blocks etc.	encourage	yes
Paul	Nothing to date	To some degree	Yes, having an open mind	Unsure	Encourage	no
Dan	Yes, we often discuss examples of mathematical scenarios while driving, shopping, watching TV etc.	Yes	Yes—the puzzles and the parent interactions how I liked the professor's speaking abilities	Yes, I feel enlightened to think of and accept various ways to solve problems	Encourage	unsure
Andrew	Yes, I have my kids explore with the materials first.	Yes	Yes—the importance of having a positive attitude.	unsure	Encourage	unsure
Juan	No chance yet	Yes	Yes, talked about looking at problems a different way	Yes, there is not just one way to do things	Encourage	unsure

	Tried Any Recommended Practices	Have New Ideas	Discussed with Child	Feel More Able to Help	More Inclined to Encourage or *Save*	Noticed Child's Self-Concept Improved
Julia	No response	Yes	Yes, taking a positive attitude towards math. Also talked about the exercises we did with the blocks and the cards	Yes, attitude adjustment! Expecting the best and making math fun.	Encourage	yes
Bill	Yes, routinely I use world examples to teach math	A little, it has reassured me that some of the things that I am doing are correct	No	Yes, I am more sure that what I have been doing so far is going to help	Encourage	unsure
Manjit	Yes, integers, playing with chips to add and subtract	Some	Yes, card games to gain confidence in multiplication	Unsure	Encourage	unsure
Maria	Yes I have given my kids special puzzles and mathematical riddles.	Yes	Yes, we talked about different ways to look at math problems and many ways can be right.	unsure	Encourage	unsure
Mark	No response					
Lelei	No response					

Appendix F.

Sample Logic Model for a Districtwide Family Engagement Strategy[1]

1. Goals

- Children and youth are better prepared for post-secondary success.
- Family members are wise consumers and active partners in their child's education.
- Schools are transformed, high-performing, and accountable institutions.
- The school district has a systemic and co-constructed family engagement strategy.

2. Inputs

- Shared vision for family engagement
- Family engagement connected to student learning
- Strategic investments in programming and staff
- Robust communication systems
- Evaluation for accountability and continuous learning

3. Activities

Foster districtwide strategies

- Align family engagement with district learning goals and standards
- Create a well-staffed office for family engagement
- Include family engagement in classroom, school, and district performance measures

Build school capacity

- Provide ongoing professional development opportunities for family engagement to all staff
- Hire family and community liaisons
- Implement school-based action teams for family engagement
- Create mechanisms for administrators and educators to share lessons learned

Reach out to and engage families

- Create feedback loops with families to plan, implement, and assess activities
- Provide leadership and skills development training to families
- Create data systems that collect and share information with families

[1] Reprint of Westmoreland, Lopez, & Rosenberg (2009); used with permission from Carly Bourne, Harvard Family Research Project.

4. Outcomes

Short-term outcomes

- Increased awareness about the importance of family engagement (D, S, F)
- Increased awareness about rights and opportunities for family engagement (D, S, F)
- Improved attitudes for shared responsibility, role efficacy, and coordination of family engagement (D, S, F)
- More knowledge and skills about strategies for family engagement (D, S, F)
- More knowledge of strategies and resources to support student learning (S, F)
- Better understanding of child academic progress, strengths, and weaknesses (S, F)

Interim outcomes

- Improved home-school communication and family-school staff relationships (S, F)
- Better home environment and parenting to support learning (F)
- Improved parent-child relationships (F, C)
- Improved school culture, including trust among staff (S)
- More participation and use of programs and resources that support student learning (C)

Long-term outcomes

- Improved work habits and motivation (C)
- Increased school attendance (C)
- More enrolment in more challenging courses (C)
- Smoother transitions across schools and grades (C)
- Increased student achievement (C)
- Decreased likelihood to engage in high risk behaviours (C)

5. Performance Measures

Measures of effort (selected examples)

- # of hours of professional development/training provided
- # of participants that attended PD/training events
- # of hits to district family involvement website
- # of new school and district family engagement hires
- % of participants reporting that trainings were useful
- % of schools in compliance with all Title I requirements

Measures of effect (selected examples)

- % of participants reporting that they gained new skills to enable better family engagement
- % of family members reporting more literacy activity at home
- % increase in attendance at parent-teacher conferences

Changes in school/district policies that promote family engagement

- % change in student attendance at participating schools

Appendix G.

Resources for Parents[2]

Elementary and Middle School (K-8)

- *Arcademic Skill Builders:* Online educational games for learning basic math, language arts, vocabulary, and thinking skills. Math games include addition and subtraction, multiplication and division, and fraction and ratio games.
- *Gamequarium:* Interactive mathematics games, virtual manipulatives, online calculators, and graphing tools.
- *Harcourt Math Glossary:* Interactive math glossary for students in K-6 that provides a searchable database of math terms, accompanied by illustrations and animated examples.
- *Mathematics Benchmarks, Grades K–12:* Benchmarks for K-12, as well as models of secondary school courses, sample secondary school assessments, and tasks.
- *Math123xyz.com:* Interactive multimedia math resources, including math lessons, interactive tutorials, learning tools, enrichment, and extra practice. Basic Skills, Pre-Algebra, Geometry, Algebra, and Trigonometry.
- *Math Dictionary for Kids:* More than 600 interactive mathematical definitions for elementary school students.
- *Math Playground:* Play logic games, solve word problems, and watch math videos.
- *Mathwire.com:* Activities, worksheets, and creative ideas for teaching math that are classroom-tested by teachers. Based on NCTM Standards.
- *Numbers Made Meaningful:* Teacher-tested math stories and games based on the story *Trouble with Zero*, for PreK through Grade 1.
- *Rockin' the Standards:* A veteran elementary school teacher and his rock band have taken lyrics from common tunes and changed them to help kids remember the mathematics they've been taught in school.
- *Soft Schools:* Worksheets and games.
- *Superkids:* Online resource for teachers or parents to create math worksheets on topics including addition, exponents, and telling time.
- *Time Monsters:* Interactive online lessons and quizzes about time.

Parents Share Math Help Tips

What can I do to help my child get the most out of math?

- Helping your child succeed in math is not much different from helping your child with anything else. Here's what parents and other family members say about helping their children with math.

[2] Reprint of National Council of Teachers of Mathematics (n.d.a, n.d.b; NCTM); used with permission from permissions@nctm.org.

Be positive about math

- "My daughter is growing up with a "can do" attitude towards math. Her skills are more advanced than mine, and I let her know I'm proud of her. Maybe you weren't good at math, but your kid doesn't have to know that. Have a good attitude and he will, too."
- "I enjoy sitting down with my teenager and struggling through a problem together. Sometimes it's hard work, but every chance I get, I tell her how important it is."
- "When I was young, I thought only nerds could do math. Man, was I wrong. Now I realize that anyone can do math, and everyone needs it. It's where the jobs are."

Communicate with your child

- "It may be only a few minutes a day, but I'll sit down with my grandson and ask him what math he's working on. Sometimes by explaining it to me, it becomes clearer to him."
- "I've learned to listen more than I talk. Listening to my niece talk about her math problems is a challenge, but it's another way to show I care."
- "I try to work math into our everyday conversation at home. Since I work in industry, I know how important it is for kids to know math in today's world."
- "From talking with my daughter, I've begun to see math in an entirely new way. She likes taking the lead, and I'm sure that teaching me helps reinforce what she's learned."

Have high expectations

- "My kid's teacher says 'more math, more opportunity.' She's telling us to push to get our children into the challenging math courses they need."
- "My daughter's only in the sixth grade now, but I've already talked with her counselor. We're going to plan her schedule so she can take math every year through high school."
- "I quit taking math after algebra. What a mistake! I'll urge my stepson to take all the math he can get."
- "I guess I'm pretty tough. From Day 1, I tell my son that not passing math is not an option. But I also let him know I'm there for him every step of the way."

Respect the way your child learns

- "Don't start '20 questions' the minute your kid walks in the door."
- "Think how you feel when you first get home. Just like you, he probably needs to take a break."
- "Recognize that she has her own work habits, and they're probably different from yours. You can give her a tidy desk in a quiet setting, but she may prefer her headphones and an unmade bed."
- "For my child, doing well in math means doing his very best, not necessarily getting an 'A.' I love to see his excitement when he cracks a problem and knows it's right."
- "You've got to be ready when they are. Most teenagers won't set a time to do math. So relax. Help them on their terms, not yours."