Parent Journeys Through Number Talks With Their Children

by

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Abstract

This study examined twenty-four parent journeys as they engaged in number talks with their children. The researcher used action research through the presentation of three workshops. Data included four rounds of interactive writing with all participants, the researcher's reflective journal and follow-up interviews with four participants. The researcher composed narrative stories to interpret each of the interview participant's journey. Through reflecting on all of the data, themes and sub-themes emerged to address the research questions and objectives. The research question was: When parents engage in number talks, what are the aspects of their experience that they consider to have contributed to their children's development of mathematical problem solving and number sense? The three objectives were:

1. To determine how parent participants learn to support their children's mathematics growth through participation in workshops.
2. To determine what factors affect parents as learners (with regard to noticing opportunities, engaging learners, attitudes, and use of problem solving) while leading their children during number talks.
3. To develop recommendations about how to support and guide parents to help their children develop number sense.

In terms of the first objective (i.e., how parents learn), the researcher discovered that all parents were on their own unique journey. However, three main themes did emerge with corresponding sub-themes. To directly address the research question, the themes of developing a growth mindset, foundational experiences, and the relationship of the parents with the researcher were the aspects of parents' experiences that contributed to their own as well as their children's development as learners of mathematics. For the second objective, the sub-themes varied and represented the factors that affected parents as learners. For the third objective, recommendations have been developed based on the experiential nature of the research to empower other parents to be involved in numeracy talks with their children.

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My last thank you, goes to the parent participants of my study. Without them, my research would not have been possible. Their dedication, willingness to learn and heartfelt emails helped guide me towards this truly amazing accomplishment.

Thank you all from the bottom of my heart and soul.

Dedication

To my Mom

My mom always instilled in me the love of learning and the value of hard work. She taught me to read, bake, cook, think for myself and strive for the best. She guided me to the best of her ability. Since she died, I still feel her presence and know that she is still guiding me today. She will be forever in my heart and I thank her for teaching me to love learning!

To my Dad

My dad has always been there for me especially during the hard days of school. He would help me learn math and teach me foundational concepts through number talks, even though he did not know what he was instilling in me. In Grade 4, he taught me how to public speak and face my fears in front of a crowd. Thanks to my Dad, I have used foundational math and public speaking skills for my thesis and will continue to do so in the future!

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Chapter 1: The Empowerment of Parents: The Big Picture

How do parents guide their young children in numeracy? In my experience, many parents want to help their children in numeracy, but reasons such as lack of knowledge, resources, time, confidence and motivation can affect their ability to guide their children. Research shows that when parents guide their children in numeracy activities at home, children are more successful in math in later years (Bleach, 2015; Segers, Kleemans, & Verhoeven, 2015). I believe that the core of my proposal is that parents need more education to develop their children's understanding of numeracy. This chapter outlines the major ideas of my thesis that are developed further in Chapter 2.

To educate parents, I aimed to teach them about how to do number talks with their children regarding the concepts of time, money and temperature. This instruction took place during a three evening workshop series over six weeks. The purpose of teaching number talks to parents was to help them guide their children while building numeracy skills. Parrish (2010) defines number talks as a way for students to explain their learning to teachers and peers during problem solving in the classroom. Parrish encourages students to write down their thinking processes to be able to describe their own strategies to their teachers and peers. My goal for number talks was different than Parrish's number talks. My aim was for parents and their children to discuss the three concepts of time, money and temperature during number talks without writing anything down to keep the authenticity of the parent-child interaction. Therefore, my goal during my workshops was to teach parents how to guide their children in number talks, to help children problem solve during everyday activities; specifically using the three contexts mentioned above. Another one of my intentions was for children and their parents to have positive experiences while building confidence in the parents' own abilities. The purpose of this research was for parents to have a positive influence on their children through talking.

I have met many parents who have difficulty understanding how to help their children in mathematics since they do not understand what is expected and what is taught in each grade. Even if parents know how to read the curriculum outcomes, many would not know where or how to begin to teach their children, which could lead to a feeling of helplessness. My workshop series involved helping parents guide their children through number talks of the three concepts, without accessing curricular outcomes. Parents guided their children by asking questions during

daily real life experiences. Examples of such number talks would entail telling time to know when to go to school, counting money to buy something, or reading the temperature to decide what to wear to school.

Despite parents' efforts to guide their children, there may be gaps in parents' knowledge or confidence. My research study consisted of three workshop sessions that guided parents through number talks while they worked with their children at home. Each workshop focused on one real-life context: time (workshop 1), money (workshop 2) and temperature (workshop 3). As well, there was an explanation of the concepts of zone of proximal development, neuroplasticity, child motivation and math anxiety so that parents understand how their children learn. I also explained number talks, problem solving and number sense along with videos of how to guide parents in number talks with their children. My workshop series helped parents learn how to guide their children in understanding number relationships without following a complex written program or asking them to help their students work in math workbooks.

In addition, during the three workshop sessions, I taught parents to become the adult guides to their own children. While they attended the sessions, I explained different steps to guide parents in their number talks with their children. Based on knowledge of their own children, parents were able to brainstorm ideas of different number talks to work with their children in order to help them to learn. Since parents knew their children best, they became the teachers who discovered the best way to engage their children in learning and would continue to search for their child's zone of proximal development (Kozulin, 2003).

The principal intention of the three workshops was to provide parents with enough confidence to overcome their own uncertainties. The goals were for parents to understand the reasons for teaching life math skills to their young children, successfully leading number talks, and empowering them to feel more confident themselves. Also, I intended for parents to understand the links to the curriculum in their children's later grades along with the step-by-step guidelines.

Another goal of my research was to inquire about parent learning during the experiences of number talks with their children. I did not provide parents with printed resources and websites to read and give to their children. Rather I aimed to empower parents in their ability through action and in-person support, to guide their children to problem solve and develop number sense through number talks. A positive effect of this learning is that at school, children

can better understand math while they connect their knowledge from their home experiences to their school activities (Hanlon, 2012; Manitoba Education, 2013).

In my experiences, I have seen children in schools who do not have a solid mathematical understanding and it seems to me that they are missing a few basic concepts. For example, I have seen teachers work on a concept for a specific amount of time and then move on to another one, even though children may not have mastered the previous concept. In my school, I have seen students who have isolated understandings of concepts, but are unable to link them together to impact number sense and problem solving abilities. My intention was for students to develop a conceptual system of understanding to help them problem solve through number talks with their parents.

My purpose is to help parents guide their children to problem solve regarding the three contexts of time, money and temperature. All three contexts are real-life mathematics that can be found both at home and in a classroom where number sense can be developed. The reason I chose these topics is that in my school, the students who are having overall math difficulty seem to show difficulty with one, two or all of these three topics. If children gain knowledge of the topics of time, money and temperature at an early age during number talks with their parents, it enables them to develop math connections in school. By exposing children to daily number talks and providing parents with the hands-on resources needed for the three real-life concepts, students can start to learn the vocabulary, give the words meaning, relate the words together and move toward verbal problem solving and number sense. The rich experiences that parents could provide to their children, would enable them to have strong conceptual experiences, enabling them to connect their learning at home to their learning at school.

Specifically, for the concept of time, I have met many 9- and 10-year-olds who cannot tell time on an analog clock and are sometimes taught this skill only briefly when they are in Grade 4. In my teaching experience, this brief exposure is not enough for students to develop a conceptual understanding. Therefore, my suggestion to parents is to guide their children to learn how to use the concept of time on a daily basis to provide a rich context for children. For example, parents could teach the numbers from 1 to 12 and 1 to 60 along with the concepts of seconds, minutes and hours. Parents could also ask daily routine questions, (e.g., How many minutes until bedtime? How many minutes until we turn off the video game?), to help their children understand the concept of time. The questioning technique of number talks allows

parents and children to interact with each other in order to be able to problem solve and develop number sense during habitual household routines and activities.

For the context of money, in my teaching experiences, many children do not have a conceptual understanding of the value of coins and bills. They may know that money is used to purchase items, but from what I have observed, children do not see their parents count out coins and bills to pay for items in stores. Rather, they see credit cards being swiped and replaced back into a wallet. Since we live in a more digital world than previous times, children may have less opportunity to observe coins and bills used at home on a daily basis. If children are not exposed to coins and bills, it can be very difficult for them to develop a concept of money when it is abstract and not visible at all. In response to this need, I suggest that parents do number talks while using real coins to help their children conceptualize their learning. During the *Money Talks!* workshop, parents viewed videos of my own children learning about money to determine how to introduce money concepts with their children. Parents could teach the values of coins by going to the store, saving money for a purchase or earning an allowance. The goal of the *Money Talks!* workshop was to explain to parents how to expose their children to real coins and bills to promote number talks regarding money. Understanding money helps Grade 5 students (i.e. 10 year olds) to connect concepts to decimal numbers and beyond (Manitoba Education and Advanced Learning, 2014b).

In terms of the temperature context, I have seen many students have difficulty understanding if it is cold or hot out when I tell them the temperature number in degrees Celsius. I have heard students ask, “Is that hot?” I have also worked with students in later grades who have difficulty with the concept of positive and negative numbers but I have also met students who found integers easy. I strongly believe that the difference with these students could have been exposure to and understanding of the concept of temperature earlier on. In general, I do not see many thermometers outside of houses. Even in our house, the weather channel is no longer on. Rather, I see many people check the temperature on their phones. Thus, since our world is more digital now and our children are less exposed to real-life examples of mathematics, there is an overwhelming need to expose and help our children develop number sense through foundational experiences (Mason & Erickson, 2015). Unless parents are talking about negative and positive temperatures in everyday life with their children, the children are not exposed to the language of temperature on a daily basis and students may have difficulty understanding integers

in later grades. My goal in my workshop sessions was to present videos of number talks with my own children talking about or reading the temperature on a weather application using my cellular phone. Example talks included how cold or hot it was outside and calculating the difference in temperature from the morning to the afternoon. These discussion number talks helped my children conceptualize temperature by knowing what to wear in the morning compared to the evening, while using Celsius degrees as the measurement even if the temperature is read digitally. In general, understanding the concept of temperature can help students connect their knowledge to Grade 7 integers and these intuitive connections are essential to learning and progressing in mathematics (Hanlon, 2012; Manitoba Education, 2013).

To conclude, the main focus of the three workshops was to guide parents in learning how to do number talks with their children, so that they could help their children learn the concepts of time, money and temperature. During the workshop sessions, I aimed to create a positive atmosphere with my group where I included ice-breakers and provided information on important theory. I also showed demonstration videos of myself with my children completing numeracy tasks during number talks to help guide parents towards an experience that would help their own children learn. For the duration of my workshop series, I aimed to learn about the aspects of the parent experience in regards to their children's mathematical development.

My Journey

I have had many experiences that have guided me to where I am today. My personal journey through my own experiences as a child, a university student, an overseas substitute teacher, a French Immersion teacher, a student services teacher and as a parent, have all contributed to my passion to empower parents and help children improve their numeracy understanding.

As a child, I always felt like I was strong in math as I was confident and could tackle any problem at school and at home. Looking back on that time, I know that I developed this confidence and understanding of numbers through foundational experiences with my parents. My dad taught me many card games and talked about daily life everywhere we went and answered any question that I had. Together, we learned about time, money and temperature, car speed and distance, prices in stores, taxes as well as many other topics. In addition, my mom taught me how to cook and bake where I learned about time, temperature, measurement and fractions all while talking in the kitchen.

A defining moment for my mathematical journey was when I expressed an interest in purchasing an oversized stuffed gorilla for my bedroom that cost $100. My dad promised me that if I saved my money, then I would be able to purchase it for myself. I was so motivated to buy that gorilla with my own money that I worked so hard to save every penny I earned. I would count and recount my money over and over to see how close I was to my goal. I did not know it at the time, but my parents were continually doing number talks with me during foundational experiences in order to develop number sense and problem solving. Since the learning with my parents set me up for positive mathematical learning in my life, it is my goal to bring the same understanding of number talks to parents and children everywhere.

Through the years at school, right up until the end of Grade 12, I knew how to problem solve mathematically through the understanding of formulas and how to "plug in the numbers". The only problem was that when I reached university, I realized that I didn't really understand the math problems anymore, especially in physics and statistics. I did not know how to explain the thinking behind the formulas. For the first time in my life, I was faced with not understanding mathematics. This experience has guided me to explain to my students how to use real-life contexts to understand math concepts and then later, when the conceptual understanding is learned, to explain why formulas work.

Throughout my university years, I studied in Mexico and taught in China and Japan. Within the first few days of being in these three countries, I had to learn the numbers in the Spanish, Chinese and Japanese languages in order to purchase food or clothing. In markets, there were no prices on items, so if I didn't learn how to negotiate in the local language, then I would have been overcharged for anything I bought. These international experiences with numbers gave me an understanding of the importance of vocabulary and number sense that would again serve to guide me towards my goal of helping parents.

Once I completed my education degree, I became a substitute teacher in England for two years where I taught in many different multicultural schools. I saw different styles of teaching and groupings of students in many classes, where there seemed to be a segregation of the struggling math group who received easier work than their peers. I also saw these students being insulted by others and looked down upon as the "stupid" group. Seeing this made me sad, and I was determined to help all students in class feel like they could do math even though I would only be their substitute teacher for one day. I felt that if students were taught and guided in a

specific way, then they could all understand the same concept without feeling "stupid". Since there was very little planning for substitute teachers, I designed and taught my own math lessons on a daily basis to ensure that all students learned something that day. The grade or school or cultural context did not matter. What mattered was that I was helping all children feel more confident in math. This experience helped me develop a passion to help students who have difficulty in math, and guiding parents to help their children is one of the first steps on my journey.

Upon returning to Canada, I started teaching grades 4 and 5 French immersion in both rural and urban schools. I had to attend the new math curriculum training to learn new strategies of how to teach addition, subtraction, multiplication and division. During these sessions I saw the mental math strategies for the first time and I was fascinated at thinking differently about numbers. I did not have to "just carry the one" in addition anymore. It was at this time, that I realized that my university professors were not to blame for my lack of understanding statistics and physics. Rather, it was that I was not taught how to think about the numbers and how to make sense of them in a difficult situation. I did not understand the formulas and certainly was not taught the conceptual mathematics. This realization was a huge revelation for me, and a turning point in my mathematical thinking, as I realized that problem solving is truly, understanding the problem and not just "plugging in the numbers" in a formula. This experience opened my eyes to teaching math with meaning through number sense, which is one of the concepts I explained to parents.

During my transformation as a teacher, I started to have fun teaching all of the new strategies to my Grade 5 students. However, every year, there were four to five students who struggled in math. It was at this point that I did not know how to help those students. I would sit with them and repeat the lesson in a different way while the others completed their work independently. I would often spend lunch hours with them trying to explain and re-explain the work. I had an educational assistant assigned to me to help them in math, but I did not know how to guide her to help my students. I found that I did not know what to do. I spoke to colleagues teaching earlier grades and they gave me basic ideas. However I struggled with how to integrate their strategies with my Grade 5 content. I was a dedicated teacher, but wondered every day how to solve this problem. This experience motivated me to find out how I can help to

prevent students from falling behind in the later grades, which led me to look at the role that parents could play in their child's mathematical learning.

After having three children, I became a student services teacher where I helped students with counseling and math resource support. I was excited about the opportunity to help students with math in a small group setting. Through attending many math workshops and listening to early years' teachers, I learned a lot about teaching of early math. It quickly became obvious to me that the number vocabulary linked with number sense is key in the development of later mathematics (Nelson, 1985; Napoli & Purpura, 2018). This realization convinced me that if parents interact with their children on the number vocabulary and representation of larger numbers at an early age, then it could help children understand numbers at school.

For the last four years, I have tested my theories with my own children who are now the ages of 5, 7 and 9. I have integrated all of my previous experiences especially from when I was a child. As learning opportunities present themselves, we have daily number talks. Every time I guide my children, I think about why it is important that they understand. I ask myself what curriculum content is linked to this number talk and how will this talk help them in the future? I find myself teaching them about money so that they can learn the value of money, how to save for something they are motivated to buy, as well as to give to the less fortunate. These are core values that in the process, provide them with access to connecting this valuable learning in school. Having confident children in school is just an added bonus to the core values they are learning. The other topics of time and temperature help my children understand daily life around them while making connections to real contexts. The number talks that I use help them to develop problem solving skills so when they are faced with a problem, they have the essential thinking skills to tackle it. I hope that my children become confident with a solid number sense and problem solving ability so that they can contribute positively to society.

As a parent, I know that it is not easy to teach my children while they are sitting down looking in a math book. I have found that the best way for me to teach numbers and number sense to them is through number talks and foundational experiences where they are motivated to learn. Through my research, I aimed to learn about other parents' experiences through number talks.

Getting Focused

All of my experiences led me to wonder: if I could learn as a child through number talks with my parents, and my children can learn through number talks with me, could I then teach other parents to do the same? I have spoken to many parents who want to help their children, but they do not know what to do or how to help. If parents are guided, then they can become active teachers in their children's learning. Therefore, it was my desire to share theories of what I have learned with parents and help them to guide their children to become confident in math. It was this desire to help parents that led me to my research topic.

My research topic was the study of parents learning how to do number talks with their children through foundational experiences in the contexts of time, money and temperature. I explained many topics to help parents understand how to guide their children in their learning, such as: number sense, problem solving, zone of proximal development, neuroplasticity, and attitudes. Other topics were also discussed as they emerged within the learning context.

The main focus of my research was to notice if and how parents changed throughout the workshops when shown how to guide their children in learning math through number talks and foundational experiences. I was able to see the aspects of their experience through my data collection techniques that included interactive writing, my own reflective journal and informal interviews. By listening and reading about each parent's experience, I learned about what contributed to the change in parents and developed themes in regard to their learning through number talks with their children. I aimed to see themes such as the development of a positive relationship between parents and children, the importance of building a conceptual foundation in numeracy and possibly the appreciation of financial literacy. Through this research, I also focused on contributing to more research in regards to parent education in numeracy. Thus, my research goals led me to ask my research question:

When parents engage in number talks, what are the aspects of their experience that they consider to have contributed to their children's development of mathematical problem solving and number sense?

Chapter 2: The Study of Experience and Learning

Experiential learning can lead to many opportunities of learning (Kolb, 1984). One application of this theory is considering how children learn numeracy skills under parent guidance. Compared to home literacy learning, parents place less of an emphasis on teaching math to their children with fewer resources, leading to devalued and de-emphasized numeracy learning in early childhood education (Skwarchuk, Sowinski, & LeFevre, 2014). In this chapter, I discuss the study of experience while examining experiential learning and how it relates to the realm of numeracy, as well as how experiences influence opportunities of learning. Using a theoretical framework of Dewey's Theory of Experience (Dewey, 1938/2015), I aimed to engage parents in number talks with their children to influence home numeracy experiences and development. I supported parents with their children, increased awareness of attitudes, and modeled problem solving; all in the real-life contexts of exposing children to time, money and temperature concepts.

Understanding Experiential Learning

During every experience, there is an opportunity for learners to learn. Sometimes, it is up to the adult guide and the student to find the opportunity and learn from it. At other times, learning comes from problematic experiences where the learner has to reflect consciously about the problem, learn from it and grow from within. Dewey (1938/2015) states that "problems are the stimulus to thinking. That the conditions found in present experience should be used as sources of problems…growth depends upon the presence of difficulty to be overcome by the exercise of intelligence" (p. 79). Dewey is explaining that when learners are faced with conflicted thoughts about an issue, this thinking represents problems based on the experiences that need to be worked through by the learner. For students to learn from an experience, it is not only their self-growth through problem solving that helps them, but it also takes an adult guide to recognize how to guide them. Dewey explains that for a learner to grow, a teacher must ensure for each student:

> Firstly, that a problem grows out of the conditions of the experience being had in the present, and that it is within the range of the capacity of students; and, secondly, that it is such that it arouses in the learner an active quest for information and for production of new ideas. (p. 79)

For the first point that Dewey makes, the adults must guide their students through the problems that they face to help them understand the meaning and context behind each experience. In terms of the second point that Dewey makes, it is important that students are motivated to learn and that the learning experience must be at an appropriate level for students where it is not too difficult or too easy for them. For my research, I intended for the parent participants to self-reflect about their previous learning, confront any problems that they had in the past or have in the present and learn from the workshop experience, to then be able to guide their children in number talks. In this section of Chapter 2, theoretical concepts that pertain to learning, such as learning through experiences, the zone of proximal development, mindset, neuroplasticity, making meaning and culture and diversity are introduced within the context of parent number talks.

Learning Through Experiences

Dewey's *Experience and Education* (1938/2015) book provided a framework for my beliefs of learning through experiences. Dewey (1938/2015) suggests that:

> Experiences in order to be educative …[are] satisfied only as the educator views teaching and learning as a continuous process of reconstruction of experience. This condition in turn can be satisfied only as the educator has a long look ahead, and views every present experience as a moving force in influencing what future experiences will be. (p. 87)

According to this passage, Dewey emphasizes the important role of adult guidance to help students through 'educative' experiences which should include a teacher who thinks that "teaching and learning" is "a continuous process or reconstruction of experience" (p. 87). Dewey is explaining that adults need to recognize how to guide students when they teach them something new, so that students integrate it with their previous learning to make sense of the new experience. To explain the adult guide's role further, Dewey suggests that teachers or educators must look at "every present experience as a moving force in influencing what future experiences will be" (p. 87). To me, this means that each experience guides adults to develop and plan the next learning opportunities to maximize every student's learning.

Wright, Martland, and Stafford (2006) confirm Dewey's (1938/2015) position about adult guides by explaining that to help students learn, there must be an adult who can observe and understand how they learn and what kind of teaching is needed to help them advance their understanding. When children are unable to learn, it means that there is a reason why. In my

experiences, it is often because the teaching is beyond their capacity of understanding or is too difficult. Alternatively, the material could be too easy, and therefore not motivating. To help adults guide children to learn, it would be helpful for children to think about connecting their thoughts and words together. Vygotsky (1962), states that:

> The relation between thought and word is a living process; thought is born through words. A word devoid of thought is a dead thing, and a thought unembodied in words remains a shadow…Words play a central part not only in the development of thought but in the historical growth of consciousness as a whole. (p. 153)

In my interpretation of Vygotsky, words are essential to making meaning and it is people's thoughts about the words that help them develop an understanding about life. For my research, number talks provided an opportunity for parents to think about what they were going to say and give meaning to words so that their children could benefit to learn about time, money and temperature.

The Zone of Proximal Development

To help a child learn, Vygotsky (as cited in Kozulin, 2003) suggests that an educator needs to create an opportunity for learning by identifying the child's zone of proximal development to then teach the child in that zone. Vygotsky further describes the zone of proximal development as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 40). In other words, Vygotsky states that the zone is "what the child is able to do in collaboration today he [sic] will be able to do independently tomorrow" (p. 40). In my understanding, the zone of proximal development is when children require guidance to learn a concept or skill until they are able to do something on their own. If the concept is below the zone, then it is too easy and children may get bored and if the concept is higher than the zone, then, children may become frustrated (Fournier & Riccio, 2013).

To continue the discussion about the zone of proximal development, Bruner (1990) explains that students require support to gain knowledge of a concept and then nudged ahead slowly by adults to challenge them to learn more. This is otherwise known as scaffolding. Bruner (1983) describes that in a learning situation, an adult is there "to give the child reassurance and information as, if, and when, the child needed it" (p. 67). This directly

correlates to Vygotsky's (1962) zone of proximal development, as the learning would occur in the area where children can maximize their learning potential. Anderson (1997) reaffirms both Bruner (1990) and Vygotsky's research when she described the importance of parents scaffolding mathematics for their children in order for them to develop meaning while learning. In addition, when Santoro (2014) describes the importance of teachers knowing students, to me, she is explaining the use of zone of proximal development. She states that "knowing pupils means knowing and building upon what pupils already know, knowing what they still need to know, knowing how they learn best – and knowing them as people" (p. xiii). In effect, I had intended to teach parents how to notice where their children were in relation to how they learn best, so that they could plan number talks for their children. In addition, this research helped me as a learner, as I prepared to guide parents on how to scaffold their children in learning about time, money and temperature by providing them with step-by-step guidelines for each topic.

Neuroplasticity

To enhance the opportunity for learning for children, it would be helpful to the adult guide or educator to understand neuroplasticity (Doidge, 2015). Doidge describes that "neuroplasticity is the property of the brain that enables it to change its own structure and functioning in response to activity and mental experience" (p. xv) and "that as learning occurs, the connections among nerve cells increase" (p. xvi). Research shows that increasing neural connections in the brain by repeating cognitive exercises is essential for learning (Gallagher, 2005). The importance of neural connections is described by Byrne (n.d.), where they are responsible for "mediate reflexes, process sensory information, generate locomotion and mediate learning and memory…recognition and cognition" (para. 2). In terms of memory, Carter, Aldridge, Page, and Parker (2009) explain that when new learning occurs, two neurons fire together and connect. If similar learning occurs, the same neurons fire together again and connect to new neurons and in turn, makes the previous neural connections stronger. The repeated firing of these neurons is how memories are created and consolidated (Carter et al., 2009).

Carter et al.'s (2009) explanation of connecting neurons as learning repeats, is similar to Vygotsky's (1962) explanations of thoughts. Vygotsky (1962) explains that "thought is not merely expressed in words; it comes into existence through them. Every thought tends to connect something with something else, to establish a relationship between things. Every

thought moves, grows and develops, fulfills a function, solves a problem." (p. 125). Bruner (1962) reiterates Vygotsky's (1962) comments: "once a new structure has been incorporated into his thinking…it gradually spreads to the older concepts as they are drawn into the intellectual operations of the higher type" (p. ix). In other words, for learners to develop more complex learning and understanding, when new concepts enter the brain, they must connect with prior knowledge to establish new meaning of the new concept. Whether it is neurons firing together or thoughts, both Carter et al. (2009) and Vygotsky (1962) recognize the importance of learners connecting prior learning to new learning to help make sense of the world. If neural connections are important to learning, memory and processing, then parents can help their children by guiding them through repetitive number talks. Considering neuroplasticity (Doidge, 2015), children's brains are malleable. This results in learning with repetition if it is within their capacity of learning (Gallagher, 2005), and thus, children can form new thoughts about their learning.

Mindset

Another important aspect of learning is mindset. Dweck (2016) explains that as students become more conscious about their thinking and learning, they develop a growth or fixed mindset. Dweck describes "people with a fixed mindset-those who believe that abilities are fixed – are less likely to flourish than those with a growth mindset – those who believe that abilities can be developed" (back cover). In other words, Dweck explains that through experiences, people develop either a fixed or growth mindset about what they believe they can do. If people believe that they can't, then they won't and they have a "fixed ability that needs to be proven" (p. 15). If people believe that they can learn, they will challenge themselves, try harder, push themselves to succeed and have "a changeable ability that can be developed through learning" (p. 15). In my experiences, I have seen children with a fixed mindset, where they think that they cannot do something, and are closed to any learning possibilities.

Dweck (2016) continues to explain "how a belief that your qualities are carved in stone leads to a host of thoughts and actions, and how a belief that your qualities can be cultivated leads to a host of different thoughts and actions, taking you down an entirely different road" (p. 10). Her explanation matches what Vygotsky (1962) claimed about making meaning through thoughts and words. However, when people make meaning through their experiences, thoughts and words, the meaning can either be positive and represent a growth mindset or be negative and

represent a fixed mindset. Dweck's research found that people with a growth mindset have "a special talent for converting life's setbacks into future successes" (p. 11) which coincides with Dewey's (1938/2015) stance on learning through problems. Dewey states that through experiences, "the conditions found in the present experience should be used as sources of problems…and growth depends upon the presence of difficulty to be overcome by the exercise of intelligence" (p. 79). To me, Dewey is explaining the nature of problem solving. If there is a problem that presents itself, it is up to individuals to figure out how they are going to "overcome" the problem. Whether the experiences present themselves as problems to solve or ideas to think about, the important thing is taking advantage of an opportunity of learning.

I agree with Dewey (1938/2015) in that through experiences and problems, people can learn, and learning is a continual process. However, Dweck (2016) takes it one step further and emphasizes the importance of what people think about themselves after being faced with problems through their own experiences. What Dweck and Dewey's research meant for my study was in setting as a formal goal to help parents overcome any fixed mindset about math that may appear over the course of my study. Boaler (2018) also describes the need for "developing mathematical mindsets" in learning (p. 28):

> Successful math users have an approach to math as well as mathematical understanding that sets them apart from less successful users. They approach math with the desire to understand it and to think about it, and with the confidence that they can make sense of it. Successful math users search for patterns and relationships and think about connections. They approach math with a *mathematical mindset*, knowing that math is a subject of growth and that their role is to learn and think about new ideas. We need to instill this mathematical mindset in students from their first experiences of math. (p. 29)

Boaler has recognized that students with the mathematical growth mindset are more successful, more confident and are eager to learn than students with fixed mindsets. My goal was to create a relationship with parent participants so that they would feel comfortable sharing their thoughts, feelings and experiences with me. Their previous experiences may have affected them to think negatively or positively about their ability to guide their children in math. During my research, I aimed to help parents with a fixed mindset shift their thinking so that they could develop a mathematical mindset and in turn help guide their children to feel positive about math.

Making Meaning

Another aspect of learning is making meaning. Nelson (1985) describes making meaning as a complex process and is related to "cognition, context and culture" (p. 249). Each aspect of making meaning is described below.

Making meaning through cognition. In terms of cognition, Nelson (1985) suggests that there are three levels for when a child makes meaning and is dependent on "the perceptual, the event representation, the conceptual (with various sublevels…), and the semantic" (p. 251). To help a child make meaning of words through perceptual cognition, Nelson explains that a child must take part in "participatory interaction" (p. 253) where there must be representation of words, actions and communication. To me, this indicates that for children to acquire meaning, there must be an adult guide or an older child interacting with them, playing with them, discussing with them and showing them how things work. Nelson states that "without the social interactive basis for conceptualization, the child's meanings would be confined to concepts of small objects, and both language and thought as we know it would be thereby impossible" (p. 253). In terms of my research, the perceptual phase is an essential step for number talks as parents were able to interact, engage and discuss with their children. This phase represents parents exposing their children to the vocabulary during number talks about time, money and temperature.

The second level of cognition that Nelson (1985) discusses is the conceptual phase. She refers to this phase as "the analysis of concepts and the relating of concepts to each other both syntagmatically and paradigmatically, resulting in new conceptual organizations" (p. 254). In other words, through time, children can continue to develop their meaning of words while they relate them to their real-life experiences. Since my research is about parents guiding their children through number talks, each number talk is a real-life experience for children which allowed them to make sense of the words related to time, money and temperature.

Nelson's (1985) last level of cognition is the semantic phase. Nelson describes this phase as:

> Words can be manipulated independently of concepts. Language becomes an autonomous and automatic system. The child can begin to think *in* language and *about* language. Obviously, words do not lose their conceptual meanings, but words and concepts no longer stand in a one-to-one relationship to each other. (p. 255)

From what I understand, the semantic phase is about children making and developing their own meaning of words so that eventually, they can use them independently without being guided as much as before. In terms of my research, this was when children learned words through number talks and the exposure to vocabulary about the concepts of time, money and temperature. My aim was for children to learn about the concepts of time, money and temperature and develop meaning through the conceptual, perceptual and semantic phases all while being guided through number talks with their parents.

In summary, Nelson (1985) suggests that the cognitive phase of making "meaning depends upon at least three different interpretive structures – perceptual, conceptual, and semantic" (p. 228) as well as the learner's personal experiences. This is supported by Bruner (1962) that "concepts and the language that infuses and instruments them give power and strategy to cognitive structure" (p. ix). In other words, if learners are able to make sense of all that they learned, then they are able to make meaning. "However, their interpretation of terms used by others may be faulty whenever these uses do not fit the child's own experiential base" (Nelson, 1985, p. 229). In my school, I have seen many children with fragmented knowledge who have been exposed very little to one or more of the described structures in their home environment. Thus, when teachers teach the semantic language of mathematics without the proper concepts and perceptions already in place, the child is unable to interpret and make meaning out of what is being taught. Based on what I have seen while I work with students who have difficulty in numeracy, the older the children are, the harder it is for them to make meaning as the concepts and semantics build on each other. Research has found that there is an absolute need to scaffold children's early numeracy so they are able to build a relationship between structures in order to make meaning (Skwarchuk et al., 2014).

Making meaning through context. Context is another aspect of developing meaning (Nelson, 1985). Nelson (1985) explains that children make meaning through words in different social contexts. She states that "participatory interaction is seen as essential to the child's acquisition of meaning, not only because language is used within interactive contexts but because these contexts provide the structures that make mutual interpretation possible" (p. 253). To me, participatory interaction is describing how parents and children would interact during number talks while making meaning through language and positive interaction. Nelson also suggests that the repetition of similar social contexts may lead to aiding the child in making

meaning of words. The intention of my research was to encourage children and parents to interact and engage multiple times about time, money and temperature. The goal was for parents to lead children to a better understanding of life, as well as aid in their development of numerical understanding and problem solving.

Making meaning through culture. Lastly, Nelson (1985) mentions culture as yet another aspect in making meaning through words. Since "language is, of course, a form of culture as well as a carrier of culture" (p. 258) then "the meanings associated with particular forms must be mastered by children who grow up within a given cultural-linguistic community" (p. 258). Nelson indicates that children's experiences through exposure of language and culture, help them to build meaning and understand their own world. For me, culture is an important aspect of any experience and the topics of time, money and temperature can be used in any culture and language. During my research, there were a few participants who spoke different languages, and I encouraged them to try number talks in their own language. This allowed parents to incorporate their culture and language into number talks and they knew how to present the concepts to their children the best.

To continue the discussion about culture and the possibility of guiding adults to teach their children through number talks, it is important to look at the significance of culture in schools. For many years, Canada has had an increase of immigration and the diversity of classrooms is increasing (Schmidt, 2014). In terms of how to guide adults, Schmidt (2014) has found that learning about others' language is helpful for newcomers and states that, "one of the ways in which the school facilitated effective relationships with parents and families was by reinforcing the importance of maintaining their first language at home" (p. 70). To me, Schmidt's research demonstrates that parents should communicate with their children in their first language. In my research, I encouraged the participants to practice number talks with their children in their language.

Another aspect of making meaning through culture is children learning through culturally relevant pedagogy (Ladson-Billings, 1995). Ladson-Billings (1995) states that:

> Culturally relevant pedagogy rests on three criteria or propositions: (a) Students must experience academic success: (b) students must develop and/or maintain cultural competence; and (c) students must develop a critical consciousness through which they challenge the status quo of the current social order. (p. 160)

As Ladson-Billings points out, the last criteria can be better explained by McLaren (as cited in Ladson-Billings, 1995) as consciousness that is "a process that invites learners to engage the world and others critically" (p. 162). It is clear that Ladson-Billings suggests that for students to be exposed to culturally relevant pedagogy, then they must feel successful, culturally connected and conscious of their learning where they can look at the world in a new way. Indirectly, I aimed to teach parents how to guide their children through culturally relevant pedagogy during number talks. For example, to promote a child's success, the first aspect of culturally relevant pedagogy, I taught parents to look for the zone of proximal development and begin a talk when the child is engaged and stop when the child is no longer interested. To help parents know when their children are ready for a talk, I guided them to notice their mood, interests and motivation. In regard to children feeling culturally connected and conscious of their learning, parents were able to infuse cultural aspects as number talk opportunities arose as well as guided their children to understand real-life concepts. Thus, making meaning through culturally relevant pedagogy occurred for at least two of the participants.

In summary, through the experience of the workshop sessions, I taught parents about how to scaffold their teaching to help their children make meaning during number talks (Bruner, 1990; Nelson, 1985; Vygotsky, 1962). I also provided some background information about the zone of proximal development and neuroplasticity so that parents found their child's zone to be able to conduct number talks at their level. I then demonstrated to parents how to increase the difficulty of the concept in small steps in order to increase their children's learning for the concepts of time, money and temperature. My intention was for parents to use hands-on resources while teaching time, money and temperature to their children, to guide them to make meaning through the contextual and cultural experiences. My aim was for children to build conceptual understanding, perception and language and guide them to an opportunity of learning to enhance their problem solving ability (Anderson, 1997).

Examining the Role of Experiential Learning on Numeracy Development

The experience of learning is found in every learning context for any topic anywhere. The goal of this thesis was to explore how numeracy learning is influenced by adult guidance, awareness of attitudes and problem solving, and as a predictor of mathematical success through the use of number talks on the topic of time, temperature and money.

Mathematics and Numeracy

Mathematics, math and numeracy concepts are often used interchangeably, and their complexity makes them difficulty to define. Manitoba Education (2013) describes mathematics as "one way of trying to understand, interpret, and describe our world. There are a number of components that define the nature of mathematics…These components include change, constancy, number sense, patterns, relationships, spatial sense, and uncertainty" (p. 8). Manitoba Education further explains that:

> Mathematical processes are critical components that students must encounter in a mathematics program in order to achieve the goals of mathematics education and encourage lifelong learning in mathematics. Students are expected to
>
> - communicate in order to learn and express their understanding
> - connect mathematical ideas to other concepts in mathematics, to everyday experiences, and to other disciplines
> - demonstrate fluency with mental mathematics and estimation
> - develop and apply new mathematical knowledge through problem solving
> - develop mathematical reasoning
> - select and use technologies as tools for learning and solving problems
> - develop visualization skills to assist in processing information, making connections, and solving problems. The Common Curriculum Framework incorporates these seven interrelated mathematical processes that are intended to permeate teaching and learning (p. 11)

According to Manitoba Education, mathematics represents not only the components of mathematics but also the processes that are all interconnected. For students to learn math, they must be engaged in their thinking and connect their learning to their previous understanding of many different concepts. Mathematics does not just mean the memorization of math facts or understanding of one specific math unit. Rather, mathematics as an interconnected circle of aspects that lead learners to be able to succeed in math. In using the words mathematics or math, it is inherent that I am referring to mathematics that can be found in any real-life daily experience where people can problem solve for themselves, while using any of the above-mentioned processes.

Numeracy is also a difficult word to define. In the Manitoba Curriculum Framework of Outcomes (Manitoba Education, 2013), numeracy is captured in the following statement:

> Students are curious, active learners with individual interests, abilities, and needs. They come to classrooms with varying knowledge, life experiences, and backgrounds. A key component in successfully developing numeracy is making connections to these backgrounds and experiences. (p. 3)

Furthermore, Manitoba Education and Training (2019) defined numeracy together with literacy in the 2018 provincial summit as:

> Literacy and numeracy are fundamental to all learning across our entire lives, from early childhood to adulthood. They enable us to understand, interpret, create, communicate, and interact with ideas, other people and the world around us. They are complex and dynamic processes that involve building on prior knowledge, language, culture, and experiences to develop new knowledge and deeper understanding.
>
> Literacy and numeracy involve more than reading and writing words, numbers or symbols on a page, or knowing grammar and math facts. They include the capacity to understand and use language, signs (cues and gestures), numbers, symbols and images for learning, communicating and creating. They are embedded in learning experiences across all subject areas, and in learning and life outside of school.
>
> Literacy and numeracy are among the essential skills adults need to succeed in the workplace and to be active citizens. They are lifelong endeavours that evolve as we live, learn, work and grow. (p. 1)

The report clearly outlines the importance of both literacy and numeracy skills and how they are essential to everyday living to understand how to function and connect to every day real-life experiences. To further enhance my own definition of numeracy, I read about the National Numeracy (n.d.a) charity and its way to define numeracy. The charity was developed in the United Kingdom to help "raise low levels of numeracy among both adults and children and to promote the importance of everyday math skills" (para. 3). The organization defines numeracy as:

> …the ability to use mathematics in everyday life. Numeracy involves skills that aren't always taught in the classroom – the ability to use numbers and solve problems in real life. It means having the confidence and skill to use numbers and mathematical

> approaches in all aspects of life. Numeracy is as important as literacy. In fact, it's sometimes called 'mathematical literacy'. We need both skills to function in modern life. (National Numeracy, n.d.b., para. 1)

Similar to the Manitoba Education and Training (2019) report, the National Numeracy (n.d.a.) charity views the importance of using mathematics in real life experiences and compares the skills to literacy skills as well. Numeracy and mathematics can be described as any real-life daily experience, where people can problem solve for themselves while using any of the mathematical processes defined by Manitoba Education (2013).

Adult Guidance

The role of adult guidance is often embedded in children's experiential numeracy learning. As described in Vygotsky's (as cited in Kozulin, 2003; Newman & Holzman, 1993) definition of zone of proximal development, it is through adult guidance that a child learns. Furthermore, Vygotsky (as cited in Newman & Holzman, 1993) explains that "the maturation of the child's higher mental functions occurs in this cooperative process, that is, it occurs through the adults' assistance and participation" (p. 59). In my experiences, I find that it is necessary for an adult guide, parent or teacher to understand how children learn and then guide them toward success. Researchers have focused on how children learn numeracy concepts, but it has not been until just recently that the role of the parent, and the nature of parent/child interactions, the availability of resource materials, in relation to learning and motivation has become a focus.

In this section, I examine parental involvement, parent/child interactions, as well as the available parent websites, programs and workbooks. In addition, I discuss parental motivation as well as the interplay between learning and motivation.

Parent involvement in mathematics. Parent involvement in children's learning of mathematics from a young age has been shown to be positively correlated with children's learning and future success in school (Bleach, 2015; Greenfeld et al., 2009; Lukie, Skwarchuk, LeFevre, & Sowinski, 2014; Nguyen et al. 2016; Segers et al., 2015). Segers, Kleemans, and Verhoeven (2015) explain that if parents promote early numeracy learning at home, it has a direct impact on numeracy learning at school. But Napoli and Purpura (2018) suggest that further research should focus on promoting better support for parents and their young children in the home environment. In addition, Napoli and Purpura (2018) found that assessments of the

quality of children's home numeracy environment was predictive of preschoolers' numeracy outcomes.

Other research indicates that parents want to help their children in numeracy at home, but they are often unsure of how to help (Brandt, 1989). Epstein (as cited in Brandt, 1989) describes five types of parent involvement including parent and child interactions in home activities. In general, Epstein found that parents, including those from a range of socioeconomic communities, want to help their children at home, however "they need the school's help and teacher's help to know what to do with their children at each grade level" (p. 27). Epstein explains that "our data suggest that schools will be surprised by how much help parents can be if the parents are given useful, clear information about what they can do, especially at home" (p. 27). My goal is to provide helpful, precise information to parents in order for them to be able to help their children at home.

It is evident that if parents work with their children during their preschool years, then it can promote math success in school (Lukie et al., 2014). Boaler (2018) states that "in the early years of school…this is the time when it is most critical that teachers and parents introduce mathematics as a flexible conceptual subject that is all about thinking and sense making" (p. 29). As a practicing teacher, I agree with Boaler as I see a difference with students in early grades who already have a conceptual understanding in math. In my experiences, many students who come to school with that mathematical understanding, are better prepared for school because their parents guided them at home with real life concepts. For some parents, this interaction comes naturally, however, for many other parents, they do not know what to do. Thus, there has developed a need to educate parents in order for them to know how to help guide their children (Lukie et al., 2014). The National Academy of Sciences (2009) released a report from the National Research Council that stated that a "national initiative is needed to improve early childhood mathematics education" (p. 1). Christopher Cross stated that:

> Young children have a keen interest in learning about everything in their environment. That naturally translates into becoming competent in mathematics, but right now most children's potential is not being realized because we have not given parents, educators and caregivers the tools that they need to build on that interest…Evidence shows that early success in math is linked to later success in both math and reading. Given the increasing importance of science and technology in everyday life and for gaining entry

> into many careers, it's crucial that we give all children a strong foundation in math and that we start many years before they enter formal schooling. (National Academy of Sciences, 2009, p. 1)

Based on my own experiences, I agree with the National Academy of Sciences' statement of the need to educate parents. I have met many parents and teachers from diverse backgrounds who do not know how to guide their children in early math experiences, however there are studies that show that parents can be guided in order to help educate their children in numeracy.

Other studies have shown that positive parent and child interactions increase numeracy skills in children (Merenda, 2000). For example, Vandermaas-Peeler, Nelson, Bumpass, and Sassine (2009) indicated that daily mathematical conversations and interactions between parent and child increased numeracy skills. Young-Loveridge (2004) found that parents who read number books and played number games with their 5-year-old children had increased their children's math understanding by one year. Anderson (1997) showed that when parents integrated math into everyday activities while using questioning techniques with children, then they had a rich set of mathematical experiences even though the parents were not educators or teachers. Even though the research demonstrates the effectiveness of parent-child interactions in terms of numeracy, there is much more research needed to know exactly what activities are recommended to promote child success (Napoli & Purpura, 2018).

Parent resources. There have been a few numeracy education programs to support parents. Onslow (1992) studied a Family Math program that presented five evening sessions to 148 parents of children ages 9 and 10, in different schools, that increased parental math confidence and changed attitudes towards math. Similarly to Onslow, Mendoza (1996) presented 8 math sessions over 12 weeks for parents of 56 at-risk Grade 7 students. Her objectives were to "increase parental involvement by 40%, increase parental knowledge and reverse their negative attitudes toward mathematics by 40%, to change students' attitude toward mathematics and increase motivation by 40% and to enhance student achievement by 35%" (p. 1). Mendoza achieved her objectives and was recommended to continue the workshops for all students and parents as well as to expand the workshops to other subjects.

In addition to parent programs, websites have been developed to promote math learning or provide tips to help parents educate their children in math for free ("Bedtime Math For Families," 2015; "Homework Help," 2000-2005; "Parent Primer: Math," 2018). Locally, the

Manitoba Education and Training (2018) website has downloadable games and activities with instructions for parents as well as a Parent's Guide for Helping your child learn math (Manitoba Education, Citizenship and Youth, 2004). There are other websites that offer parental math help through a subscription or online account ("Parent Support," 2019; "Help Your Child With Math," 2019; "Support Your Child's Math," 2019). One of these is a parent website called Komodomath ("Help Your Child With Math," 2019) that offers a three-step plan for parents. The goal of the website is to help children develop an understanding of the basics, practice the basics and develop positive attitudes. Parents pay for an online program that is at the child's level based on an online diagnostic evaluation. Once children complete a level, they advance to the next level. The subscription can be monthly or annually. These websites offer ideas, tips, articles and leveled math learning, however none of them provide number talk videos to guide parents through problem solving with their children and consequently the face to face parent and child interaction is not found.

Other parent resources include printed math workbooks available to purchase, for parents to give their children extra practice such as Math Made Easy (Wilson, 2005) or Jump Math (Mighton, 2010). Other printed resources discuss the importance of learning math through every day problem solving and activities (Apelman & King, 1993; Rachlin, Ditchburn, Bannon, & Sawicki, 1993). For this project, parents did not need to purchase math workbooks for their children as the number talks presented themselves from real-life problem solving situations, as children became self-motivated to learn about the environment and life around them.

Learning and motivation. For parents to guide their children to learn mathematics, they must also understand factors that affect their child's learning, such as the interplay between motivation, learning and engagement. Vygotsky (1962) states that "thought itself is engendered by motivation, i.e., by our desires and needs, our interests and emotions" (p. 150). Vygotsky (as cited in Newman & Holzman, 1993) also explains, that "children must learn in order to be motivated. In other words, learning leads development" (p. 57). Thus, Vygotsky (as cited in Lucariello et al., 2015; Kolb & Kolb, 2005) believes that when children learn first, it can increase their motivation. On the other hand, other research indicates that when children are motivated and they are interested in a topic, learning can increase. Similarly, kindergarten students who are happy and comfortable in the class, have their level of motivation and learning increased as well (Stephanou, 2014). The American Psychological Association (Lucariello et al., 2015) states that

one of its key principles to motivate students is that they "tend to enjoy learning and to do better when they are more intrinsically rather than extrinsically motivated to achieve" (p. 16). In addition, David Hunt (as cited in Kolb & Kolb, 2005):

> describes *inside-out learning* as a process of beginning with oneself in learning by focusing on one's experiences knowledge, that is, the implicit theories, metaphors, interest, desires and goals that guide experience. Making space for inside-out learning by linking educational experiences to learners' interests kindles intrinsic motivation and increases learning effectiveness. (p. 209)

Based on my own experiences during my childhood, as a parent, and as a teacher, I have seen students learn very quickly when they are motivated to find the solution to a problem. Whether learning occurs before motivation, or vice versa, it is important that both learning opportunities and motivation to learn are present. However, to further the discussion, it may be child engagement that is key to both learning and motivation. Manitoba Education (2013) says that "curiosity about mathematics is fostered when children are actively engaged in their environment" (p. 5). In other words, when children are interested in an activity or discussion, whether or not they are talking about math concepts, then they are engaged in learning and motivated to learn. I strongly believe that the key to learning and motivation is engagement. My goal was for parents to engage children in number talks in a positive way when children demonstrated their interest and motivation to learn. I taught parents how to notice those moments through the zone of proximal development and example videos.

In addition, some studies demonstrate that parental motivation affects children's education (Bleach, 2015; Fan & Chen, 2001; Onslow, 1992). For example, Bleach (2015) found that it was difficult to motivate a few parents to conduct the numeracy activities with their children. Onslow (1992) found that "since few parents of disadvantaged children attended the special sessions, the Family Math program may be widening, rather than decreasing the gap between students able to understand mathematics and those struggling with new concepts" (p. 1). The challenge then becomes how to recruit participants from all different backgrounds, how to motivate them, how to increase parental expectations and how to teach them how to guide their children.

Considering the importance of parental involvement and parent/child interactions as well as the available parent websites, programs and workbooks, my research provided parents with an

alternative. For children between kindergarten and Grade 2, parents were not required to give their children workbooks or websites to work on. In my work, I included example number talk videos where I guided my own children through problem solving while they were in the zone of proximal development. These types of videos do not appear in research currently available. I aimed to motivate parents by teaching them how to kindle the intrinsic motivation of their child to promote learning based on the three life skill topics of time, money and temperature.

In this study, parent guidance was based on how parents engage their children in number talks to develop problem solving and number sense skills following the workshop sessions. Parents wrote to me about their own motivation and engagement with their child to see if they were able to provide motivational cues as some of the contributing factors in their child's learning.

Predictors of Mathematics Success

Some research has documented predictors of mathematical success. For example, Geary (2011) found that:

> Intelligence, working memory, processing speed…word reading…visuospatial sketch pad…early fluency in processing and manipulating numerical set size and Arabic numerals…sophisticated counting procedures for solving addition problems, and accuracy in making placements on a mathematical number line were uniquely predictive of mathematics achievement. (p. 1539)

Moreover, Praet, Titeca, Ceulemans, and Desoete (2013) found that "language and logical thinking as predictors for arithmetic skills in kindergarten and Grade 1" (p. 90) and "also number estimation" (p. 90) played a role as well. However, they suggest that further research "can reveal if an intervention on language and/or number naming ability in kindergarten can increase arithmetic skills in first grade" (Praet, Titeca, Ceulemans, & Desoete, 2013, pp. 94-95). Furthermore, LeFevre et al. (2010) describe their pathways model and how they predicted young children's mathematical skills two years later. They wrote that the pathways included: "quantitative, linguistic and spatial attention. These pathways (a) contributed independently to early numeracy skills during preschool and kindergarten and (b) related differentially to performance on a variety of mathematical outcomes 2 years later" (p. 1753). They suggest that future research is needed to understand the "fundamental underlying skills that contribute to all of these specific domains" (p. 1765). Additionally, Krajewski and Schneider (2009) found that:

> Preschool quantity-number competencies predicted mathematical achievement in primary school…basic arithmetic fact retrieval in Grade 1 had an impact on early mathematics school achievement…the influence of socioeconomic status and number naming speed, assessed in kindergarten, became especially important at the end of Grade 4. (p. 513)

In addition, Cirino (2011) found in his study that there was "strong predictive power for addition number combinations. Linguistic and spatial attention domains showed indirect relationships" (p. 713) as well. Overall, from what I understand, depending on what the researchers studied, they found strong predictors ranging from addition, estimation, number line, counting, and language to the brain processes such as working memory and processing speed. To me, this means that there are a variety of early mathematics predictors that help children succeed in later years.

Even though there are many predictors of early mathematics success, my aim was to teach parents how to do number talks so that they could incorporate many predictors into the talks. My intention was that through guiding parents to do number talks with their children from an early age about time, money and temperature, their children were able to develop the necessary skills from as many predictors as possible. In addition, my aim was for the participants to use a conceptual approach with their children during number talks, rather than a set of tasks with their children. Boaler (2018) explains that "mathematics is a conceptual domain. It is not, as many people think, a list of facts and methods to be remembered. When students learn to count, they remember order and names for numbers, but they also develop the *concept* of number; that is, the idea of a number" (p. 30). Boaler explains how mathematics is conceptual, where children need to make sense of numbers. For me, it was through the concepts of time, money and temperature that I taught parents how to guide their children through conceptual mathematics from exposure to vocabulary to problem solving. My goal was for children to grasp and make sense of numbers in their own real-life experiences.

Awareness of Attitudes Toward Mathematics

To create opportunities of numeracy learning, parents should consider their own attitudes as well as those of their children in order to build self-efficacy and confidence. Experiences influence learning as they are directly related to emotions, (Sousa, 2008; Tobias, 1987). Gunderson, Ramirez, Levine, and Bielock (2012) grouped constructs of anxiety, self-concept, and self-efficacy together when measuring adults' personal mathematics attitudes. They

explained that "math anxiety can be thought of as a negative emotional reaction to the prospect of doing math" (p. 154). Adopting Gunderson et al.'s work, math anxiety is considered to be negative attitudes toward mathematics that affect children's performance. Some research has shown that negative mathematics attitudes may be counterbalanced with self-efficacy and confidence.

If parents are going to guide their children in mathematics learning, it is important to examine parent and child math anxiety as a consistent body of research has shown that anxiety affects learning (Shanker, 2017). When students are experiencing anxiety, fear or negative experiences, their learning is reduced (Ashcraft, 2002; Kolb & Kolb, 2005; Stephanou, 2014). This research is also supported by Shanker (2017) who explains that high math anxiety may be related to low self-esteem, low self-confidence, negative early numeracy experiences, gender and racial stereotypes, and anxiety levels of teachers or parents. Shanker further explains that the brains of 7 to 9-year-olds with high math anxiety during a mathematics problem demonstrate that they "are going into fight-or-flight" (Shanker, 2017, para. 1) mode which is a sign of cognitive stress. If the brain is in stress mode, then it is unable to access working memory, as it is the limbic brain that takes over (Shanker, 2017). Tobias (1987) has found the same results with students who experience math anxiety. She describes that "the understanding and recall pathways have become cluttered by emotions…the pathways have been blocked, you cannot remember…you lose self-confidence…Your brain stops functioning. You can't work, you assume, because you can't think" (p. 7). Parents need to understand possible math anxiety in their children in order to help them in mathematics. In my experiences as a teacher, I often tell parents to stop teaching mathematics when their children start to cry, get angry or upset because their brain is not able to learn when they are in that state, and math becomes associated with negative emotions.

Child anxiety is often related to parent's math anxiety (Shanker, 2017). Many researchers have explained that "students' attitudes towards mathematics are strongly influenced by the attitudes of their parents" (as cited in Onslow, 1992, p. 24). Onslow (1992) suggests that if parents are taught mathematical methods in order for them to understand mathematics taught in school, then it would be helpful to their children in order to "enhance the positive attitudes of students and reduce their negative attitudes" (p. 24). Other researchers have shown that parents who have negative attitudes and feelings about mathematics can influence their children's

feelings about math (Gunderson, Ramirez, Levine, & Beilock, 2012; Tiedemann, 2000b; Yee & Eccles, 1988). Maloney, Ramirez, Gunderson, Levine, and Beilock (2015), found that when parents with math anxiety helped their grades 1 and 2 children in mathematics, "their children learn significantly less math over the school year and have more math anxiety by the school year's end" (p. 1480). On the other hand, when parents who have high math anxiety do not help their children in math very much, "children's math achievement and attitudes were not related to parents' math anxiety" (p. 1480). Thus, Maloney et al. are explaining that parents' math anxiety influenced their children's thinking of their own mathematics ability, suggesting that "intergenerational transmission of low math achievement and high math anxiety" (p. 1480) actually exists. I have seen this first hand as I have heard parents frequently say in front of their children, 'It's okay that my child does not know math. I did not get it either and I still don't.' These types of parental negative attitudes influence children's attitudes immensely. The simple step-by-step number talks about time, money and temperature, that I presented in my three workshops aimed to help parents understand how to teach simple mathematics to their young children in order to help reduce future math anxiety for themselves and for their children.

To counterbalance parent or child math anxiety, research indicates that developing self-efficacy and confidence can help with learning (Bandura, 1993). Bandura (1993) explains that to relieve anxiety, it is best to "build a strong sense of efficacy. This is achieved through development of cognitive capabilities and self-regulative skills for managing academic task demands and self-debilitating thought patterns" (p. 134). From Bandura's description, my understanding of students being self-efficient occurs if they have strong beliefs about themselves while problem solving. Based on my experiences, as soon as students feel like they can succeed with a task, they realize they can. To me, this is not only self-efficacy, but is confidence as well.

Since building self-efficacy and confidence are important to reducing negative math attitudes, then my goal was to help parents increase their own confidence, by helping their children problem solve through number talks. Ramirez, Chang, Maloney, Levine, and Beilock (2016) state that:

> One important starting point for improving attitudes about mathematics and how children perform is to prevent children from developing math anxiety in the first place. Working with teachers as well as with parents to change the (negative) ways they interact with

> their children about math is likely important for stemming children's math anxiety and increasing positive attitudes about math." (pp. 96 – 97).

Through my workshop series, I suggested that if parents have positive interactions with their children during number talks, then they can both build "beliefs in their efficacy to regulate their own learning and to master academic activities determine their aspirations, level of motivation, and academic accomplishments" (Bandura, 1993, p. 117).

Evidently, the attitudes of both learners and parents can affect a learning situation (Gunderson et al., 2012). In this study, parents' descriptions of their own mathematics attitudes and confidence before, during, and after the workshop sessions is discussed at length in later chapters

Encouraging Problem Solving Through Number Talks and Foundational Experiences

Students may also learn about numeracy concepts through problem solving (Manitoba Education, 2013) and number talks provide the opportunity to expose the student to foundational numeracy experiences (Mason & Erickson, 2015). The workshops were used as a conduit for exposing participants to the broad concepts aforementioned in this section (definitions of mathematics versus numeracy; anxiety effects, predicting success, adult guidance and awareness of math attitudes).

Parrish (2010) describes number talks as a method for teachers to use in their classrooms to help students "focus on number relationships and use these relationships to develop efficient, flexible strategies with accuracy" (p. 13). Number talks are about real situations where students share their strategies and learn from each other. The goal was to teach parents about these number talks to be used at home.

The number talks that I explained to parents differed from the number talks that Parrish (2010) refers to for teachers. During number talks for the classroom, students are encouraged to write down how they solved a problem and then share their methods with classmates. The approach to number talks that I taught parents relied on no written information at all. They were simply verbal conversations between caregiver and child, sometimes with activities such as moving the hands on a clock, counting change, or going outside with a thermometer. Klibanoff, Levine, Huttenlocher, Vasilyeva, and Hedges (2006) found that preschool teachers who spoke more about numbers improved mathematics results of their students even though there was a difference in knowledge at the beginning of the year. In addition, Kilbanoff et al. suggest that

the reason for the improvement is that preschool is a time for learning vocabulary, and children who are exposed to numeracy skills can inadvertently increase their mathematics skills. Although there has been some research demonstrating the benefits of number talks with teachers, there is little knowledge on whether this inquiry method is beneficial to children and their caregivers.

Some parents may find it difficult to do number talks with their children, especially if they have math anxiety themselves (Tobias, 1987). However, if parents can be shown how to be responsive to their child, by focusing on the child's capabilities and curiosities, number talks could have benefits of reducing family anxiety patterns (Aschaiek, 2016). "Research on children's mathematical thinking has shown that paying attention to the details of children's strategies matters because these details provide a window into children's understandings--information that teachers can use to decide their next instructional steps" (Jacobs and Philipp 2010, p. 101). If teachers, including parents can be guided by children's mathematics skills, then so can parents as they know them best. During the workshops, parents were able to see how they could guide their children through number talks while observing and understanding how their children learn in order for them to develop number sense.

An ideal opportunity to do a number talk is when there is a rich context that allows for it (Bruner, 1983). Bruner (1983) showed that children's constructive play experiences may be guided by an adult, resulting in opportunities that:

> For the child and for the adult alike, is a way of using mind, or better yet, an attitude toward the use of mind. It is a test frame, a hot house for trying out ways of combining thought and language and fantasy. And by the same token, there is much that one can do to help the process of growth. But do not overheat the hot house! (p. 69)

In other words, during play, I guided the parents to decide when to do a number talk. I then explained that they are there to guide the child in their learning, but are not there to guide the child to frustration. Play can be as simple as baking together and playing with fractions, or eating supper where a child is counting how many peas there are on the plate. They are both examples of rich contexts where parents can find many opportunities for number talks.

Another aspect to look at for number talks is the context of learning and how it is important for children to understand mathematical relations. For instance, Anderson (1997) suggests that a context could be "providing parents and children certain materials with which to

play may permit children a greater opportunity to display their strengths" (p. 485). Vandermaas-Peeler et al. (2009) support Anderson and use the word context to describe a learning opportunity using materials and imagination such as pretend play, cooking materials, books and toys and further explain that numeracy learning could occur "in the context of daily routines" (Vandermaas-Peeler et al., 2009, p. 79). Anderson takes it one step further and explains the term "contextualized learning" (p. 79) as represented by the interaction between the learner, the parent, the materials and the environment. This contextualized learning between caregivers and their children was a goal of the current work and a primary reason for providing the materials: : analog clocks, real coins and thermometers.

Once parents and children engage in number talks in a rich real-life context, Parrish (2010) outlines the importance of mathematical number sense instead of memorizing algorithms and rules to solve equations. Manitoba Education (2013) suggests that number sense "can be thought of as intuition about numbers…Number sense is an awareness and understanding of what numbers are, their relationships, their magnitude, and the relative effect of operating on numbers" (p. 9). In my opinion, if children are to develop number sense and an intuition about numbers, then the best way forward is to guide parents in what to do to help their children learn.

In many ways, parent-led number talks are an ideal context for children to develop number sense:

> Number sense develops when students connect numbers to real-life experiences, and use benchmarks and referents. Number sense evolves and typically results as a by-product of learning rather than through direct instruction. Number sense can be developed by providing rich mathematical tasks that allow students to make connections. (Manitoba Education, 2013, p. 9)

In terms of number sense at home, Fennell (2008), the past president of the National Council of Teachers of Mathematics, describes number sense as developing:

> Through a variety of experiences. Home is a great place to start. Talk, talk, talk! These experiences bring math into the lives of children early on. Students approach school with a growing sense of number, and parents and others can build on this. (para. 3)

In my experience as a teacher, children who have built number sense through home experiences are able to transfer their number sense at school with ease as they have already developed the "intuition" (Manitoba Education, 2013) about numbers. It is expected that through number talks

with their parents, children develop a general understanding and intuition about numbers so they can relate them in many different real-life contexts. If students have general number sense when they enter kindergarten, they can easily make new neural connections through previous learning (Byrne, n.d.; Doidge, 2015).

Another way to describe the rich contexts of number talks is Mason and Erickson's (2015) description of foundational experiences. Foundational experiences are encouraged in problem solving approaches (Mason & Erickson, 2015) and can be described as:

> Opportunities to explore big mathematical ideas rather than focusing on procedural details. The lessons avoid the formal content and symbolic arithmetic associated with those big ideas, featuring instead, opportunities for active and interactive engagement with visual and tactile forms of the patterns at the core of the mathematics topic.

In other words, foundational experiences give the chance for everyone involved in the experience to engage and learn with each other to understand big concepts without focusing on the arithmetic. For me, these experiences are the epitome of what I asked parents to do with their children in the form of number talks. Counting money with a child before going to a store or deciding what to wear outside based on the temperature are examples of interactive conversation which would be described as foundational experiences. My expectation of parents was not to teach their children the arithmetic, but rather to discuss, explore, and engage with one another, to promote child learning and motivation.

An additional way to describe foundational experiences and number talks is informal numeracy where there are no direct teaching objectives by parents (Skwarchuk et al., 2014). Sénéchal and LeFevre (2002) and Skwarchuk, Sowinski, and LeFevre (2014) define the difference between formal and informal numeracy and literacy practices for parents to work with their children. Skwarchuk et al. define:

> Formal activities as shared experiences in which parents directly and intentionally teach their children about numbers, quantity, or arithmetic to enhance numeracy knowledge. In contrast, informal numeracy activities are those shared activities for which teaching about numbers, quantity, or arithmetic is not the purpose of the activity, but may occur incidentally (e.g., playing number board games; measurement activities required in cooking, carpentry, or crafts; quantity comparisons; spatial processing) (p. 65).

Through many observations working with teachers and students from kindergarten to Grade 5, many parents are not sharing informal numeracy activities with their children and kindergarten children are coming to school without basic foundational experiences to relate to in their school setting. Baroody and Ginsburg (1990) explain that when children are connecting their informal and formal mathematics, they need the learning to make sense. They say that "mathematical symbols, computational algorithms (step-by-step procedures), and so forth can make sense to children *if* it is connected to their existing, personal, counting-based knowledge of mathematics…Only gradually, then, does knowledge in any domain become relatively complete, systematic, and logical" (p. 57). Thus, my goal was for parents to provide informal numeracy activities for their children to help build the foundation. For my research, I guided parents about how to use number talks for time, money and temperature, which would be informal activities according to the definition above. However, the number talks that I presented on videos were intentional, and step-by-step in order to promote mathematical learning. Thus, it seems to be that the number talk videos I presented were a mixture of both formal and informal numeracy to guide children towards a more "complete, systematic, and logical" (Baroody & Ginsburg, 1990, p. 57) understanding of numeracy.

Learning mathematics informally or formally could also be seen as learning mathematics in "spontaneous and nonspontaneous" (Vygotsky, 1962, p. 85) ways. Vygotsky (1962) does not explain the process of learning in terms of mathematics, but rather how students learn. However, his description can apply directly to learning mathematics. He explains that:

> We believe that the two processes – the development of spontaneous and of nonspontaneous concepts - are related and constantly influence each other. They are parts of a single process: the development of concept formation, which is affected by varying external and internal conditions but is essentially a unitary process, not a conflict of antagonistic, mutually exclusive forms of mentation. Instruction is one of the principle sources of the school child's concepts and is also a powerful force in directing their evolution; it determines the fate of his total mental development...concepts form and develop under entirely different inner and outer conditions, depending on whether they originate in classroom instruction or in the child's personal experience...When we impart systematic knowledge to the child, we teach him many things that he cannot directly see or experience. (pp. 85-86)

There are many aspects to what Vygotsky is explaining about learning. Essentially, he is saying that when children learn, it is caused by both formal and informal teaching, that can be based on school experiences as well as life experiences. Wherever students learn, whoever teaches them, and whatever concepts they learn, Vygotsky views it all as a part of learning from where they can process their understanding and develop their own meaning. Vygotsky's thinking ties in very well with my research. In terms of my workshops, I taught parents how to guide their children in number talks step-by-step in a systematic way to teach children in a non-spontaneous way.

When there is a rich context, an adult guide, a foundational experience and a number talk with number sense, problem solving occurs. Research suggests that mathematics should be taught through problem solving (Van de Walle & Lovin, 2006). In my opinion, when people are faced with a problem, they require skills on how to critically think of different solutions, and choose the best solution. According to Manitoba Education (2013), "learning through problem solving should be the focus of mathematics at all grade levels… Students develop their own problem solving strategies by being open to listening, discussing, and trying different strategies" (p. 12). During number talks with parents, problem solving helps children to develop strategies and mathematical thinking. For students to succeed in a problem solving context they need "to get from what is known to what is sought" (p. 12). Along the way, "students use prior knowledge in new ways and contexts. Problem solving requires and builds depth of conceptual understanding and student engagement" (p. 12). Student success in mathematical problem solving, "empowers students to explore alternatives, and develops confident, cognitive, mathematical risk takers (p. 13). In my thesis, I refer to many parts of Manitoba Education's description about problem solving. Problem solving is connecting to previous learning, thinking about a problem and being open to different ways to solve that problem through listening and engaging with others. My aim was for parents to guide their children through number talks to promote problem solving skills.

The problem solving approach to learning mathematics aligns well with the theories discussed earlier. For example, the ideas of zone of proximal development and neuroplasticity assist parents to know how to guide their children during number talks. Manitoba Education (2013) encourages educators to consider student's conceptual understanding, motivation and confidence to develop problem solving abilities. As well, according to Vygotsky, (as cited in

Kozulin, 2003), in order to create a possibility of learning for children, adults must guide them during problem solving opportunities to help them view problems as the "stimulus to thinking" (Dewey, 1938/2015, p. 79). In other words, in order to help children think and connect their learning, the adult guide is there to ask questions such as "How many do you have? How do you know that? Is there another way to show me?" (Wright, Martland, & Stafford, 2006).

My research aims were for parents to guide their children in problem solving while building number sense through "rich mathematical tasks" (Manitoba Education, 2013, p. 9) that are presented through number talks. Research has shown that children are able to learn mathematical concepts through real life problem solving and parents have the ideal opportunity, as they know their children best (Apelman & King, 1993; Parrish, 2010, p. 48; Rachlin et al., 1993). Therefore, during my research, I provided number talk guidance to parents in the context of three topics: telling time, learning about the functionality of money and reading temperature as they are three skills found in daily life that are relevant to children. The intention of my research was to empower parents in their ability to guide their children through number talks to help children build number sense and problem solve. My research was not to provide parents with more printed resources to give to their children nor was it to guide parents to teach content from the curriculum.

Considering Three Context Areas for Mathematics Learning: Time, money and temperature

Three real-life contexts of time, money and temperature were chosen to guide parents while providing learning opportunities to their children. For that reason, each topic is discussed in terms of: the importance to my study, the link to the Manitoba Education (2013) curriculum, teacher resources as well as parent resources and ideas. The purpose was for children to make meaning out of numbers through their daily experiences regarding the three contexts.

Time. Telling time is the first real-life context topic that I presented to parents. Earnest, Radtke, and Scott (2017) explain that time is "A measurable quantity that is both invisible and untouchable. Because of its abstract character and its unusual groupings of 12 and 60, research has shown that children struggle with time and elapsed time" (p. 97). Earnest et al. are making it clear that time can be difficult for children to learn as it is not concrete. In addition, Van de Walle and Lovin (2006) explain that teaching telling time on an analog clock can be difficult for children to understand, however if it is taught in steps, then children can learn. Thus, it seems

that adult intervention is required. The goal for my research was for parents to engage with their children about time, within the context of their lives together. As well, I intended for parents to share with their children how to tell time on both analog and digital clocks, using the math-vocabulary words that are a part of everyday speech about time, including counting to twelve, and encountering fractional and proportional concepts within the context of telling time and reading clocks.

The Manitoba Curriculum Framework of Outcomes supports problem solving and number sense through the learning of time in grades 3 and 4 (Manitoba Education, 2013). In Grade 3, students are expected to "relate the passage of time to common activities using non-standard and standard units (minutes, hours, days, weeks, months, years)" and "relate the number of seconds to a minute, the number of minutes to an hour, and the number of days to a month in a problem-solving context" (p. 85). In Grade 4, students are expected to "read and record time using digital and analog clocks, including 24-hour clocks" (p. 96). This learning could occur with example number sense activities such as to "express the time orally and numerically" on both analog and digital clocks along with describing "the meaning of AM and PM, and provide an example of an activity that occurs during the AM and another that occurs during the PM" (p. 96). It is clear that Manitoba Education (2013) believes that if students learn how to tell time in grades 3 and 4 and are able to relate it to their lives, then they are developing number sense and problem solving abilities in relation to time. However, in my experiences, many students do not know how to tell time even after being taught in grades 3 and 4, which suggests that more must be done.

There are many resources available to help teachers teach the concept of telling time (Horstmeier, 2004; Small, 2017; Van de Walle & Lovin, 2006). There is also research that shows teachers how to teach the concept of telling time through problem solving, that include example activities and how to bring inquiry based learning into the classroom (Enns, 2014; McMillen, & Hernandez, 2008; Moone & de Groot, 2005). The importance of this research is to understand that to teach the concept of time, it needs to be broken down in steps for children to understand the big ideas of time including the hour, minute and second hands (Horstmeier, 2004). My research provided step-by step teaching for parents to fill this gap.

Research suggests that parents have the biggest impact on their children when it comes to teaching time (Heins, 1997). Heins (1997) states that "difficulties in associating the visual

representations of the clock with the spoken and written word need precise and sequential instruction" (p. 6), but he explains that parents can teach their children. Based on my experiences, I believed that parents would be able to teach their children time, even if they do not recognize the richness of number sense involved in telling time. My research aimed to help them.

For parents, there are a few resources and activities that are available to help their children learn about time. For example, there are websites such as Khan Academy (Khan, 2019) that provide step-by-step video commentary about how to tell time. The idea is that once children watch the video, then they may continue with their learning and type their answers for each question. This website may assist parents in knowing how to break down the concept of time for their children. Another resource for parents is animated videos about clocks and telling time for children to watch, however they do not teach and guide parents on how to help their children put it into practice (Math & Learning Videos 4 Kids, 2012). Another website is HelpingWithMath.com ("Telling Time," 2018) that provides downloadable worksheets in order of difficulty to assist children. This website, however, does not provide step-by step instruction to parents on how to teach children. In addition, there is also a lot of mathematics literature, such as telling time picture books, available to parents to help talk about the real-life context of telling time (e.g., Kappely & Pinnington, 2002; Older & Halsey, 2000). These books do not guide parents on how to teach their children to tell time, however they do provide a good way for parents to interact with their children that can create an excellent opportunity for a number talk about time. These resources all have ideas for parents to use when they talk about time with their children, however none of them teach parents about how to do a number talk with their children in the context of time in a real-life situation.

Considering the expertise described above about time, it is clear that telling time is a context for developing number sense and problem solving skills. Therefore, my workshops provided an important opportunity for parents to learn how to guide their children.

Money. Money, specifically coins and bills, was the second real-life topic that I prepared parents to use as context to help their children learn to develop number sense and to engage in problem solving. I chose money as one of my topics as it is a real-life topic and I have taught many Grade 5 students who had difficulty with learning decimal numbers. In my experiences, when my students knew the values of coins and how to calculate money before Grade 5, they had

an easier time linking their understanding to decimals in class. Corwin (2002) found that "fourth and fifth graders are interested in working with coins. Just as they need to work with other concrete models, so do they need to work with real money in real situations" (p. 233). Therefore, to me, it would seem wise to teach children about money at an earlier age in real-life situations. In addition, Drum and Petty Jr. (1999) confirm my thinking by stating that "teaching of monetary concepts and processes is necessary to prepare young children for experiences that they are probably already facing in the real world" (p. 268). However, research suggests that the concept of coin and money counting can be difficult to learn (Horstmeier, 2004). Horstmeier (2004), explains that "learning coin values can be very difficult for all children, in part because their sizes do not match up with their values…unlike currency…coins do not all spell out their value in plain language" (p. 290). This is also supported by the Grade 2 Mathematics Support Document that outlines that "Non-proportional models, such as money, do not have any size relationship" (Manitoba Education and Advanced Learning, 2014a, p. 33) suggesting that it is more difficult to learn it. Drum and Petty Jr. state the same thing that "teaching the names of the coins is not the problem. Instead, teaching the values of coins is difficult" (p. 264). They suggest that teachers teach the values of coins with proportional representation to help students conceptualize the value of each coin. For my study, when I taught parents about how to guide their children about money, I suggested representing the values of the coins with other coins including pennies as well as using their fingers. My goal was that through multiple conceptual number talks during spontaneous teachable moments with many years of practice, children should be able to learn about money. Horstmeier supports my thinking by explaining that even though children may have difficulty with coins, with extensive practice, they can eventually grasp the understanding of coin counting and representations. For this section of number sense and money, when I refer to the teaching of money, I am including the representation, values and counting of coins and bills which leads to a general number sense about money so that children can use it in real-life situations to solve problems (TD Bank, 2018; Manitoba Education and Advanced Learning, 2014a).

The Manitoba Curriculum Framework of Outcomes (2013) has an intriguing way of weaving the concepts of money and coin sense into the content. Money and coins do not appear as specific learning outcomes, but are rather suggested as possible activities to demonstrate the learning of outcomes in real-life contexts. Based on what I have seen in my school, not all

teachers choose to use money as a learning manipulative, and so some students may not be exposed to learning about money at all unless their parents are teaching them at home. If students do not have a solid foundation in how to count coins and how to represent money at a young age, then the chances of linking their learning to future mathematical concepts such as skip counting by 25 and decimals, is decreased (Hanlon, 2012; Manitoba Education and Training, 2017; Manitoba Education and Advanced Learning, 2014b).

There are many resources available that can help teachers teach their students mathematics while using money. For example, if teachers choose to teach the concept of money to develop number sense, they have access to a variety of mathematic resources that include activities about money (e.g., Horstmeier, 2004; Van de Walle & Lovin, 2006). In addition, there are specific money teacher resource books that explain how to teach money number sense in real-life contexts such as how to purchase items in restaurants and stores (e.g., Lee & Miller, 1997; Scharf & Johnson, 2007; Venier & Jackson, 2007). More precisely, there are resources available for teachers to teach the value of Canadian coins with images (e.g., Salerno, 2000; Solski, 1994). Finally, there are several resources for teachers to teach money through arithmetic including algorithms (e.g., "Coin Values, Counting Coins," 2013). All of these resources may help teachers support their teaching, but the focus of my research is not through printed resources especially the algorithms of money, but rather number talks for parents to help develop number sense in a real-life context.

Research indicates that parent thoughts and interactions about money influence their children's understanding of money. Observations by (Pillai & Achuthan, 2015) and TD Bank (2018) suggest that by the time children reach the age of 4 or 5-years-old, they are ready to learn the basics about money. If this is the case, then parents who are interested in learning how to influence their children about money, need to seek out resources to help them. There are numerous online resources for parents that include ideas about teaching their children about money. One example is a financial literacy webpage from TD Bank that provides tips and activities for different ages of children. In my opinion, these activity ideas are excellent, however TD Bank does not provide any teaching examples for parents on how to guide their child during the activities. Another online resource example is The Canadian Homeschooler ("Teach Your Kids," 2015) that provides access to free downloadable and printable worksheets for parents to teach their children about Canadian coins. Once again, these resources are printed,

whereas in my research, there is no printed material for parents. Also, there is money-based mathematics literature where parents can read books to their children to expose them to the money and coin language (Dowdy, 2009; Novakowski, 2004; Thomas & MacEachern, 2004). These types of books can be helpful in exposing children to the language to prepare them for the future use of money. It is clear from the above research that parents can influence their children at an early age about money, however it appears that there are very few or no current resources showing parents how to do an effective number talk about money with their children.

After studying the literature regarding money, it is evident to me that there are not enough guidelines for parents about how to do number talks about money with their children. In my study, I proposed to parents to help their children develop number sense and problem solving through the teaching of money, so that children are able to become more confident with mathematics in school and in real-life contexts.

Temperature. Temperature is the last real-life topic that I discussed during my research to help parents guide their children on building number sense and solve problems. Small (2017) explains that when students pay attention to temperature on a daily basis, they have access to positive and negative numbers depending on the area of where they live. She explains that:

> Because these temperatures are meaningful for them, and because the thermometer provides a concrete model for comparing these with warmer temperatures, young children are often ready to read and compare negative numbers on a thermometer long before integers have been formally introduced" (p. 550).

In my opinion, Small is saying that early exposure to interpreting temperature will help students later on to understand the concept of integers as well as the real-life concept. She also suggests that "any work with negative temperatures should be very informal, and should be directly related to a meaningful context, such as the outdoor temperature" (p. 553). This concept is supported by Stenmark, Thompson, and Cossey (1986), who state that the purpose of learning about temperature is "to gain intuitive understanding of the relationship between hot and cold temperatures and the numbers on thermometers." (p. 103). The intuitive understanding of numbers through temperature is the reason that I have chosen temperature as the third real-life context since my intention is for parents to help guide their children in number sense and problem solving (Manitoba Education, 2013).

As indicated by Small (2017), teaching temperature to children provides early exposure to integers, however the concept of temperature and reading thermometers is not a specific outcome at all in the Manitoba Curriculum Framework for Outcomes (Manitoba Education, 2013). The concept of integers is for specific outcomes in grades 6, 7 and 8, and the thermometer appears only once in the whole framework, as a possible achievement indicator (Manitoba Education, 2013). In the Grade 6 Teacher Support Document, there are a few teaching activities suggested to connect integers to real-life situations, but since the focus of my research is with parents of children in Kindergarten to Grade 2, I did not focus on the specific outcomes of integers in the higher grades (Manitoba Education and Advanced Learning, 2014c). Rather, my suggestion to parents was to focus on number talks with their young children about temperature to expose them to a general understanding of daily life to help them develop number sense and problem solving skills.

Since teaching temperature does not appear in the Manitoba Curriculum Framework for Outcomes (Manitoba Education, 2013) in the early years, there are only a few teaching resources that refer to possible activities about temperature (e.g., "Classroom Activities: Temperature," n.d.; Horstmeier, 2004; Small, 2017). There are other teacher resources for teaching integers and links to temperature, however they are not pertinent to my research as they are for teachers of students in older grades (e.g., Berry III & Ellis, 2013; Moore, 1999). Moore (1999), however, does suggest that "the concept of temperature is fundamental and deserves more emphasis throughout the school curriculum" (p. 543), as it is a real-life concept that students can easily relate to. In my experiences, children who know how to check the temperature and calculate the difference of plus and minus temperatures mentally at a young age are able to transfer their knowledge easily during grades 6, 7 and 8 integers in mathematics.

Other research indicates that parents can help their children with weather and temperature by talking about it daily to promote number sense (Horstmeier, 2004; Fernandez, 2008). Horstmeier (2004) provides a list of possible number talks about daily temperature activities that parents can do at home to help children learn about temperature. In addition, there are a few websites for parents that include ideas for teaching temperature ("Classroom Activities: Temperature," n.d.; Homer, 2014). For example, Homer (2014) shows parents how they can make a thermometer to help them teach their children about temperature and "Classroom Activities: Temperature" (n.d.) lists temperature activities for both teachers and parents. In

addition, parents also have the opportunity to use mathematics literature to start conversations about temperature with their children (Johnson, 2013; Manolis, 2008; Stille, 2004). This research may provide parents with ideas; however I aim for more in-depth research. I provided parents with example video number talks that promoted the development of number sense and problem solving with their children through the concept of temperature.

It is evident from the research above that knowing about temperature can help prepare students for mathematics concepts in the later grades as well as understand the life skill of temperature.

To conclude this section, the topics of telling time, money and temperature provide three real-life topics where parents are able to guide their children to develop number sense through problem solving and number talks to provide positive learning benefits. Parrish (2010) states that the "three benefits of using real-life contexts are student engagement, attaching meaning to numbers and having access to the math" (pp. 49 – 50). In other words, my purpose of teaching number talks to parents was to provide them with examples of how to engage their children while making sense of the mathematics through the development of meaning.

Connecting the Opportunities of Experiential Learning

One of the most important possibilities of learning is through problem solving, which is the ability of children "to learn how to deal with the situations they will encounter in life, make humane and informed decisions, appreciate the beauty of the world around them, and think creatively" (Apelman & King, 1993, p. 35). During this research, through problem solving, number talks and number sense in the context of time, money and temperature, parent guides will be able to guide their children to find "understanding, enjoyment and self-confidence" (Apelman & King, 1993, p. 35). In this study, I looked at how parents planned for and guided their children in number talks. I looked for themes to emerge during their experiences that assisted them in contributing to their children's mathematical development.

In my opinion, an opportunity for mathematics learning can occur for anyone, at any moment, during any experience, as long as there is a possibility for learning, along with positive mathematics attitudes, combined with adult guidance and a context for problem solving. When children and adults are together and an opportunity for mathematics learning occurs, in a context that appears at the zone of proximal development of the level of a child, then the adult can start a

number talk. In my opinion, if both adult and child stay positive, engaged and motivated, then the child can start to intuitively develop number sense and the ability to problem solve.

This chapter has made it clear that experiential learning and effective mentorship can captivate and engage both parent and child learners. The goals of my research were to expose parents to information about the importance of: the concept of the zone of proximal development and neuroplasticity, becoming involved in their children's learning through motivating them and reducing their own negative math attitudes, to help them become their children's math guides. Parents were then equipped with sufficient tools to be able to guide their children through number talks to promote their development of number sense and problem solving. During my research, every parents' experience was different; however they were able to reflect, adapt and try again to increase their own and their children's learning.

Chapter 3: Action Research Methodology

In action research, the focus is the learning of both researcher and participants. Through a three session workshop design for parents, I aimed to induce the "action-reflection cycle" (NcNiff & Whitehead, 2011, p. 9) for myself where I was able to "look, think and act" (Stringer, 2008, p. 4). I planned to reflect on how parents learn about their children's development of numeracy and problem solving. As action research, this project also intends to contribute to the participants as learners. Through a series of workshops and interactive emails between workshops, I guided parents through the process of completing number talks with their children which provided their children with foundational numeracy experiences in natural home contexts such as time, money and temperature. This chapter outlines the research design, including the anticipated flow of activity that comprised the study as planned. I describe the research with respect to: objectives, participants and site, parent workshops, data generation techniques, data analysis and data interpretation.

Objectives

The objectives of this research are:

1. To determine how parent participants learn to support their children's mathematics growth through participation in workshops.
2. To determine what factors affect parents as learners (with regard to noticing opportunities, engaging learners, attitudes, and use of problem solving) while leading their children during number talks.
3. To develop recommendations about how to support and guide parents to help their children develop number sense.

Participants and Site

Participants included 24 parents of Kindergarten to Grade 2 students in a large urban center. Parent participants were invited to attend three free evening workshops to learn how to guide their children through foundational experiences pertaining to money, time and temperature. The workshops took place in a school library, with child-care services provided in a nearby classroom.

To recruit participants, I sent a flyer advertising the research project to the parents of one school as well as through two parent groups on social media. I obtained permission from the school division as well as the school principal for advertising. For all participants who

responded, I emailed them research participant permission letters to be filled out and emailed back to me. When I received ethics permission from 24 participants, I stopped registration.

During the research, along with attending all three parent workshops, I asked participants to complete four interactive writing entries by email. One email was before the workshops began and the other three interactive writing entries followed each workshop. During the workshops, I shared an array of extracted statements from the interactive writing, and I validated the range of positions and approaches to self-expression.

Following the three workshops, I selected four parents based on their interactive writing responses, to conduct 45 to 60 minute informal interviews to delve deeper into their learning. The structure of the interviews was to promote "a natural flow of conversation…between researcher and participant" (Woloshyn, 2004, p. 41) so that I could understand the participants' thinking processes in terms of my research question. I provided all interview participants with a separate information letter, and a consent form to sign.

Parent Workshops

In my experiences through private tutoring and my employment as a classroom teacher and resource teacher, many struggling students (Kindergarten through Grade 10), have not been able to tell time on an analog clock, do not understand how coins and money work and do not understand how numbers can describe temperature and temperature change. Therefore, the three parent workshops were based around time, money and temperature and were referred to as real life numeracy skills (Alexander, 1980).

Workshop structure. Three evening workshop sessions, following a similar structure each night, were developed to allow for flow and concept building. The three workshop sessions were 90 minutes long on three evenings over six weeks. I have described the structure of the workshops below, where I outlined and described each section. It should be noted that the primary themes of Chapter 2--experiential learning, adult guidance, attitudes, number talks and problem solving--were interwoven into the workshop structure. However, as I described the workshops, I mentioned the subtopics of the primary themes and not just the main themes themselves.

I began each workshop with an overview or recap of my research question and objectives as well as the topics covered in all three workshops. My purpose for the overview and recap

allowed parents to follow the structure of the workshops easily, as well as know and understand the goals and progression of the project.

The overview was followed by an icebreaker exercise that helped my participants feel comfortable in the group and begin to set the tone of each workshop. During the first workshop, I included an in-depth introduction of myself, as well as brief introductions of each participant during the icebreaker. For the second and third workshop, icebreakers were brief re-connection activities. My purpose for the icebreaker exercise for each workshop was to allow the parent participants to feel comfortable with me and with each other in order to build the sense of community to promote an atmosphere of sharing and learning together (Palmer, 2007).

After the icebreaker, in each workshop, I explained my own observations of struggling students according to each topic and where it becomes a problem in later grades. I then explained the importance of children understanding number sense and problem solving as described in the mathematics curriculum (Manitoba Education, 2013). My purpose of this section was to help parents appreciate the importance of understanding number sense and problem solving and how they link to older grades (Hanlon, 2012).

After the icebreaker, I explained two ideas related to children's learning: Vygotsky's zone of proximal development, as where the learner is able to learn (Kozulin, 2003); and neuroplasticity, as the connections between neurons (Doidge, 2015). In the first workshop, I used the example of learning how to ride a bike to help parents understand both concepts. In the second and third workshops, I briefly mentioned both topics again to help the participants remember the concepts. My purpose of explaining the zone of proximal development and neuroplasticity to parents was for them to have a better understanding of how to plan the number talks for their children to maximize learning opportunities.

In the first workshop, one of the most important sections was when I described number talks and foundational experiences, as they are the basis of my thesis. In the second and third workshops, I referred to these topics frequently through discussions, examples and videos. My purpose of explaining these concepts to parents was for them to understand that I wasn't expecting them to teach the arithmetic of school mathematics, but rather to lead them to learn from foundational experience within real-life contexts (time, money and temperature) through number talks.

Once I explained number talks in the first workshop, I discussed the important role that parents have in guiding their children's mathematical learning from a young age and how it can benefit their children later in life. This was also a recurring theme in my second and third workshops where I consistently talked about the importance of the parental role. My purpose of explaining parent guidance was to show parents that they were able to make a difference in their children's lives by guiding them during number talks on a daily basis.

Another topic I explained to parents during my first workshop was math attitudes. I explained what parental negative math attitudes were and suggested that if parents can develop positive feelings of self-efficacy, then they can overcome their own negativity. In addition, I briefly discussed that if parents have a positive attitude about math, then their children could develop one too. I also explained how parental positive attitudes can help to avoid the development of negative math attitudes in children. In the second and third workshops, I reiterated the importance of positive math attitudes for parents, to help them remember the influence they can have on their children. The purpose of explaining to parents about math attitudes was for them to be conscious of their own attitudes when they are doing number talks with their children and to avoid any negativity while they are guiding their children.

Another concept I presented during all three workshops was child motivation. I explained that when children are motivated during experiences, then their learning increases (Kolb & Kolb, 2005). My goal was for parents to understand how to intrinsically motivate their children while using the concepts of time, money and temperature in order to expand their learning.

During each workshop, I showed sample videos between one and three minutes in length of myself talking numbers with my children according to the topic of the workshop. Each video was filmed in various locations where I was spontaneously teaching them about telling time, saving or spending money or talking about the weather and temperature as they asked questions. During each video, I pointed out to parents my child's attitude, as well as my own and where I provided guidance and motivation to my child. I also explained how I guided my children to their zone of proximal development in order to ensure that their neurons are connecting. My purpose of showing parents the videos was to allow them to see examples of number talks including all the concepts I had previously discussed, including math attitudes. In the past, when parents have seen my videos, they have said something like, "I can do that. I didn't think I could

help my child in math, but I can do that." As well, my intention for the videos was to allow parents to realize how a number talk could be broken down into simple steps and how they could adapt and change a number talk to allow their own children to learn.

Toward the end of each workshop, I asked the whole parent group to brainstorm ideas for possible number talks. The purpose of the brainstorming activity was to allow parents a chance to see many ideas in relation to the topic and to help them decide on their own ideas of number talks for their own children during quiet independent planning time. I also asked parents to write down one to three number talks that they planned to try with their children around the topic of that workshop. At that point, I reminded parents to try a number talk with their children and to send me an interactive writing email about their experience before the next workshop.

At the end of each workshop, I provided parents with hands-on resources to help them try number talks with their children. For the Telling Time workshop, they received an analog clock and a cardboard clock with movable hands. For the Money Talks! workshop, I provided each parent with a bag of real starter coins for money number talks including pennies, nickels, dimes, and quarters. For the Experiencing Temperature workshop, I showed parents weather information on a website and phone application that they could show their children for number talks. My purpose in providing these manipulatives and resources directly to parents was that they would be equipped with everything they needed to try a number talk after each workshop.

After I handed out the manipulatives in each workshop, I allowed time for any questions parents had about the content that I presented. The purpose of the question period was to allow parents the opportunity to ask for clarification regarding anything taught, in order for them to feel ready to do a number talk with their child or children between workshops.

Action research cycles of all workshops. I, as the researcher, followed the action research cycle after receiving parent personal interactive writing emails after each workshop. I was able to "look" (Stringer, 2008, p. 4) at my reflective journal notes and study what parents say during their number talk experiences. After the first and second workshops, I was able to "think" about how to respond to the interactive writing, along with how to adjust my next workshop to answer and address any parent questions or concerns in order to allow for more parent learning to occur. Any adjustments I made to workshops two and three was part of the "act" phase of the action research cycle.

My intention for the parent workshops and action research cycle were to help parents and children interact during number talks to promote reflecting, learning and excitement about math for everyone involved.

Data Generation Techniques

This study included three main data sources: interactive writing (before during and after the workshops), my reflective journal, and four final informal interviews. All data generation techniques followed the procedures approved by the university ethics board. The goal of my data choices was to develop "a frame for understanding and reflecting on processes and changes of the knowledge production" (Kvale, 2007, p. 43), to gather information about my participants' 'thoughts and feelings' towards their personal experiences with number talks.

Interactive writing. I used interactive writing as a data collection technique to listen to the perceptions of parents before, during and after my research study. For my research, I used the term of interactive writing as described by Mason and McFeetors (2002). They stated that "an interactive writing program is most valuable when, over time, it deals with a range of matters regarding the challenges of learning mathematics…the writing becomes an interactive aspect of the teacher-student relationship" (p. 2). Similarly, I used interactive writing between myself, (the researcher), and my participants, (the parents), with the goal of developing our relationship.

Another type of data gathering for me to consider was log-interviews. To me, this method was also a way for parents to share their thoughts in a meaningful way throughout their participation during the workshops. In Woloshyn's (2004) research on parent perceptions about mathematics, she used log-interviews to gather information to record parents' thoughts going into the workshop series and at the end of each workshop. However, because I wanted participants to write to me about their number talks at home, not just their experiences in the workshops, I used email-based interactive writing and focused on the relationship between myself and my participants.

McFeetors (2003) summarized the importance of the relationship between researcher and participants by stating that:

> The process of interactive writing is important to the forging of a personal and interpersonal relationship because it is a venue, just between teacher and learner, where dialogue can occur. Learners are willing to share their thoughts, and they know that their teacher has heard them - in the literal words that they write as well as the intentions with

> which they write. Interactive writing is also a context in which a learner and teacher can have a dialogue about progress, creating opportunities to notice and celebrate success. Further, it helps the teacher recognize what can be done to sponsor each individual's success…The recognition of each learner as a person builds an environment that invites each individual to become the best learner, student, and human being that he/she can be. (p. 24)

McFeetors' words are very powerful as her main focus as the teacher/researcher was to concentrate on the personal relationship with her students, the participants, while promoting dialogue, learning and success. In my case, I am the researcher/teacher and the parents were the participants and my goal was to develop the same interpersonal relationship as McFeetors did with her participants. In addition to McFeetors' points through interactive writing, my guiding questions encouraged parent self-reflection and change throughout their number talk journey. I intended to see a shift in parents' attitudes and learning from before the workshops began to after.

I used three different types of interactive writing, depending on the time they were written. They were:

1. Pre-interactive writing: Before the first workshop, the participants were asked to respond to introductory guiding questions about their attitudes and beliefs towards mathematics (Woloshyn, 2004), as well as gather information about the type of mathematics activities they were doing with their child. The purpose of this writing was to understand what a parent was doing with their child at home in mathematics. As well, it provided a chance to listen to parents' past experiences, and a chance to develop a sense of their attitudes, confidence and motivation toward mathematics and toward leading their children in mathematics.
2. Interactive writing between workshops: My participants then used interactive writing via email between workshops. They wrote about their reflections, thoughts and feelings related to their number talk experiences with their children. The purpose of this type of interactive writing was to gather information about their experience and to see how they were feeling, learning and changing throughout the workshops (McNiff & Whitehead, 2011). Guiding questions were provided to help the participants between workshops (Kvale, 2007). I responded to all emails to help guide parents throughout the research.

3. Exit Interactive Writing: Each participant was asked to write an exit interactive writing entry so that I could compare parent's perceptions and thoughts from before, during and after the workshops and interpret their experiences in terms of their learning during their number talks (Kvale, 2007). I provided guiding questions to parents to help them think of their experiences and I invited them to share any final thoughts about the workshops. For each participant, I responded via email one last time with any remaining thoughts and to thank them for their time.

    Through the interactive writing, I saw a positive change in math attitudes in terms of confidence and self-efficacy in terms of numerical learning for both the parents and children. I expected to see similar results as Merenda (2000) found in her study of the interaction between parents and children at home, when working on numeracy activities that were supplied by teachers. Parents had to write in a family response journal about the family's learning during the specified activities. Merenda found that "sharing math ideas orally and representing them symbolically became a main strength of this interactive partnership" (p. 156). Most importantly, through interactive writing, I developed a rich relationship with the participants over time, that was personal reflective and introspective. The interactive data revealed how parents grew over time. Parents who were possibly unsure at the beginning of the workshops, became more confident in how to guide their children by the end of the research.

Reflective journal. For my second data collection technique, I had a reflective journal that was a written account of my learning, including my own researcher's notes and observations after and between the workshops (Kvale, 2007; McNiff & Whitehead, 2011; Stringer, 2008). Woloshyn (2004) referred to this type of researcher reflection as her notes while she studied the perceptions of parents during her intervention. In addition, when Kvale (2007) collected data from interviews, he used work-journals to "record his or her learning throughout the investigation" (p. 43). I chose to name this form of data collection as reflective journal as it included my own thoughts about my journey throughout my research.

During and after my workshops**,** I recorded my notes in my reflective journal. I watched and observed my participants' "behavior and their interaction with their environment" (Kvale, 2007, p. 43) during my workshops to learn about their perceptions. I also wrote my feelings and thoughts about my own learning process and how I felt the workshops were impacting the

participants. I intended to learn about what motivates parents to learn to teach their children mathematics in regards to number talks, foundational experiences, and problem solving. Similar to Bleach (2015), I aimed to see "how significant adults in children's lives can create enriching and diverse numeracy learning opportunities for children" (p. 26). Bleach found that after parents attended math workshops to learn about what they can do with their preschool children at home, parents "were positive about the programme and agreed that they understood numeracy more and would use the information with their children" (p. 30). I expected that after receiving emails following the workshops, I would be able to track changes in parents' excitement levels over the duration of the action zone. The data revealed a change in parent's attitudes and perspectives over time. I wanted to learn about the impact that my workshop series may have had on parent learning about how to help their children in mathematics in a home numeracy environment (Napoli & Purpura, 2018). My goal was also to contribute to research about parent education and numeracy learning at home as suggested by Vandermaas-Peeler et al. (2009) so my reflective journal was imperative to that discovery (McNiff & Whitehead, 2011).

Final interviews. The third data generation technique that I used was final interviews where I conducted four in-depth final interviews to find out more about parent learning. McCracken (as cited in Lichtman, 2006) suggested that the goal of interviews was for participants to share their thoughts and feelings about their own life so that the interviewer could study their background and understand why they felt the way they did. As suggested by Kvale (2007), it is useful to have a few guiding interview questions such as "introductory questions, follow-up questions, probing questions and specifying questions" (pp. 60 – 61) to allow for a starting point in the interview to discover and learn more from participants' experiences.

For my research, I selected four participants to interview whom I wanted to find out more about their learning based on their experiences during, between and after the workshops. I used some of Kvale's (2007) interview questioning ideas to formulate my own guiding questions for the final interviews. When I conducted each interview, I recorded and transcribed them onto my computer (McNiff & Whitehead, 2011). I chose to conduct the final interviews so I could thoroughly understand parent learning following the workshops, to help guide me in developing my own theory. The purpose of the interview process was to delve deeper into parents' reflective writing in order to obtain more specific examples to help me understand the aspects of their experiences. My interview purpose was similar to Lukie, Skwarchuk, LeFevre, and

Sowinski (2014) where they studied interviews "to provide further explanation concerning the relation between home environment and children's numeracy abilities" (p. 255). I, however, studied the strategic choices of parents in relation to their goals to help their children regarding their numeracy development.

Data Analysis

For the data analysis, I read, responded and studied the data throughout my research in all three workshops, as I responded to each interactive writing email that I received. I had 21 different stories that emerged, which contained multiple themes and complex relational situations between parents and children. I ensured that I responded to each email that I received by answering questions and writing comments to help each participant develop their abilities to help their child in mathematics throughout the six weeks. In Chapter 4, my data analysis chapter, I selected quotes from participants to share which best related to the goals of this research.

In Chapter 5, I presented four narratives of the interview participants. In this chapter, I interpreted each interview participant's individual journeys as whole experiences, to understand how they learned and changed throughout my research. I used Hesse-Biber's (2011) data coding analysis guidelines for all of my qualitative data. I printed hard copies of all interactive writing and my reflective journal, as well as the transcriptions of the four in-depth interviews. I then read, highlighted and colour-coded data with the goal of identifying emerging themes. Once I had analyzed the participants' experiences through reflecting and theme coding, I was able to interpret the data relationally to start to build narrative stories as part of my data interpretation.

Data Interpretation

For my data interpretation, I aimed to create four narrative stories after analyzing the data from my research. According to Clandinin (2007), "narrative inquirers study experience" (p. 2) and a narrative "is the best way of representing and understanding experience" (Clandinin and Connelly, 2000, p. 18). Since my theoretical framework was based on Dewey's (1938/2015) experiential learning, writing narrative stories fit well with my research as I interpreted the experiences of the participants. To explain further, McFeetors (2003) described the role of the researcher who used narrative inquiry such that "the inquirer is a collaborator in the construction, the telling, and the retelling of the stories" (p. 78) of the participants. Therefore, from my perspective, the purpose of narrative inquiry was for the researcher to listen to, understand,

interpret and analyze the stories and experiences of the participants in order to further the researcher's learning.

Another aspect of narrative inquiry is the relationship between the researcher and the participants. Clandinin and Connelly (2000) write that narrative inquiry promotes "healthy, productive, human relationships" (p. 18) and McFeetors (2003) states that, "relationships are fundamental to the phenomena and the method in narrative inquiry" (p. 88). I agree. Through my workshops, interactive writing and interviews, I aimed to develop a relationship with the participants that encouraged them to share their past, positive or negative, experiences with me, so that I could help guide them towards growth throughout their journey. In essence, through narrative inquiry, I addressed Clandinin and Connelly's "three dimensional narrative inquiry space" (as cited in McFeetors, 2003, p. 78). That's where I considered the participants' experiences in the past (temporal), the location of my workshops and their number talks (situation) all while developing a relationship with the participants through interactive writing and interviews (interaction).

I used the basis of narrative inquiry while studying the interactive writing and interviews of my participants. While I interpreted the data, I identified similarities and differences between participants' experiences with the goal of writing four narrative stories that represented each of their individual journeys. As I read my participants' interactive writing and their interview transcriptions, I aimed to piece their journey together and retell their narrative story based on their experience. I described my data interpretation and analysis in more detail in Chapter 4 and Chapter 5 which prepared me to write Chapter 6.

Proposed Timeline

Table 3.1, below, provides the originally proposed timeline for the research study. The flow of the research as it actually took place is in Chapter 4.

Table 3.1. Proposed Timeline and Research Methods

Proposed Action Research Timeline	Dates
Recruitment flyers sent out on social media to parent group	August 20
Recruitment flyers sent out via parent school emails during opening day conferences	September 4-5
Permission forms filled out online and emailed back	September 6– 26
First round of interactive writing	September 27 – October 3
Workshop 1: Telling Time	October 4
Number talks and interactive writing round two	October 5 – 17
Workshop 2: Money Talks!	October 18
Interactive writing round three	October 19– 31
Workshop 3: Experiencing Temperature	November 1
Fourth and final round of interactive writing	November 2 – 8
Interview recruitment and permission forms Four Closure Interviews	November 10 – 17

Chapter 4: Workshops and Data in Action!

My action research through workshops, my reflective journal, interactive writing and interviews were life-changing, not only for me, but also for many participants. In this chapter, I will take you along this journey from the day I successfully defended my thesis proposal to the end of my data collection where, along the way, I present my data in action. Overall, the research proceeded as described in Chapter 3 after the proposal was approved in June, 2018. However, there were some significant variations. The first part of this chapter provides an overview of the research processes as they were enacted, including the workshop preparation as well as the descriptions of data generation. The rest of this chapter provides, in chronological sequence, sample data from all four interactive writing phases along with data from my own reflective journal regarding each workshop. At the end, I will provide a brief introduction to the final interviews to foreshadow Chapter 5.

Workshop Overview

After successfully defending my thesis proposal defense in June of 2018, I was required to complete a few steps before presenting the workshops. First, I applied to the ethics board of the University of Manitoba (ENREB), followed by an application to the ethics committee of the school division where I work. After ethics approval, I was able to recruit participants, prepare the location of the workshops as well as plan for childcare. Once I had recruited the participants, I organized and presented the workshops and kept track of participant attendance. In this section, in chronological order, I will describe each step in the preparation for the workshops and each of the three workshops, ending with an account of participant attendance.

Ethics

In early July 2018, I submitted my ENREB proposal and in August 2018, the ethics coordinator sent it me back to me along with the required revisions. I completed the revisions, resubmitted the revised application and received approval a few days later. ENREB approved two phases of recruitment of sending the recruitment poster through one school's parent email addresses and then through social media for more participants if needed. Following ENREB's approval, I submitted a proposal to the school division to ask permission to send a recruitment poster through the host school's email addresses to recruit parent participants with children in kindergarten, Grade 1 or Grade 2. By mid-September, the school division granted permission and the recruitment letter was sent shortly after.

Participant Recruitment

During the recruitment phase, I had a lot of interest about the workshops, but many said that they could not attend on Thursdays. Others asked me to email them if I was going to repeat the workshops on different days or later in the year. I did receive 16 reply emails from possible parents who could and were interested in participating in my research. Three of those parents did not email the consent form. Three other parents filled in the consent form, but they withdrew from the study before it even began due to working abroad, illness and employment opportunities. From the school, I recruited eight parents from separate families as well as two couples (four parents) from two other families. In total, I recruited 12 parents from 10 separate families from the host school.

Since I had space for 24 participants, I sent the recruitment poster on social media, the second phase of recruitment. From social media and word of mouth, 10 participants from different families and one couple from the same family signed their consent forms to participate in the study. In total from the social media recruitment, 12 other parents from 11 different families signed their consent forms.

In summary, I was able to recruit 24 participants from 21 different families that included three couples. Three parents did not have children in the kindergarten, to Grade 3 range, but they had older children and asked if they could attend the workshops. Since I had space for them, I allowed them to participate. All participants signed the research participation consent forms. Overall, about half of the participants were recruited through the school and about half were recruited through social media and word of mouth.

Diversity of Participants

In terms of the diversity of participants, the 24 parents represented 17 mothers and 7 fathers. Most were from the south of Winnipeg. Of the 21 families, 3 families had one child, 7 families had 2 children, 7 families had 3 children and 4 families had 4 children. The ages of the 21 families' children ranged from baby to university age.

When writing emails to me, some participants shared many details, and others revealed very little. From what the participants told and wrote to me, it seemed to me that I had a group of well-educated parents with at least four who recently immigrated to Canada. Some participants revealed their careers in their emails. The group included three teachers, three engineers, a dentist, an accountant, a bookkeeper, a police officer, an educational assistant, a

statistician and a child care coordinator. The diversity of the participants' careers allowed me to understand their backgrounds and helped me to plan and prepare the workshops as well as respond to their emails regarding their experiences with their children.

At times, participants with strong mathematical backgrounds revealed that they were having substantial difficulty teaching their children step-by-step. Other participants with negative math attitudes expressed wanting to help their children develop positive beliefs about math so they could feel better about it themselves. There was variation in the parents' first email messages that pointed to experiential diversity. Generally, the emails from participants with older children differed from the emails from participants with younger children as the former had already experienced trying to support their older children with the more complex mathematics in higher grades.

Workshop Location and Childcare

For the location, the workshops were hosted in the school library, where the first phase of recruitment took place. Childcare was provided in another school classroom with four babysitters to allow participants with children to attend the workshops. The childcare room had between 8 and 14 children depending on the night of the workshop and the children ranged in age from baby to 10 years old. For the babysitters, I had planned a routine and supplied nametags, crafts, games, books and snacks for them to keep the children occupied while their parents attended the workshops.

Actual Workshop Timeline

For the actual workshop timeline, many dates were adjusted as necessary due to ethical restrictions, school division ethics approval, the recruitment process and the data collection process. I had collected all data by December 13, 2018. Table 4.1 represents the actual timeline and research methods of my research.

Table 4.1. Actual Timeline and Research Methods

Actual Action Research Timeline	**Dates 2018**
ENREB university ethics approval	August 23
School division ethics approval	September 17
Recruitment flyers sent via parent school emails	September 18
Recruitment flyers sent on social media to parent group	September 27
Permission forms filled out and emailed back	September 18 – October 11
First round of interactive writing	September 20 – October 11
Workshop 1: Telling Time	October 11
Number talks and interactive writing round 2	October 15 – 25
Workshop 2: Money Talks!	October 25
Interactive writing round 3	October 29 – November 8
Workshop 3: Experiencing Temperature	November 8
Final round of interactive writing	November 12 – December 7
Interview recruitment and permission forms	November 30 – December 13
Four interviews	December 9 – 13

Actual Workshop Structure

I taught three workshops on October 11 (Telling Time), October 25 (Money Talks!) and November 8 (Experiencing Temperature). Each workshop lasted 90 minutes, beginning at 6:00 p.m. The content and structure of all three workshops was similar to what I had originally intended. However, for each workshop, I taught different content at the beginning of each workshop and added or removed certain topics. The reasons for the changes were due to the interactive email data that I had received and what I planned to teach for each workshop

depended on the participants' needs. Table 4.3 represents the actual content and structure of the three workshops and below Table 4.3, there is a description of each workshop.

Table 4.2. Workshop Content and Structure

	October 11, 2018 **Workshop 1** **Telling Time**	**October 25, 2018** **Workshop 2** **Money Talks!**	**November 8, 2018** **Workshop 3** **Experiencing Temperature**
Beginning Content	Introduction Research overview Number talks My math journey Math holes/gaps The zone	Reality check video Introduction Digital world Math gaps Money vocabulary Concept review My childhood journey Neuroplasticity Learning retention	Introduction Math puzzle pieces Spirited child Making mistakes MB curriculum Confidence Curriculum links
Icebreakers	Double circle introduction	Action introduction circle	Question circle
Step-by-Step Explanations and Videos	Steps and Videos	Steps and videos	Steps and videos
Resources	Cardboard clock Actual analog clock Guidelines handout	Actual coins	Homemade thermometer Actual thermometer
Practice and Planning Time	Partner practice Discussion Number talk planning	Partner practice Discussion Number talk planning	Partner practice Discussion Number talk planning
Conclusion	Sharing ideas Question period Thank you	Sharing ideas Question period Thank you	Sharing ideas Question period Foundational experience analogy Thank you

Leading up to the Telling Time workshop, I had prepared a PowerPoint presentation with a handout and two clocks. Continue to build on our relationship that had started in the first email exchanges was a significant goal. My other goals were to help the participants feel comfortable in the group, understand who I am and why I am on this journey myself regarding my own experiences and my three young children. I also wanted the participants to understand the mathematics gaps that I see in older children and help them to feel like they could lead number talks with their children regarding telling time in an easy, positive, fun and interactive way.

After my introduction, I facilitated a group icebreaker activity to help build the relationship between the participants and me (Pearpoint & Kahn, 2017). After the icebreaker activity, I followed prepared slides that explained to parents how to teach their children, step-by-step, about how to tell time. I showed a few video examples of me doing number talks with my own children so that parents could see the simplicity of the talks and the flexibility of when and where they could hold a number talk. To assist parents even more, I provided step-by-step handouts, a cardboard analog clock and a real analog clock so that they would be ready for telling time number talks as soon as they returned home with their children. At the end of the workshop, I gave time for the participants to practice telling time number talks with their partners and to ask any questions they may have had.

For the second workshop, I started off with a comical 30 second video (TD Bank, 2017) that has children telling their parents that if they don't teach them about money, who is? The children go on to say that the future possibility for their parents is that their adult children could be living off their estate even when they are 37 years old. This video demonstrated the need for parents to explain money to their children.

After the video, I addressed some of the concerns and questions that the participants had asked me in their emails after the Telling Time workshop. Two main topics that I discussed were: clarifying telling time questions and explaining how to do targeted number practice for children to practice the vocabulary and meaning of numbers. To address the telling time questions, I provided a handout with extra ideas to help parents. For targeted number practice, I explained how to practice numbers in steps with their children and provided photocopies of number practice in a page protector along with a dry-erase marker.

After clarifying the Telling Time workshop questions and targeted number practice, the Money Talks! workshop began. I explained that since we live in a digital world (credit cards,

tap, ATM machines), children have much less exposure to real coins and money than I did when I was growing up. I then went on to describe my own childhood journey with money. I reviewed the topics of number talks and the mathematics gaps that I see in older children, with links to current brain research regarding neuroplasticity followed by an icebreaker activity.

We then moved directly to the topic of number talks with coins and money. I outlined 17 steps for teaching children about money, supported again by videos of number talks with my children and me discussing money in various locations. I also provided handouts with the step-by-step guidelines along with a bag of real coins to practice with their partners during the workshop. At the end of the workshop, I was available for questions and comments and continued support.

The third workshop began with a PowerPoint presentation that featured the main puzzle pieces that helped guide me to where I am today. The puzzle pieces I referred to and explained were: the experiences with my own children and teaching, when children make mistakes, the links to the curriculum, research for early number sense, the mathematics gaps I see in older children, confidence and step-by-step guidance to help children feel successful and confident. I also addressed why I chose temperature as a topic, explaining how learning about temperature can prepare children for later grades, with links to the Manitoba curriculum. We then had another group activity to strengthen the relationship bond between the participants and me, and to have fun. I then provided the handout and taught the three steps in teaching about temperature. Again, I showed a few videos of my children and me doing number talks about temperature. One of the videos showed my son who had no interest whatsoever in talking about the temperature. Rather, he just wanted to play with the thermometer, rather than pay attention to the numbers on the thermometer. I think this video reminded the parents that leading a number talk means accepting the child's focus of attention. I gave the participants homemade and real thermometers followed by guided interactive partner practice. I even had some of the real thermometers stored on ice so that parents could play with them and practice number talks with each other as the temperatures changed.

At the end of the final workshop, I ended by explaining an analogy for number talks by discussing a house structure. I showed parents an image of the foundation of a house and explained that every number talk is like pouring a little bit of cement into the foundation of the house. I explained that parents will not really see the results right away. Rather, it will take

years for the payoff to come. I then showed an image of a house being built and I explained that every board and nail added to the house represents another number talk, experience, or teacher's explanation. If the foundational experiences, along with key experiences and teachings are not there, then there are gaps and holes in the house. I then showed an image of a beautiful finished home and explained that if there are no gaps in a child's mathematics learning, then the result is a beautifully finished home. My goal at the end of the workshop series was for parents to understand that through foundational experiences (Mason & Erickson, 2015) at home, parents and children together can build a strong mathematics foundation.

Participant Attendance

Overall, workshop participant attendance was excellent. In total, 20 out of 24 participants attended the first workshop, and 3 of the 4 who had missed it attended a make-up workshop on November 15. All participants attended the second workshop. Despite a significant snowstorm, 19 parents attended the final workshop. In summary, of the 24 participants, 18 participants attended all three workshops and the other 6 participants attended two of the workshops.

Data Generation

As mentioned in Chapter 3, my research consisted of three data generation techniques that included: interactive writing before during and after the workshops, my reflective journal and four final interviews. Overall, the data gathering went as according to plan. Below, I explain each data generation technique as well as include a sample of guiding questions for the interactive writing and interviews.

Interactive Writing

In regards to interactive email writing, I asked each participant to write four emails. Since I had a total of 24 participants from 21 different families, I was unsure of how many responses I was going to receive. As it turned out, the 3 couples that participated (representing 6 participants) either wrote their responses together or one partner wrote on behalf of both of them. Thus, for the interactive writing responses, I received up to 21 possible responses: 18 from separate parents and one response from each of the 3 couples. Some participants sent their interactive writing responses on the same day as the next workshop. Thus, I was only able to respond to their interactive writing, after the workshops occurred.

As it turned out, some participants missed a few emails during the research process due to missing workshops, illness, unexpected circumstances and other reasons unbeknownst to me.

The participants who missed emails, at one point or another apologized for their lack of communication and then explained the reasons why. I was touched about how the participants showed their commitment to the study. Out of all the missed interactive data, there was only one participant who did not let me know the reason. For the participants who attended the makeup workshop, I counted their interactive writing responses with those from the Telling Time workshop to group them together. In summary, of the 24 participants, including the 3 couples in the study, 18 participants attended all workshops and wrote all 4 interactive writing emails. The other 6 participants attended two of the workshops and had one or two emails missing in their data set. There were 3 participants who missed the fourth and final interactive email.

In terms of the pre-interactive writing, as soon as the participants sent me their signed consent forms, I emailed them the first interactive writing questions. After reading each email, when time permitted, I responded to each of them. Below are the first interactive writing questions that I sent to the participants.

1. Can you tell me about some of your own experiences regarding math?
2. What are your own attitudes about math?
3. What do you hope to learn from these workshops?
4. Describe the type of math you do with your child presently.
5. How do you and your child feel about math?
6. Are you confident in your ability to help your child learn math?
7. Do you have any questions or comments or anything else you would like to share regarding mathematics?

The second interactive writing was after the Telling Time workshop and the third interactive writing followed the Money Talks! workshop. Below are the second and third interactive writing questions.

1. What did you learn in the Telling Time/ Money Talks! workshop?
2. What are your thoughts and feelings about the Telling Time/ Money Talks! workshop?
3. What number talk(s) did you try with your child this week?
4. Can you describe your experience?
5. Do you have any questions, comments or anything else you would like to share regarding this week's workshop?

Throughout my research, after reading several interactive writing responses, I realized that I had to alter a few guiding questions for the last round of interactive writing. My goal was to ask the participants to think profoundly about their learning and their children's learning. Below are the last and final interactive writing questions which I sent following the Experiencing Temperature workshop.

1. I hope that you have been able to try a temperature talk with your child/children in the last two weeks. Please describe your experience(s) with me including any thoughts and feelings you and your child may have had.
2. Since the temperature workshop, were you able to continue number talks about time and money as well as temperature? Please explain.
3. During the last six weeks, please describe any changes in YOUR learning, confidence, attitude and/or understanding of numbers and math.
4. Please describe any changes that you noticed in your child/children. (In terms of learning, confidence, attitude and/or understanding of numbers and math or other)
5. Please explain what you think contributed to these changes for you and your child/children.
6. How do you think your use of number talks might develop in the future both short-term and long-term? Please explain.
7. To conclude, I invite you to ask me any final questions or say any final remarks regarding your experience in the last six weeks.

Reflective Journal

My reflective journal was the second type of data that I generated. As described in Chapter 3, I recorded my own thoughts and feelings about the workshops in my reflective journal. I had originally intended to record my thoughts during the workshops, but I was too busy presenting, answering questions and facilitating partner practice times. I did, however, write about my thoughts after every workshop. Most of my thinking and reflecting came in the form of my writing responses to the participants about their journeys, and for some of the more powerful responses, I copied them into my reflective journal to think about at a later time.

Final Interviews

The final interviews were the last data generation technique and the goal was to find out more about parent learning. Following the reading, responding and collecting of all the

interactive data, I was required to select four participants to interview. To decide who I wanted to interview, I looked at all the journeys from start to finish. Since I had 18 participants who attended all workshops and wrote all four emails, I selected from that group. As I was reading through all interactive emails, I was writing notes in my reflective journal as well as on an Excel spreadsheet to mark down possible themes, feelings and experiences for each participant. I noticed that some participants had low confidence and negative math experiences before the workshops began and others had higher confidence and even used mathematics in their occupations. I also noticed that there were a few teacher participants in the group and their emails reflected what they did with their own children as well as what they did or would do in the classroom. There were also participants who wrote detailed emails and told me stories of their children and their own transformations. Other participants wrote short, precise and to the point emails. Every one of the participants' journeys was unique and I would have enjoyed interviewing every participant. However, I decided to select four participants, two mothers and two fathers including one teacher. Three of the participants had low confidence in mathematics before the workshops began and the other participant had higher confidence.

Once I had selected the participants, I emailed them directly asking if they would be willing to have an interview with me. Every participant that I asked to interview was willing and two of them expressed that they were honored. Once they filled out their consent forms and emailed them back, we coordinated a time and place for the interview.

The 45 minute interviews took place between December 9 and 13 and I audio-recorded them. Before each interview, I reread all interactive writing and constructed questions specifically for each participant according to their individual journey. Below, I included a sample of interview questions which are represented below.

1. You said that you struggled in math. Can you describe that comment? Was there a specific experience that led you to believe that?
2. Was there an AHA moment in your journey when you realized you could do number talks with your children?
3. You said that you and your children are more confident now. Can you explain what you meant when you said that?
4. When you mentioned _____, what did you mean by that?
5. What specifically contributed to your changes?

6. How do you see number talks fitting into your future?

After each interview, I transcribed the interview into a Word document while using the Dictapad phone application. I was able to complete each transcription before the next interview and sent them to each interview participant to review. When the interview participants had completed the transcription review, they emailed me granting me their permission to use the transcribed version of their interview.

To conclude the first half of this chapter, I provided an overview of the workshops as well as of the data generation methods. I found that every step was crucial in the preparation and delivery of the workshops. As well, with the three data generation techniques, I was able to gather information about the participants' journeys and to watch the participants begin their number talk transformations. Through reading the data and interacting with the participants, I was also able to reflect and adapt interactive writing and interview questions according to each participant's needs. For the second half of this chapter, I present some of the rich data that the participants shared to help me understand their perspectives.

Participants' Perspectives on Their Experience

As I was reading through the three forms of data, I was struck with deep and profound reflective moments as I realized the impact that the workshops and writing were having on myself and the participants. The second half of this chapter will unveil the data to uncover some of the heartfelt moments that touched me as a researcher. Below, in chronological order, I will share some of the data from the interactive writing, alternating it with data samples from my own reflective journal regarding the workshops. I provide samples of the interview data in Chapter 5 where I present the four narratives of the interview participants. Even though I asked the same questions to all participants, every email response I received was different and unique. The sample data that I am including below represents emails from many of the participants but not from all of them. The selection of data that I have chosen is based on what I have deemed important to my research and where the themes from Chapter 6 started to emerge.

Interactive Writing 1

Before the workshops began, the participants sent me the first email responses regarding their own attitudes about mathematics. I found that the participants' prior experiences with mathematics varied greatly and not one story was the same. Many parents shared negative math experiences and others shared more positive ones. Below, Ted (all names are pseudonyms)

summarized the sentiments of several participants in the study and wrote about his negative math experiences. He wrote:

> I am very poor at mental math. I panic in meetings when I need to do mental math in front of a group of people (even a simple equation). I did not do well in school with Math (specifically in Grades 10 and 11). I went on to College and was exposed to complex math, that I also struggled with. I was able to memorize enough to pass, but did not learn how to do it. (Interactive Writing 1, Ted, October 5, 2018)

Ted's negative experience with mathematics in high school is still affecting him today as he fears math even as an adult in the workplace. When he said he could pass with enough memorization even though he did not really learn how to do it, I feel like he missed out on foundational experiences since they could have helped him make sense of what he was trying to learn. I wondered whether or not Ted could overcome his fears through the study!

Jana, Suzanne, and Nikki also wrote to me about their negative memories. They wrote:

> It was a struggle growing up. Now I need to use math in my budgets with work and life, visa reconciliations and working with grants. It's not my favorite thing to do. Me and math do not get along. (Interactive Writing 1, Jana, October 7, 2018)

> Trouble with it as a child. I had a tutor but still always felt unsure. I never failed anything including provincial exams however lacked confidence and felt I never actually understood. I am not confident in teaching my children math. (Interactive Writing 1, Suzanne, October 9, 2018)

> I am not super strong in math. I remember many tears over doing math problems as a kid. I managed through math but never excelled at it. Only took what was required in high school. (Interactive Writing 1, Nikki, October 10, 2018)

The three separate comments of "it was a struggle growing up…me and math do not get along", "I am not confident in teaching my children math" and "I am not super strong in math" represent Jana, Suzanne and Nikki's negative attitudes about mathematics because of their struggles when they were younger. Again, for me, I wondered if these negative attitudes and fears about math could be overcome throughout their journeys during the research study.

Two teachers, Nancy and Leona, shared similar negative math attitudes and experiences. They wrote:

> Myself, I have never been strong in math and it is only in becoming a parent, adult, teacher that I feel comfortable with numbers. And even now, I struggle at times. In high school I was laughed at by a teacher for asking a simple question. That broke my confidence and I disengaged completely and immediately. (Interactive Writing 1, Nancy, October 9, 2018)

> I have always been unappreciative of math. I have a poor attitude towards this subject perhaps even a fear. I hated teaching math and feel I never did justice to my students in this subject area. At home, we focus more on literacy unless given specific activities by teachers. Then I am really good at follow through. (Interactive Writing 1, Leona, October 10, 2018)

When Nancy was laughed at by a teacher, it made her lose confidence. She became more comfortable, but the negative experience still affected her after the workshops. Leona admitted to having a poor attitude towards math which had affected her ability to teach math to her students. For me, the fact that many of the participants including two teachers had negative math attitudes and experiences intensifies my belief that we must conquer this negative perception in society so that children do not adopt the same kinds of thinking when they are faced with mathematical tasks!

Throughout the study, I responded to each email I received from parents. For many of the responses to participants, I commented on their bravery and courage of attending the workshops despite their negative feelings towards mathematics. One email I wrote to Leona was:

> Thank you so much for your honesty about your feelings of math…I admire your bravery to overcome some of your feelings about math by coming to the workshops. I hope that I can provide you with some strategies that you are able to integrate naturally into every day conversations and maybe hopefully grow to appreciate math in a new way. (My Interactive Writing Response 1, October 2018)

Generally, my responses to the participants with negative attitudes about mathematics commended them for their bravery in attending the workshops and sharing their past

experiences. I encouraged them to start conquering their fears and anxieties all through the development of a relationship with me.

There were also many participants in the study who had positive mathematics experiences and attitudes. Laurel, Minnie and Abigail all shared how they use mathematics in the workplace and how important it is in real-life. They wrote:

> I've always loved math and asked my mom to buy me math activity books as a child. I was in the higher level math classes in high school and also tutored elementary to high school math/chemistry/science to my peers. Now, I'm in a statistician type role. (Interactive Writing 1, Laurel, October 8, 2018)

> Came easily as kid, enjoyed logical, practical, analytical thinking. Felt very lucky that it was easy for me, I understood that many struggled with math… Love the subject, feel it's an important subject. I encourage my older kids to be the best they can in the subject; that it is in every aspect of our lives. (Not a difficult sell – since I'm an accountant. I love that kids are learning new ways to understand math. We grew up with "one way" to perform it (not 10 different ways to add!) and was part of the "memorize your timetables" age… however, I think there is still value in some memorization! I hope these new ways to learn math are less intimidating to kids, math shouldn't have such an intimidating stigma to it ;) (Interactive Writing 1, Minnie, October 7, 2018)

> Math is everywhere! In my Cooking (time/measuring) my work (counting, breathing, sequencing, angles of poses), parenting ("I'm going to count to 5", Lego), driving (speed, distance) and I also use at the workplace daily, scheduling appointments (time)… I use math in measurements, calculating force, shear and friction. I calculate angles and pressure management… Design and plan custom seating surfaces including varying densities of foam, plastics, metals. I use pressure gauges, tools and computer systems to calculate risk of injury. I also have to complete spec sheets with measurements when ordering equipment and materials. I also predict wear and tear of materials and cost of systems. I gather data and look at statistics in other areas of my job. Looking and analyzing trends and reading charts/graphs/reports. (Interactive Writing 1, Abigail, October 10, 2018)

The comments from Laurel, Minnie, and Abigail all indicated positive math attitudes. All three of them embraced mathematics in their everyday lives. After reading the positive math attitude emails, I wanted to thank them for participating in the study and shared my hopes for them. Below is the part of my response to Wade's email where I thanked him and explained my hopes for his journey. I wrote:

> Thank you so much for your email. It sounds like you have had many positive experiences with math…You must be very proud of yourself and it is evident that you have passed on your passion for learning to your child. I hope to share some new strategies with you…I look forward to working with you. (My Interactive Writing Response 1, October 10, 2018)

Even though Wade had positive experiences, I was looking forward to seeing what his journey would look like. Although these participants had positive relationships with math, they all expressed a desire to learn about how to interact better with their children. When I wrote back to the participants with positive mathematics experiences, my goal was to thank them for their participation and to start building a relationship with them so that they would be open to me teaching and guiding them.

Overall, after the first email, I was impressed and humbled by the sharing of such personal experiences both negative and positive about mathematics. After the first round of interactive emails, I was looking forward to studying the participants to see how their journeys were going to change, especially for those with negative math perceptions!

Workshop 1: Telling Time

After the first workshop, I felt really positive about how I presented it and I even had many parents telling me how happy they were by thanking me. I recorded in my reflective journal what my own thoughts were. I wrote the following:

> Wow! What a workshop! I felt so good and positive presenting it and I had such excellent feedback! It flowed really well and I am very happy about how it went. The 2 clocks I gave were a hit and I am so glad I decided at the last minute to get the cardboard clock with movable hands as that it was the parents were able to use to practice with! (My Reflective Journal, October 12, 2018)

My self-reflection indicated how pleased I was and how effective the hands-on resources were, especially during the practice part of the workshop.

I also wrote in my reflective journal about what one parent found specifically helpful in the workshop when I was talking about my own math journey. I explained how when I was substitute teaching in England, in every class, there were students who said they were stupid and couldn't do math. I explained that no student should feel frustrated about mathematics and that it is in part thanks to those students, that I have such a passion to help them! One mother, Karina, referred to that experience I shared and said to me after the first workshop:

> Your experience about the students in [country] with other kids telling them they are weak…brought me back to [my foreign country] where in math class, the teacher would call out the top 3 students' names and would call out the bottom 3 students' names…I would feel horribly about my friend being at the bottom of the list. Thank you for sharing. (My Reflective Journal, October 12, 2018)

When Karina told me about her experience in her country, she was connecting with me as we shared similar feelings and experiences about children feeling stupid in math. It was at that moment, I realized that the front matter of each workshop could make an impact on the participants to help build a relationship with them through my own experiences. Other realizations and aspects came after reading the responses to the second interactive email about telling time and thus my journey continued.

Interactive Writing 2

After the first workshop about telling time, the participants' second interactive writing went above and beyond my expectations. For the research requirement, I asked the participants to do one number talk with their child. However, many told me that they were so excited to start number talks, that they left the workshop, started right away and continued telling time talks for the next two weeks! When I asked the participants about what they learned and how they felt about the Telling Time workshop, Abigail, Karina, Suzanne and Leona wrote the following:

> I walked away with a desire to interact more with my children in the area of math/time. I learned the developmental stages of teaching time to children. I loved the video examples and reference to your own children when teaching/learning about time. (Interactive Writing 2, Abigail, October 20, 2018)

> I learnt about the importance of watching out for gaps in how kids learn and understand math. Very insightful learning how kids can fall through the system. I

> also learnt about the importance of terminology and relating teaching numbers to everyday life events. (Interactive Writing 2, Karina, October 24, 2018)
>
> The breakdown of the different stages of learning to tell time. Excited to implement and have clear guidelines to help guide my children and know what to do or what to try when they get stuck. (Interactive Writing 2, Suzanne, October 22, 2018)
>
> In the videos I learnt that we as parents naturally integrate math talks into our daily lives but I think part of the problem comes from the fact that we do it without foresight, purpose and efficacy. I felt that having natural ways to explain time with guidelines like stop when they need to or keep them in the zone of proximal development so they can develop the most are really helpful. I loved the idea of explaining number sense or place value by using hands and time. I never thought of this…It is amazing how much I never purposely do. I think a lot of gaps come because I don't always realize things need to be learnt and not always innate. I thought the workshop was great. It is a lot of information to wrap my head around. The handout is a big help I am going to put it on the bulletin board for reference. I think I need to be purposeful and set goals for using this information to make sure I take the time to use them…In our family we plan how we want to grow financially, spiritually, physically, emotionally but not always academically for the kids. We kind of rely on the teachers in the sense that the homework the kids do is expected to help them improve their math abilities. (Interactive Writing 2, Leona, October 24, 2018)

After reading the participants' responses, I was proud of them for recognizing the importance of interacting with their children as well as breaking down the explanations into small steps. From what they told me, they did not know that there could be gaps in their children's mathematics learning. What I realized was that the participants were referring to the workshop teaching that included the zone of proximal development, step-by-step guidelines, mathematics gaps, using hands for conceptual understanding, video examples and stories about my own children.

After reading the participants' various email responses, I realized that they were starting to undergo a transformation and their journeys had begun. I was excited about the possibilities

of future workshops for parents and teachers and what impact it could make on their own children and students.

Another realization I made after the emails about the Telling Time workshop is that I needed to help the fixed mindset participants shift their thinking to a growth mindset. For example, I learned that the participants needed to know that for children to learn, it is a long work in progress. A few of the participants expected their children to learn really fast and were overwhelmed when they did not learn quickly. Minnie wrote:

> I found it inspiring yet a little overwhelming. My daughter (5 years old)…her understanding is minimal with the analog clock and is nowhere near the problem solving steps. She seems very understanding with basic math, adding, subtracting, grouping, …but why we show time in 5 minute increments and trying to explain why we only go to 60 minutes was beyond me! (…"because honey, that's the way it is"!) We have a long way to go and I find I'm not as good a teacher as I thought…Haha. I hope to glean more in the next workshop and work to improve my teaching skills as we go on! (Interactive Writing 2, Minnie, October 23, 2018)

In her writing, Minnie called herself down saying that she was not a good teacher. Since that was not my intention at all, I realized that I had to help her shift her fixed mindset about not being a good teacher to a growth mindset of her being capable of teaching her daughter. My interactive writing response to Minnie was:

> Thank you so much for your insightful email and thoughts. Your daughter, being 5, is exactly what is expected right now! It sounds like you are a wonderful teacher! Just by your comments explaining that she is excited about you asking her the time shows me how good of a teacher you are! Wow! She is at the exact same level as my son, who is 5 as well…He was the one reading the digital clock in the car and said 21 for 12. He is at the beginning stages as well, so please do not get discouraged…We are preventing the holes in the future. I will clarify this on Thursday that it can take up to a full year before a child is ready to read an analog clock with confidence, so thank you so much for your honest email. Your comments will help me explain to parents better in the future. (My Interactive Writing Response 2, October 22, 2018)

By responding to Minnie this way, I was able to respond and guide her with the goal of shifting her fixed mindset thinking. In response to Minnie's interactive writing, during the next

workshop, I explained to the participants that the learning process does take time. To help parents understand, I related it to learning the letters of the alphabet and the sounds each letter makes. I explained that children do not learn the sounds after a few experiences with them. Rather, it takes years of practice for them to make sense of letters, sounds, words and reading. The same is for numbers.

Workshop 2: Money Talks!

After Workshop 2, Money Talks!, I self-reflected extensively. I realized that the workshop had too much information and I needed to revise the original money steps that I had developed. In addition, I had not given the participants enough time to practice number talks with the coins I provided. Below is most of the entry in my reflective journal, written the day after the workshop. I wrote:

> I did my 2nd workshop last night. It went ok, but I had too much information. It was a heavier session. I had to stop after step 9, to do a movement break and so I got them (the participants) to do a number practice with coins to think about how they would work with their kids. This was the only time I had them work with coins. I wish I had broken up my talks more after a few slides, then they try. And maybe having at least 2 trial number talks with a partner. The slide I had prepared with the example number talks, at the end, we didn't have enough time for. So I feel like this session could have broken up into 2 workshops. I could not have cut down on my steps, however I maybe could have reduced the info?...
>
> In fact maybe an activity halfway through could be: Brainstorm at your table all of the places where you could do number talks with money. Have a notetaker at each table taking notes of their ideas, as that is priceless information for me. Then I could email that information back to them when I have compiled the notes. Also, I would have liked the parents to work with a partner. I had them all standing practicing on their own as I gave them directions with money. I wanted my sessions to be more interactive and less information. Less is more. What I realized today is that after I had completed my Money Talks! PowerPoint, I started to infuse the ideas of parents from the emails after the first workshop to help clarify their questions and thoughts. THAT INFORMATION WAS TOO MUCH!!! …

> We must give children time with their numbers during foundational experiences like time, money and temperature before jumping to conclusions that they are not getting it… Something was telling me that it was too much. I need to listen next time. But I don't regret these decisions. I learned a lot from this experience, more from the 2nd workshop then the from the first workshop. Now I can adjust.
> Slides to remove: number talks compare to memorization slides, Step 2 numbers.
> Best things about my workshop: TD video, icebreaker, my own journey…My number talk videos – but I had too many in total. Sharing ideas for planning, break halfway through – coin talks, how to work with coins are all things to consider for next time. (My Reflective Journal, October 26, 2018)

The journal entry reveals that as I was finishing the workshop, I was distraught. In particular, I felt that the heaviness of the workshop in terms of content might have overwhelmed some of my participants. I resolved that in responding to the participants' interactive writing I would accept responsibility for the overwhelming information and attempt to reassure and give each of them specific and clear guidance about any concerns they expressed.

After rereading the reflective journal entries, my thoughts remained the same. I presented too much information, however I learned so much from that workshop. Even though I felt like I could have done a better job at the workshop and that so much needed to be improved, I did receive many positive comments from the participants directly following the workshop. After the workshop, I recorded in my reflective journal what a few participants said to me. Leigh told me "Thank you so much for your workshop. I never take my kids to the grocery store, but now I am going to start bringing them every time" (My Reflective Journal, October 26, 2018). As well, Leona, a teacher participant, said that at her school, she could see my workshops and videos being used for teachers to explain to parents what to do in a home program to help children advance levels (My Reflective Journal, October 26, 2018). What I realized from Leigh and Leona's comments was that even though the workshop was overwhelming, many participants were still able to learn from it and see future possibilities with their children and students. I hadn't realized that my workshops could possibly be used by teachers, but I would welcome that opportunity in the future!

Interactive Writing 3

Since I felt overwhelmed following the Money Talks! workshop, I was wondering how the participants were going to feel about it. However, I was pleasantly surprised when the participants emailed me about their experiences. There were a few who agreed with me that the money workshop had too much information, but the majority of the participants were grateful for the information. Below are some of the emails I received about the money workshop when I asked about what the participants learned as well as their thoughts and feelings. The first two comments are from Nancy and Leona (both teachers), who mentioned that the workshop was overwhelming. They wrote:

> Mostly, I came away remembering how important it is to talk to the kids about money and to talk about money in front of them, engage them as often as possible…It was a little overwhelming and required a lot more thinking afterwards: how am I going to implement these things in the future. (Interactive Writing 3, Nancy, November 5, 2018)

> In the money workshop I learned that I was shying away from talking about tax myself as I have no strategies beyond a calculator for determining the tax on the purchases. I was a little overwhelmed about doing time and money talks with the kids at the same time. However, I find setting a goal about what talks to do within a week (of course being flexible) I can incorporate purposeful talks that don't take long into a day. (Interactive Writing 3, Leona, November 6, 2018)

I really appreciated the feedback that Nancy, Leona and others explained to me about the Money Talks! workshop being overwhelming, as it confirmed how I had been feeling as well. However, I was pleased that even though they felt overwhelmed, that they were still able to learn about the importance of talking to their children about money and how simple it could be to integrate money talks at home. When I responded to the participants' writing, I wanted to address their feelings and say something positive about what they wrote to me. Below is an example of how I responded to Wade, another participant who also told me the workshop was heavy. I wrote to Wade and said:

> Thank you for your feedback. I also thought the money workshop was heavy, so I appreciate you bringing it up with me. I really liked your money talks about budget and price comparisons even though I believe your daughter is in Grade 2. Keep up the great

> work of exposing her to lots of money vocabulary! (My Interactive Writing Response 3, October 29, 2018)

With this response, I wanted to let Wade know that I had addressed his feelings about the heaviness of the workshop and at the same time, I offered encouragement about the number talks he had tried with his daughter.

Other participant emails I received after the Money Talks! workshop were extremely positive and motivating to me. Jana and Ted, both with older children, wrote about what they learned during the Money Talks! workshop and how they felt before the workshops began. They wrote:

> I learned how to simplify on how to teach money to my kids. Breaks it down pretty simple to teach. Before, I stressed about teaching about money at times and making things too complicated. (Interactive Writing 3, Jana, November 12, 2018)

> That it is never too early to talk about money with your kids. There were a lot of great ideas about how to have math talks about money. It gave us things to think about incorporating into our home routine to do with money, shopping, allowance, chores etc. We found the session quite informative and fun! Sometimes money talks can lead to frustration for both adults & kids but, the session was a good reminder that money talks don't have to be stressful – they can be fun! (Interactive Writing 3, Ted, November 15, 2018)

Ted and Jana's emails after the Money Talks! workshop showed that they had reflected about their mindset about money. Before the workshops, they both recognized that talking about money had been stressful for them, but then realized that money talks could be easy and fun. Their emails revealed that they were switching from a fixed mindset about teaching money to more of a growth mindset.

After reading everyone's emails about money, I felt validated in what I had explained including the later steps of talking with children about mortgages, budgets and more. I was so appreciative and cognizant of the participants' emails and their experiences. Their thoughts and feelings confirmed my own beliefs about mathematics and how if parents are taught and guided step-by-step, then they could succeed in teaching and guiding their own children.

After reading the interactive writing written after the Money Talks! workshop, I myself recognized that I needed to shift from a fixed mindset to more of a growth mindset. The day after the workshop, I had been distraught and had a fixed mindset. After reading the interactive writing, I realized how much I learned from the participants and shifted to have more of a growth mindset. On November 7, the day before my third workshop, I wrote in my reflective journal how I would change the Money Talks! workshop. I was succinct, direct and no longer emotional. I had written:

How I would change the money workshop

- Less front matter before the ice breaker.
- No revision of clock as they had ample time to email me and I responded to everyone. Also, what one person emailed me, is not what another one needed. So no need for summary.
- Keep the review of that it can take years for the change to occur with kids. (parents needed to be reassured about that)
- The slide with the table…no need for that. To compare number talks with memorizing. Pull it out.
- More stopping and allowing the participants to interact more.
- Fewer videos.
- Keep video in front of Dollarama and in Dollarama.
- No number discussion and targeted number practice sheets. No videos about that either.…it was covered enough in time workshop. Create another workshop about targeted number practice to offer participants.
- Add slides about my husband and I's differences about money to help participants understand what thoughts and beliefs they are transferring to their children. (My Reflective Journal, November 7, 2018)

The Money Talks! workshop and interactive writing afterwards helped me to develop more of a growth mindset about future teaching of that workshop specifically. The participants have encouraged me to keep teaching the workshops as they have found them helpful. Research shows that parents have always had an interest in helping their children in mathematics, but they just didn't know what to do (Epstein, 1989). With the workshops and interactive emails from parents, I feel like we are headed in the right direction.

Workshop 3: Experiencing Temperature

The planning of the third and final workshop about temperature was greatly influenced by my thoughts and feelings about the second workshop about money. Since I thought I had too much information in that workshop, I reflected and decided to keep the temperature workshop more lighthearted. When I started planning the temperature workshop, I referred to the notes in my reflective journal that I had written on October 26, 2018, the day after the Money Talks! workshop. I had written:

> Thoughts about temperature workshop:
>
> I will exclude the number slides from the temperature workshop…My goals for the temperature workshops are: Fun, lighthearted, more interaction, more ideas to be given to me from the participants, more sharing, Even start with a brainstorm after the icebreaker of all the places you see temperature and what kind of talks could you do? (My Reflective Journal, October 26, 2018)

For the Experiencing Temperature workshop, I stayed true to my word. I included some information, but it was not overbearing. I kept it light with more interaction with the participants, they learned and I had more fun teaching it! After the workshop, I felt much better and more positive about this one compared to the Money Talks! workshop. I had developed a solid relationship with the participants through the workshops and interactive email experience and that helped me to plan, prepare and present the last workshop. Below is an entry from my reflective journal the day after the Experiencing Temperature workshop. I had written:

> It was a much easier flow. Very easy going and laid back. Lots of interaction and planned activities for the participants. Working with the thermometer and the beads was a huge success. And freezing the other thermometers was awesome. They had fun trying to warm them up and seeing the red line go up. The numbers counting by 1s on the homemade thermometer and the numbers skip counting by 2, made them think. Overall, this was the most relaxed workshop. But I think it was because parents were comfortable with me and knew what to expect. Also, all the front matter had been covered such as number talks, zone, brain, etc. The Temperature workshop had the puzzle pieces, but no new in depth learning had to occur. I had thought that maybe the temperature workshop should be first, but I don't think so. If I switched them, I would still have to teach them

> how to do a number talk, etc. I think I did it in the right order. I also wouldn't have wanted money to be last as it was too heavy. (My Reflective Journal, November 7, 2018)

After reading my reflective journal entry, I still agree with what I had written in the research journal after the Experiencing Temperature workshop. Since there was no new teaching, other than discussing confidence, I was able to carry the light-hearted flow throughout the whole workshop. I believe that one of the main reasons that the workshop went so well is because of the positive relationship that the participants and I developed through the emails and workshop experience. Thus, due to the rapport we had built, it was easy to plan the third workshop as I knew what helped them learn best.

Interactive Writing 4

After completing the last workshop, the participants' final email responses showed how much they had grown and learned through their two-month number talk journey. All participants' journeys were unique as it depended on their own experiences and many other factors. Below are a few of the participants' final responses about when I asked them about changes in their learning and their thoughts and feelings about the workshops. Ted wrote that he noticed a difference in his:

> Confidence, attitude and/or understanding of numbers and math or any other changes. I think that the sessions gave us resources on how to approach number talks and give us the confidence to incorporate them into daily routines. I think that the kids feel more confident about themselves when they know the answers to the questions we are asking. It gives them a boost to their esteem, that they know what they are talking about! (Interactive Writing 4, Ted, November 20, 2018)

Ted wrote to me in the first interactive writing that he panics in meetings because of his fear and negative experiences in math (Interactive Writing 1, Ted, October 5, 2018). For Ted to write that he has found new confidence to interact positively with his children in mathematics means that the workshops helped him to shift his mindset! In developing a more growth mindset, Ted helped his children develop more positive self-esteem and shift them to feel more positively about mathematics too!

In addition, Abigail's final interactive writing revealed how she was able to transfer her number talk understanding into different learning opportunities that were not even discussed during the workshops! She wrote:

> The kids are really using that analog clock you gave me to put in the basement. I've been using it to plan and set limits on screen time and when we are going to start a movie. We even used the clock to time how fast the commercials were coming on during the football game last night…My son is using the clock and actually going up to it and counting the hands etc… I regret not getting an analog clock sooner!
>
> Plant Climate: My older son and I went to Rona to buy houseplants…We looked at the back of the plant information cards and compared the temperatures and light recommendations for the plants. Some plants needing way more tropical conditions. Some plants ok with a draft or cooler night temperatures. Some plants needing increased humidity. We discussed the light/temperature/humidity in our home. What plants would work in our home and what wouldn't. It was pretty neat because I was actually learning at the same time. I felt we connected by learning something new together. (Interactive Writing 4, Abigail, November 22, 2018)

Abigail explained the use of the analog clock well and how she took the information about temperature and transferred it to talk about plants. She used the clock resource I gave her, but also used the resources of real plants and information cards to teach her children about temperature and humidity. For her, it seemed to be that the hands-on resources were key to her children's mathematics learning and engagement. It was inspiring for me to see how she transferred the concepts that she learned and transferred them into activities and conversation that made sense for her and her family.

Another participant, Dahlia, shared her thoughts of how the different topics that I taught in the workshops helped her. Below was her final email to me where she wrote:

> When discussing family overseas we were able to talk about the difference in time zones and temperature…I'm more relaxed in covering the topics than before. The different ideas and videos were really helpful in seeing how to do this. I'm also better at staying in the zone and paying attention to where my son is at and when he needs a break and when to continue on. I'm also getting better at noticing moments that allow for number conversations in everyday life. Lots more to apply still but it's been a great boost in the right direction…My son's confidence has been great from the start of this process. It's been a journey, but the progress is clear and positive…Although I don't practice with him that often - mostly only on the week-end when life slows down - it's so cool to have these

> tools that enable him to feel like the smart and capable kid that he truly is. It's the most amazing thing to see one's child go from feeling hopeless to confident. (Interactive Writing 4, Dahlia, November 21, 2018)

In her final email, Dahlia mentioned many things that helped her on her journey. She noticed that she is more relaxed during number talks thanks to the videos. She also was able to engage her son and keep him in the zone during teachable moments. She recognized that she was still on her journey but it had already been positive. She was also pleased that her son became more confident too! For me, Dahlia captured the essence of the workshops. She learned what she needed from the workshops to be able to guide her son to learn and feel more confident in himself. She knew that her journey would continue but had a renewed, more positive outlook about mathematics.

Abigail wrote a very similar email and encompassed a lot of the same learning. She said:

> In the past few weeks I've totally upped my numbers game with the kids. I am more aware of the many number opportunities in the day and I try not to let any of those natural learning opportunities pass us by. In addition, I'm extra cautious about keeping the sessions short and positive. I realize how sensitive the kids are to any negative feelings or discussions around math. I'm also much more aware of my values and attitudes around money and how this affects the children's view of money and spending in the future. Using Self-reflection regarding my teaching style and math attitudes has really helped a lot. The number talks will continue. I've already seen the benefits in the kids including; improved self-confidence, more of an interest in math, the connection with the kids is pretty cool too. It's a nice way to ask about what's going on in the day. I've been asking "what did you learn in math today" "What was the temperature at lunch recess? Did you wear your ski pants or not?" Also, the number talks are a good way to check up where the kids are in their math abilities at the moment. It helps me see where there might be holes. (Interactive Writing 4, Abigail, November 22, 2018)

Like Dahlia, Abigail learned how to notice number talk opportunities and how to keep the discussions short and positive to help her children stay engaged. She was aware of her own values and math attitudes and how her own thoughts affected her children's thinking. Also, Abigail explained the benefits of number talks and how she noticed her children's interest and confidence increasing in mathematics. Through the number talks, Abigail felt more connected to

her children which she appreciated and used the talks to check for mathematics gaps. For me, Abigail also encompassed the intentions of the workshops as she was able to guide her children to learn while interacting positively! I am pleased to know that her plan was to continue the talks as she was seeing positive benefits!

In addition, Nancy, another mother and teacher, captured the purpose of number talks! She wrote:

> I also see the number talks creating the framework in their overall learning…this (number talks) is the building blocks and collectively it will further enhance their (children's) confidence when it comes to math. I think my number talks will continue to evolve with my kids' needs to be challenged. I think for the most part, it has become part of our family culture. (Interactive Writing 4, Nancy, November 19, 2018)

Nancy recognized that number talks provided a foundation of learning as she described them as building blocks. She also realized that as her children grew older, then the number talks would become increasingly difficult. When Nancy defined number talks as becoming part of her family culture, it helped me to see the potential to help many parents and children in the future.

Throughout the interactive writing and workshop experiences, I realized that the participants who were having ongoing number talks explained that their children were starting to build a solid foundation about time, money and temperature. Parents also noticed that their children became more engaged in the talks which led to an increase in their confidence and self-esteem.

Since a few of the participants were teachers, I noticed a trend in their emails. Their final emails showed me that number talks along with the step-by-step guidelines could possibly help teachers too not only for their own children, but also for their students as well. Leona wrote:

> I think that this is definitely something I will keep with my kids. As an educator, I actually feel like this is something that I could incorporate into my classroom (if I ever have to teach math) because it breaks down where to start and what goals to work towards. I think that teachers and students would benefit from something like this. It is a resource that I think is missing in a lot of programming for children who have obvious gaps in their math education. (Interactive Writing 4, Leona, November 24, 2018)

I was impressed to hear that Leona felt that the step-by-step programming could be useful for children who have gaps in their mathematical understanding at school. After following the

journeys of these teachers, I realized that the workshops could have an even larger impact on the community by helping both parents and teachers.

Overall, the number talks workshops provided the participants with a foundation of how to talk about the three concepts in everyday language. The goal was for parents to use the contextual experiences that naturally occur on a daily basis so that they could introduce their children to general mathematical language. Exposure to these experiences would allow children to have a basic understanding of mathematical concepts in everyday language before they learn about arithmetic in school. When children have experiences with number talks, they may transfer their understanding from their informal learning to make sense of the more complex concepts during formal mathematics teaching in school. For example, when I taught Grade 5, I worked with students who learned the concept of addition and subtraction of decimals very easily (formal mathematics) because of their previous understanding about money through number talks with their family (informal mathematics). Another example would be temperature talks (with below-zero numbers for really cold, for instance) at an early age, could prepare children to understand how to calculate with integers in school in later years. Thus, it seems to me, that children, with the support of their family during informal mathematics such as number talks, could learn to use the tools of formal mathematics to make sense of the concepts at school. Fortunately, family number talks can begin from a young age and can start to build the foundational blocks that are necessary for children to transfer their mathematical understanding later.

Interviews

After the workshops were complete, I engaged four parents in final interviews. These interviews allowed me to explore participants' journeys and study the factors that influenced their learning. The purpose of the interviews was to discover more about the four participants' journeys, how they learned through the process and the factors that influenced their learning. In Chapter 5, I present four profound, unique and personal narrative stories about their journeys. The narratives of the four interview participants along with all the data have led me to discuss common themes and address the research questions and objectives in Chapter 6.

Chapter 5: Narrative Stories

The overall purpose of the narrative stories was to represent the range of experiences among my participants through my interpretation. The twenty-four participants represented both men and women with a variety of careers. They also had a range of different experiences including positive and negative mathematical experiences as well as growth and fixed mindsets. As well, to my knowledge, a few participants were born in other countries and had various school experiences. Even though I learned from all of my participants, in the end, I chose two mothers, Anna and Lily and two fathers, Diego and Eric for the interviews.

During the number talk journeys of my four interview participants, they revealed that they transformed their understanding of learning and teaching mathematics to their children. Through their journeys, I was able to write four narrative stories. Through their heartfelt journeys, the four parents have helped me to change my own thinking about parent learning.

In this chapter, I will present my interpretations of Anna, Diego, Lily and Eric's respective narrative stories that are emotional, inspiring, life-changing and profound. First, I will present Anna, born in Poland, who had high confidence in mathematics and was an accountant. Next, I will present Diego, born in Italy, who had low confidence in mathematics and was fearful of teaching mathematics to his children. Third, I will present Lily, born in Manitoba, and a correctional officer who struggled with mathematics in high school. Last, I will present Eric, also born in Manitoba, who was a teacher who had many negative mathematics experiences when he was younger. I will try to capture each one of their unique experiences and construct their individual narrative story and journey. As you are reading about Anna, Diego, Lily and Eric's journeys, I hope that you can see themes that emerge while being inspired just as much as I was.

Narrative 1: Anna's Journey

Anna's Background

Anna was a mother of one seven year old daughter who was born in Poland and moved to Canada ten years ago. During her school days, Anna went to a private religious school where teachers taught traditionally in Polish, and students learned mathematics through memorizing and writing in notebooks. She remembered having positive experiences with mathematics, always felt successful and achieved high grades.

Anna's positive memories led her to having high confidence in her own mathematical ability as working with numbers and problem solving had always come easily. Since Anna felt confident and successful with mathematics, she chose a career in accounting where she continued to feel positive about the subject. Before the workshops began, Anna had high expectations for her daughter to learn mathematics and thus, taught her daughter through workbooks and written addition and subtraction. Anna attended the workshops to learn new techniques to help engage her daughter mathematics.

Throughout her journey, Anna had many ups and downs. Before the workshops began, Anna had high confidence in mathematics. After attending the workshops and practicing the number talks with her daughter in her own language, polish, she was faced with a few obstacles. She felt frustrated and uncertain about how to proceed and her confidence in her ability to teach her daughter decreased. Through interactive writing, determination and persistence, Anna had a defining moment of change which helped her learn how to guide her daughter to number talk success!

Anna's Uncertainties and Frustrations

Anna's journey was emotional. Since Anna started the workshops with a strong mathematical background and high confidence, she had expected the journey to be easier than it was. During her journey, Anna developed uncertainties and frustrations in her ability to teach her daughter.

One of Anna's frustrations came with the length of time it took to complete a number talk with her daughter. I had explained in the workshops that number talks could range from three seconds to five minutes, but that they shouldn't be longer than that. I also explained that the talks were supposed to be fun and interactive and if the child is not ready for a number talk, then to stop the talk. After the first telling time workshop, Anna wrote:

> Tried some of the techniques mentioned in the handout at home and was glad to see it work. She is comfortable up to 25 min on the analog, but beyond that she seems shaky. She is happy counting the one minute markings on the clock, but is yet to grasp the 5 min skip counting between numbers. Not sure how to go about doing this. It was frustrating at times 😁. Found it tough to keep her focused on this subject for more than 15 minutes at a time. (Interactive Writing 2, Anna, October 18, 2018)

When I read Anna's email, there were a few aspects to consider. First, by saying that her daughter was "shaky" beyond 25 minutes on the analog clock but "happy counting the one minute markings on the clock, but is yet to grasp the 5 min skip counting", showed me that Anna had recognized exactly where her daughter's zone of proximal development was. This also meant that Anna had learned during my workshops how to guide her daughter in clock talks.

The second aspect to consider was a cause for concern for me. It was when Anna wrote "found it tough to keep her focused on this subject for more than 15 minutes". After reading that, I knew that I had to clarify the amount of time spent on the talks to avoid both parent and child frustrations. When responding to Anna, I wanted to encourage Anna for noticing her daughter's zone as well explaining the importance of keeping number talks short. I wrote to her with the following:

> Thank you for your email. I am so happy that you noticed some changes at home. Since your daughter is in Grade 2, the fact that she can read a digital clock, is very good. She will catch onto the analog clock quickly and will soon pick up the counting by 5s. She will learn this in school too, so what you are providing to her is an excellent foundation. Keep your number talks to about 2-10 minutes for a child in Grade 2. You want to quit while she is in a happy mood! I'm glad to see that you noticed that her zone was up to 25 minutes on the analog clock. That is a very good observation on your part! Keep her in the zone, and when she is comfortable with up to 25, you will find that she will show you when she is ready. There is no rush. Give her a few months and maybe up to a year to grasp the analog clock. It is actually quite difficult. (My Interactive Writing Response 1, October 20, 2018)

By writing this response, I wanted to reassure Anna that she had noticed her daughter in the zone and that the process was going to take a lot of time, even up to a year. In essence, I was trying to teach her to become more patient with her daughter.

Anna's uncertainty for teaching her daughter continued after the second and third workshops especially after the money workshop. Anna had difficulty relating to the teaching of coins since money is digital. When referring to the teaching of coins, Anna realized that:

> It is not an easy concept to teach children, may take a long time to get the concept in place. I find it hard to relate to some of the material, given that we deal with cards and smart payment choices all the time. As an example, I have not used cash for a few weeks

> now and with each passing day I think the usage is going to come down. (Interactive Writing 3, Anna, November 4, 2018)

When reading Anna's email, I noticed that she recognized that it was going to take a lot of time for her daughter to understand coins and money. However, I was concerned with her comment about finding "it hard to relate to some of the material". I realized that Anna was referring to the actual coins and bills and how since we live in a digital world, there are fewer opportunities to have access to the real money.

At this point, I knew that I had to explain why the teaching of actual coins is important along with providing positive feedback about noticing that it was going to take a lot of time. I responded to Anna with the following:

> You are also right about money not being easy to teach and that it will take a long time for children to grasp this especially because we live in a digital world. Yes, the usage of real coins and bills is going to go down. Here is why the teaching of coins and bills is important. The Manitoba Mathematics curriculum writes in all grades for teachers to teach by using materials that are: concrete (real things - coins), pictoral (pictures) and symbolic (numbers). Real money and coins would be the concrete use of money; however teachers can use it as a modality for teaching, but is not mandatory. Plus 25 Grade 1s with real money in a classroom would be chaotic! Soooooooo...that leaves us, the parents, to teach about money if we want our children to have a real understanding of it. I have seen some children learn about money without using coins or bills, but others will have great difficulty as it is too abstract. There is no prediction of what child will understand money without coins and bills. So to ensure that all children can understand, then I recommend using coins and bills until there is an understanding of what money represents. Then, we can switch to the number talks without any visual support (Such as my tax video talk with Xavier walking in the store). The goal is to understand digital money with ease. The beauty of you being the parent, can decide when your child is ready for money talks without the coins and bills for support. This can take a few years' time. (My Interactive Writing Response 3, November 6, 2018)

The goal of my response to Anna was to outline the importance of the hands-on resources for her daughter to start learning about money in a conceptual way so that she could progress to being able to problem solve without any money in hand. This would then lead toward being able to

calculate money in our digital math world. The goal of referring to the video with my son calculating tax in his head with no visual support was to remind Anna that my son was able to do that because of all of the conceptual learning he did with coins and bills at a younger age. To point that out to Anna, and recognizing her accounting background and uncertainties, I felt that she could learn from extra information about the curriculum document to help her understand the importance of teaching coins.

Even though Anna was unsure about coins and the usage, she did try number talks with her child using actual coins and bills which included giving her daughter a wallet, discussing hot lunches, earning money from cleaning and paying her with coins. Anna even tried teaching her daughter how to compare prices between pairs of shoes, but found that it was too difficult for her. My hope was that Anna realized that comparing prices was too abstract and that she would need actual coins and money to practice with before her daughter would be able to successfully problem solve in her head. I was pleased with Anna for being brave and teaching her daughter about coins even though she wasn't sure about the usage in daily life.

Even though Anna was not sure about using actual money, she recognized the use of the actual thermometers and clocks. In her final email, she wrote:

> Working on clock has become her favourite thing now. The big confidence booster for her has been the use of little clock from the workshop along with worksheets that my wife was able to find online. Having a clock in hand certainly was a big help, same was the case with thermometer. Being slightly more patient has helped me understand her interest and temper my expectations.
>
> The temp talk was fairly straightforward; my daughter was able to understand some of the talk. Having something in your hand makes it a lot easier to understand…I have been working with her on the clock and a bit of money, the best opportunity I get to talk about money is during our shopping visits. Still find it hard to relate coins to cards or paying by phone. I feel this will be a long work in progress. (Interactive Writing 4, Anna, November 20, 2018)

Anna seemed to have an easier time with clock and temperature talks with her daughter and credited the use of the actual thermometer and clock. It appeared to me that she understood the importance of the hands-on resources for the clock and temperature talks, however she still mentioned the difficulty of relating coins to cards. This indicated to me that Anna found that the

thermometer was helpful for talks, but still questioned the use of the coins. Although, when she said that it "will be a long work in progress", she recognized that it would take time. I just hope that Anna will continue to use real coins to help her daughter understand money, just like she was comfortable using thermometers.

Due to Anna's uncertainties and frustrations along her journey, Anna's confidence in her own ability to teacher her daughter decreased. She wrote:

> My confidence has certainly taken a beating, six weeks back I was under the impression that with my background in accounting I will be able to breeze through these topics with my kid easily. Teaching her will take time and will certainly make me a more patient mom. This exercise has been a very good parenting lesson. (Interactive Writing 4, Anna, November 20, 2018)

I found Anna's comment fascinating since for most of my participants, their confidence increased. However for Anna, her confidence decreased due to the frustrations she felt when trying to teach her daughter. She did recognize and referred to it a few times that it would be a long process and that she needed to develop more patience.

Defining Moments of Change

Despite Anna's uncertainties and frustrations, there was a defining moment of change when Anna started to shift her mindset from feeling frustrated to thinking she could teach her daughter. During the interview, I asked Anna about the confidence comment that she had written about in the last email. Parts of the interview revealed how Anna felt when trying to teach her daughter as well as many realizations of having to become more patient. In the interview, Anna comments:

> ANNA: When I started...I have some math background…I think it should be easy to teach. So, the first class, it's going to be a tough one (Time workshop). But then, I went home, and I didn't do anything for the first couple of days. Then I started with her a little bit, so I think she got the hang of it. And then I think I started to push her a little bit. And then she kinda went down a little bit. And she kind of lost interest. I got frustrated and that's when I thought, oh okay. This is not the way it should be done. And this is not the way I'm…I knew that I wasn't doing it right. Then I started to think. Then I started to think what I'm doing wrong…what I am doing…what can I do… At that point I

> realized I can't push her anymore. It's not an adult doing this. It's a 7 year old. So, I had to back off. (Interview, Anna, December 17, 2018)

After the workshop, Anna had mixed feelings about teaching her daughter. She thought it would be tough, but she reassured herself that with her accounting background, that it should have been easy. In the moment of the first talk, she noticed that her daughter was getting it. However, it was when Anna started to push her daughter to learn more than what she was capable of, that started the decrease her own confidence. Anna noticed that her daughter lost interest, and in doing so, actually regressed her understanding about clock! The reality that her daughter lost interest and understood less about clock, made Anna frustrated. It was at that moment, that Anna began to change. She said to herself that she wasn't doing it right and she needed to figure out a better way. She realized that she was putting too much pressure on her daughter and so she backed off.

The realization that Anna was pressuring her daughter too much was a defining moment, but it would still take time for her to shift her mindset. Her experience after the money workshop was another key moment in her journey as she became frustrated again, but through that, she realized more about herself. In her interview, Anna continued to explain:

> ANNA: I think the reality for me was the next one. After the 2nd one. Which was the money workshop, yes. The class itself That class was a little hectic. So, I knew that it wasn't going to work straight away. I left it like that again for the next couple of days of money. And then I got a little frustrated trying to teach her frustrated with the pennies, dimes and nickels. I had to use videos, YouTube. She liked watching stuff more than anything. That's when I thought ok. It's not working the way I thought it would work, so I said well…let me just slow down…let her take her own time in doing it. Me with any background wouldn't help even with an accounting background or a PhD background wouldn't help this. It's her pace. It's her way of learning. It's not my way of teaching. It could be my way of teaching too, but I don't know. It's probably a combination of both. (Interview, Anna, December 17, 2018)

In the interview, Anna was describing another defining moment of change along her journey! Anna realized that she needed to slow down and watch for her daughter to be ready to learn the next step, rather than pushing her. She also learned that her frustrations were not helping her daughter to learn even though Anna herself had a strong mathematical background. She referred

to her daughter's learning at "her pace" and that Anna's strong mathematical background did not actually matter. In essence, Anna recognized that for her daughter to be successful, that she would have to teach her at her daughter's speed and in her own way of learning. To me, when Anna realized that she had to stop pressuring her and go at her daughter's pace was an epiphany of learning as this represented a shift from a fixed mindset to a growth mindset.

A part of Anna's last email showed the mindset shift where she recognized that she put pressure on her daughter. She explained that:

> I probably did pressurize her in the beginning forcing her to do things that she was not capable of at that time. But now I know she is capable of now. At least I think I know what she is capable of. Let's put it that way. At least I know that going one step at a time then going 5 steps at a time. That's the realization really. (Interactive Writing 4, Anna, November 20, 2018)

Anna described the importance of not advancing the concepts too quickly for her daughter so she could learn more easily. To me, Anna explained teaching step-by-step and keeping her daughter in the zone, so that she would learn easier. Anna learned that if she followed her own recommendations, that she would be able to avoid frustration and pressure.

Anna's Mindset Shift

Anna had realized a lot during her six-week journey. At the beginning, she started out thinking that teaching her daughter would be easy due to her strong mathematical background. However, Anna's journey included feeling frustrated, realizing her daughter's ability, understanding how to teach small steps at a time, knowing that the process will take a long time and becoming more patient. Some of Anna's final thoughts showed how she shifted to a growth mindset about how to teach her daughter. A few of Anna's final thoughts are the following:

> ANNA: I think as a whole journey, it's been good so far, from where I started from before the workshops to where she is now to where she was before the workshops. I think both of us have progressed, grown up, I would say. So that's definitely helpful. This exercise has been a very good parenting lesson along with my daughter learning some of the essential things needed in life…Thank you for being such a wonderful guide to us, all your talks were well thought out and engaging. Kudos to you. (Interview, Anna, December 17, 2018)

Anna indicated that she transformed during her journey especially when compared to before the workshops to after. In her words, she said that her and her daughter have both "progressed, grown up." I believe that Anna referred to her own learning about how to teach her daughter in a calm manner and at her own pace, instead of getting frustrated. Anna learned how to no longer pressure her daughter like she had before and they both felt more successful during number talks! Anna's plan was to continue with number talks as they had become a part of her lifestyle change.

It is important to note that even though Anna did not mention much about her culture and language, she did tell me that the number talks she did with her child were in Polish. This showed me that even if parents speak another language at home, they are able to learn from the workshops in English and transfer their understanding of number talks into their home language. This would inevitably help their children make meaning through their culture and be exposed to culturally relevant pedagogy.

For me as a researcher, Anna's mindset shift experience provided me with insight relevant to my research question. In Chapter 6, I will weave in Anna's experience into my thematic interpretation to answer my research question and objectives.

Narrative 2: Diego's Journey

Diego's Background

Diego was a father of two sons ages five and seven. Diego grew up in Italy where he spoke Italian as his first language. Diego attended a very traditional Italian school in Italy where marks from all subjects were posted for everyone to see. Diego was very strong in English, struggled in mathematics starting from Grade 6 all the way until high school where he had many negative experiences. He had poor mathematics results in school and became fearful of the subject because of his own memories. After he graduated high school, he took a few university courses, but did not pursue mathematics at that level. Shortly after, he found a job in Human Resources working for a local company. At that point, he met his wife, was married and had two sons. Diego and his wife moved to Manitoba two years ago when their sons were three and five years old.

Since moving to Canada, his children have learned English, but they speak Italian at home. Since Diego had no confidence in mathematics due to his many negative mathematical experiences, he chose not to teach his children mathematics or talk about numbers because he did

not want to transmit his own fears onto his two sons. Diego attended the workshops to see if he could learn some strategies about how to teach mathematics to his two sons.

Diego's journey was transformational. Before the workshops began, he had extremely low confidence in mathematics. During the very first workshop, Diego had a revelation within the first ten minutes that caused him to start transforming on his journey! From that moment on, he embraced number talks and was able to implement them daily and engage his sons and wife in number talks in both English and Italian! However, throughout his journey, Diego had written about some feelings of self-doubt and shame that we needed to work through together. By the end, he had overcome his fears of mathematics completely! For me, Diego's journey was so inspiring that I wanted to share his story!

Past Experiences and Fears

Diego had many negative memories about mathematics in school that made him fearful of the subject. He was so affected by the negative experiences, that he did not even try to guide and teach his children mathematics. Diego had written briefly about not doing well in school, so I asked him about it during the interview. Diego first explained that his negative mathematics experiences began in Grade 6. He told me that:

> DIEGO: Elementary I was good. I don't even have bad memories at all. It started when I was at 6th grade. That is where I failed in math. I didn't get the score that was expected. I was always below. My experience was finding always the maths very difficult at school. I always failed I think mainly for lack of motivation, good strategies to find it interesting and social myths of thinking it hard thing to get. (Interview, Diego, December 16, 2018)

Diego explained that after Grade 6, he failed mathematics because he didn't get the score that was expected. He then always found mathematics difficult because he was unmotivated, didn't have good strategies, didn't find it interesting and even mentioned the social myth of mathematics being hard to understand. To me, after Grade 6, Diego changed his opinion about mathematics and developed a fixed mindset about his ability because of his grades. When I asked him about that, he explained:

> DIEGO: I didn't get the score that was expected which would regularly be 6/10 in my country. So, if you didn't get 6.0, and you get 5.9, you will not be good. I was always below. I was always 4.9. In my country in general, if you don't pass, you fail. If you

> fail, you will have to do another extra exam but your other peers, mates your classmates will not get that. If they do good. Everyone will pass, except me. All my friends they will pass. In the end of the year, every year, I will have to do my extra exam to pass my maths. There was where my tutor came. My mom always contracted someone to come home and reinforce me in maths to help me pass the extra exam that I had to take. (Interview, Diego, December 16, 2018)

Since Diego had lower scores than what his country considered passing grades every year, along with his friends always doing well, he developed negative emotions towards mathematics and felt that he failed. This negative attitude towards mathematics translated into a fixed mindset that was still affecting him as an adult. He wrote to me before the first workshop that:

> Being honest, I am very resistant to maths. I avoid them every time I can and even get scared of having to face math too the rest of times. I say numbers are not my favourite thing in the world. (Interactive writing 1, Diego, October 8, 2018)

Diego had a resistance toward mathematics as well as a fear, both due to his perception of failing in high school. Since Diego had been so open and honest with me about his own experiences and fears, I felt like I needed to reassure him and thank him for his honesty. My first email response represented how I offered guidance, reassurance and encouragement. I wrote:

> Diego,
>
> Thank you so much for your honest email about your experiences and feelings about math. I hope that you can gain confidence with my workshops and realize that, yes you can teach your children, without transmitting your fears. I admire your bravery for coming to my workshops and willingness to learn to help your children.
>
> I look forward to working with you. (My Interactive Writing Response 1, October 10, 2018)

When writing this email to Diego, my hopes were for him to feel that I had listened to him while I offered my support and encouragement so that he could gain confidence throughout his journey. During my study, I had to repeat a few more emails similar to this one to continue Diego's growth toward transformation as self-doubt seemed to reappear in his interactive writing.

As an adult, this fixed mindset affected his ability to teach mathematics to his children as he was fearful of transmitting his own fears to his children. He was so fearful, that Diego never

talked about or worked with his two sons in mathematics. He wrote to me in the first interactive writing that:

> I didn't even face the fact…of even talking maths with my children. Because since I always failed, I don't consider it…it was hard for me because I was facing this barrier that I thought I had. I don't consider myself a good person in maths. I do zero math with my children. 🙈 I am confessing very poor at being resourceful with it. It's a matter I have never explored math with them. I am afraid to transmit my fears to them so I don't talk about it, I leave for them to learn from school. (Interactive writing 1, Diego, October 8, 2018)

Diego explained in his email that due to his feelings of failure in mathematics in high school, his feelings caused a barrier that prevented him from teaching his children anything to do about mathematics. He was afraid to transmit his fears to his children. I asked Diego to describe to me more about his fears in the interview. A section of our interview is included below:

> INTERVIEWER: So, would you say that your fear in not teaching your children is you didn't want them to go through the same thing as you. Or what is the fear specifically?
>
> DIEGO: Me teaching them wrong.
>
> INTERVIEWER: So…You teaching them wrong was your fear.
>
> DIEGO: So I am like that's my fear and probably that they see me…If they see that I am scared of spiders then, they would be scared of spiders and I don't want them to be scared.
>
> INTERVIEWER: So, you were cognizant of that.
>
> DIEGO: Like you recognize that you don't want to transmit your fear, so you have been hiding your fear of math, so you have not been talking to them about math, because you were trying to avoid talking to them about math. (Interview, Diego, December 16, 2018)

Diego explained his fear further that he was not only fearful of teaching them mathematics, but he was also fearful of teaching his children the wrong thing! He also clarified that he was afraid that if his children were going to see his fear of mathematics, then they may become fearful too. Diego used the spider example to help me understand what he meant. I believe that Diego, as a parent, realized that his sons looked up to him and he did not want them to be afraid of mathematics and go through difficulties just like he had. So, to deal with that fear, Diego avoided the subject of mathematics altogether.

To summarize, Diego's background and fears affected his ability to interact with his children regarding any mathematical concepts. He wanted to conquer his fears and that is why he applied to be a participant in this study. He was willing to learn, take risks and try something new and different. It paid off! His journey began during the very first workshop!

Defining Moments of Change

At first, I was not aware of the impact that the first workshop had on Diego. In his second email, he eluded that he was happy with what he learned and how simple the talks could be. He wrote:

> I was and am very happy to know now that it does not have to be difficult or too much elaborated, I had a bad preconception of the whole process. I am really happy to see how simple I could start with my children. (Interactive Writing 2, Diego, October 19)

Diego shared that he was anxious about the whole study, but learned during the Telling Time workshop that number talks could be simple. For Diego, I understood that the simplicity meant a lot to him since he had difficulty in high school mathematics. I wanted to know more about what happened during the first workshop to cause him to be happier about the study. So, I asked Diego during the interview about the first workshop specifically and if there were any defining moments of change for him. Below is a section of our interview:

> INTERVIEWER: What contributed to your change?
>
> DIEGO: It was with your first workshop. It was, and I am very happy to know now that it doesn't have to be difficult or too much elaborated.
>
> INTERVIEWER: Did that change happen when you were sitting in the workshop? Or was it after when you started doing practice talks.
>
> DIEGO: Totally with your workshops. When I was there. And you started showing us the step by step…You took me by the hand and told me little by little step by step what I was going to do with my children. Then you showed me. Then I saw, aha, there is easy things. Just as because we have been doing it with her with books. Since they were born…I am reading books to them. That is what I was used to and comfortable. They are reading perfect. They are flying now. Then I was like…Oh. That is what I should have done with math. If I would have known. It was a matter of reading things and showing. It's not complicated. I thought it was complicated because math is complicated.

INTERVIEWER: So, was it the videos that helped the most? Or the step by step written paper that you got.

DIEGO: Everything all together. Because 1st …those easy resources that we will have…and how easy it is to do it with your kid. And then you just mentioned. The first one was the talk.

INTERVIEWER: The number talk specifically?

DIEGO: Talk! Math! I'm not even talking. Imagine that. Then I am here in a workshop being told to talk at least. And just start like that. Then you show us what to do. And there are things that you can work in here. Then the resources you provide us. Then Talk. Counting numbers from 1-10, then 20 – to whatever. That is super easy. Show her the numbers. Don't expect anything from her. The time.

INTERVIEWER: Like the exposure. The Step 1 exposure for you. That was the big one for you.

DIEGO: The clock. Have her to look at the clock and say a number. How easy is that for me as the dad. Right. Of course. (exasperated.) I can do that. What number do you see here? 10. Yes. Amazing…Just that for me. It was like realizing…like the simplicity.

INTERVIEWER: Of the first steps, was specifically the change…So that first part of the workshop, I talked about what a number talk was. And then we took a break and met each other there. Then I started the step by step one and step 2? Do you think your change already started when I was explaining what a number talk was? Before I went into the step 1, step 2?

DIEGO: Yes.

INTERVIEWER: So, it was the explanation of the number talk that started making you change right away within the first 10 minutes.

DIEGO: Yes, Yes, Yes. All together. (Interview, Diego, December 16, 2018)

In this section of the interview, Diego revealed many factors that contributed to his change of mathematical attitudes including: the hands-on resources, the simplicity of the talks, the videos and the step-by-step guidelines. He referred to everything in the workshops that helped him including the talks with his children. I kept asking Diego questions to find out when exactly he started to notice a change in himself. It was at that point when he said that it was the concept of "talk".

I believe that Diego's defining moment of change had been when I explained what a number talk was within the first ten minutes of the workshop. It was at that moment, when Diego realized that he could talk about the digital clock numbers with his children and that he would be teaching them about mathematics. Diego was even able to relate this understanding to reading books to his children. If it had been easy for him to read to his children, then it should be easy for him to talk about numbers with them too. Diego's interview revealed how he started to change his negative mathematical perception and fixed mindset within the first ten minutes of the workshop when he realized that all he had to do was talk numbers. He was truly amazed.

Due to the multiple learning opportunities that Diego had during the first workshop, he started to open up to many new mathematical possibilities. After the second workshop about money, there seemed to be yet another breakthrough for Diego regarding his fears about mathematics. Through his writing, he described his new revelations about number talks, and how easy and simple the number talks were! His email shows many of his realizations:

> I am amazed with the different strategies we can find, remarking the prices in the supermarket, showing them coins and sorting them out, talking about money with them. I am very happy to see how easy I can approach my children with things that I thought were a pain or very difficult, my mental barrier did not let me think about the amazing strategies of starting by simply talking basics to them. I did not realize I did not need to be an expert in math to be able to start talking about math and introducing math to her. I am not fearful anymore and am even excited about going on introducing her into the world and into the math. I am of course also being aware that this is something that takes time, discipline and having to be consistent with your kid if you want them to succeed in the subject so I am aware I will need to keep practicing constantly. Again more than amazing seeing that my kid knows more than I even knew, was aware or expected. It is a blessing to face the fact that the difficulties were in my head. It's amazing to see her subtracting and adding and comparing numbers and deciding which is the highest and the lowest. (Interactive Writing 3, Diego, November 7, 2018)

When I read Diego's email, I was so grateful for his honesty of saying that he had a mental barrier and that he wasn't fearful anymore. I responded to his heartfelt email with my own strong reactions with:

> Thank you, Diego, for your very inspiring email. You brought tears to my eyes when I read it. My favorite parts of your email are when you say that you are not fearful anymore and that the difficulties were in your head. You recognize that you had a mental barrier and you are now excited and amazed at what you can do. It sounds like you have made a breakthrough and that you are very proud of yourself. (If you aren't, you should be.) You faced your fears and are overcoming them. (My Interactive Writing Response 3, November 10, 2018)

To me, Diego's email represented an additional change in mindset as he started to overcome his fears through breaking through his own mental barrier that had prevented him from teaching his children. My response to Diego showed my continual support and guidance all while recognizing the power of his transformation along this journey.

In the interview, I asked Diego about when specifically he changed his fears and he explained that it had been a process through number talks with his children. A part of the interview transcription stated that:

> INTERVIEWER: So now you aren't fearful anymore...Did you change the fear? Did you change your fear in the workshop or was it after when you were trying things with your children that started your fear to disappear?
>
> DIEGO: It has to be a process. I discovered. Oh My God. It is simple. I am going to do it. And then. What is really important that I discovered. When you go see your kids and seeing your kids and probably almost got it. Because it happened a couple of times. Ok. I'm going to lose my fear. I'm going to adventure myself and talk numbers with my kids. And then I come. And ask do you know time? Yes, it's 3:05. HUH???? She knows….Oh. She's smart…Numbers too [So proud and amazed]. Then It also conquers your heart as a dad…I didn't want to even explore that because I was afraid. (Interview, Diego, December 16, 2018)

Diego explained that it was through the actual number talks with his children that he started to conquer his fear. He had to overcome his fear and be adventurous to try a few talks, and when he did, he noticed his children learning through his own guidance during number talks. When he saw his children being successful during the talks, he was elated!

For me, Diego breaking through his mental barrier and overcoming his fears of teaching his children was key for him to continue to change on his journey. Diego was right when he said

that that his learning was a process. That makes sense to me because it was through multiple number talks with his children where he saw them becoming more confident in their learning, when he was able to become more courageous and realize that he could teach them.

Feeling Shame

Throughout the second and third workshops, Diego continued to learn and practice number talks with his children. Along with this new learning, he wrote that he had felt ashamed about not working with his children in mathematics before the workshops and about missing opportunities for number talks. When I read Diego's feelings of being ashamed on two occasions, I wanted to address his feelings to help him to understand that there is no need for shame.

To me, shame reiterated his fixed mindset in his ability to teach his children mathematics. Since he had so much growth, I wanted him to continue on his journey and conquer all of his negative mathematical perceptions. I responded to his second shame email with the following:

> I reread your money email from before and I know I already responded, but I just want to say that there is absolutely no shame on you whatsoever. (You mentioned it in 2 emails). I view it as you being courageous for being willing to learn, recognizing your mental barrier, breaking through and being brave enough to continue learning and experimenting with number talks! (My Interactive Writing Response 3, November 13, 2018)

Since Diego didn't reply back to that email, I asked him about his shame comments and missed opportunities during the interview. I said:

> INTERVIEWER: You had written a couple of times shame on me for not realizing that and then I responded to you.
>
> DIEGO: I remember that. (laughing)
>
> INTERVIEWER: Please don't be ashamed of yourself. Have you shifted?
>
> DIEGO: Totally. Yes.
>
> INTERVIEWER: Was that from my email?
>
> DIEGO: Totally. I will not say it again.
>
> INTERVIEWER: And when you say, I don't see opportunities and then after I think about, Oh I missed that one. Have you shifted that? Oh. I will get that one next time.

> Or do you still think, oh darn I missed that opportunity? Are you hard on yourself is my question? Still?
>
> DIEGO: No. not anymore.
>
> INTERVIEWER: And is that because of my responses?
>
> DIEGO: Totally.
>
> INTERVIEWER: Don't be hard on yourself because they come all the time.
>
> DIEGO: That part of the process was totally yours. Totally yours. It's the thing that you completely saw. I didn't. I was even laughing when I was reading your responses. Like. Don't say any more shame on me. I don't want you to say it again. Yes. She's right.
>
> INTERVIEWER: So, you are now forgiving yourself if an opportunity passes you by.
>
> DIEGO: And I think that I don't have any more shame. I am not afraid anymore. I am exploring. I am not blaming myself for not finding the opportunities anymore. And I am in the process of making it natural. (Interview, Diego, December 16, 2018)

From the interview, it appeared to me that Diego did not even realize that he wrote to me about be being ashamed. I believe that since he had such negative views about mathematics since Grade 6, that any negative thought that came into his mind, he had not even recognized. After hearing Diego's responses about not being ashamed anymore and not feeling bad about missed opportunities, I was glad that he was able to learn from my responses. After I brought it to his attention, he had not said it again. This indicated to me that he had adopted more of a growth mindset in terms of shifting his attitudes about mathematics. I am happy that I brought it to his attention and that it was part of his transformation.

Developing a Growth Mindset

Diego's profound transformational journey was about overcoming his own fears about mathematics through the workshops and number talks with his children. Once he let go of his fears and the shame and developed a growth mindset about his ability to teach his children, then he found success with his children. Diego recognized that his journey was still continuing, but he knew what he had accomplished. He wrote in his final email that:

> I totally understood the principle of foundations. As my kids learn the bases but solid bases [foundational experiences] they will be able to learn better as the concepts get more specialized. Not to talk about their confidence and their knowing. All they need is to start looking for information and investigate and get to be expert later in life in whatever

> they propose to be or to know. I think we still need more time to keep practicing and now I know that it will come. I will be forever grateful of having to be able to face my fear, insecurity and ignorance about the subjects and overcoming them by knowing for sure we are making it, I saw the possibilities, I learnt it was more simple than I thought, I learnt it is a matter of practice, discipline, passion and love at wanting to do it, it was about identifying tools and about discovering that I am able to do it. Identifying that I certainly can help my kids exposing them to math I understood it was not about being expert in math, it was about showing them the basis of something they could find interesting to do, as every science with self-awareness and curiosity. I learnt that they are smart at math, I learnt they even knew already more than I even imagined and that was moving and touching to see, how can we help them develop more abilities and skills in different fields by simply showing them and talking to them. (Interactive Writing 4, Diego, November 21, 2018)

To me, when Diego wrote "foundations and solid bases", he was referring to foundational experiences and the need for them to learn more complicated mathematical concepts. Also, Diego recognized that he was still on a journey, but that he faced his fears and overcame them.

Diego's learning about multiple aspects helped him to conquer his fears and develop a growth mindset about teaching his children mathematics. Some of the key aspects to Diego's learning that he mentioned were: the simplicity of the talks, the process, the tools (resources), realizing that he could teach his children, learning how to teach his children and realizing that his children were able to learn all through the basics of number talks! Diego's journey was phenomenal and transformational. My final email response to him summarized my thoughts and feelings about his journey. I wrote:

> As for your learning journey, it has been incredible and I have learned so much from you already. Thank you for sharing your innermost thoughts and feelings. It is very courageous of you to do. You should be very proud of yourself with how far you have come and how far you will go and how far you will guide your children in life. As you told me to keep doing what I am doing, I am going to tell you the same thing. Keep doing what you're doing and you and your children will continue to both gain confidence, self-assurance and the ability to do whatever you want in life. Diego, you can live the life you

> have always dreamed of living too, especially now that you have newfound confidence! (My Interactive Writing Response 4, November 23, 2018)

The goal of my email was for Diego to know that his journey helped me immensely to understand how he changed to be able to teach his children. Diego overcame his fears, found new confidence, and developed an ability to teach his children mathematics. In doing so, it helped him to shift his fixed mindset of negative attitudes towards mathematics to more of a growth mindset where he felt he could guide his children successfully.

In terms of culture, Diego briefly talked about his country when he mentioned his mathematics experiences. He also revealed that he and his wife were implementing the number talks mostly in Italian and sometimes in English as well. This would allow for his children to be immersed in the Italian language and learn about any cultural significant differences for the concepts of time, money and temperature. Similarly to Anna, this would allow Diego's children to also make meaning through their culture and culturally relevant pedagogy.

It would be an incredible opportunity to meet Diego again to see how his journey continued. However, to keep within the limitations of research, I can only imagine how monumental the changes went. I wish Diego the best of luck in the future and I thank him for sharing his journey with me. I hope that as his children grow older, Diego will continue to remain positive about his ability to guide his children in number talks.

For me as a researcher, Diego's journey through his defining moments of change and overcoming his feelings of shame have allowed me to address the research questions and objectives. Throughout Chapter 6, I will refer to a few of Diego's experiences while relating them directly to the research question and objectives.

Narrative 3: Lily's Journey

Lily's Background

Lily was born in rural Manitoba, and is currently a mother of four children, three sons and one daughter, ranging in school age from Grade 2 to Grade 8. During her school days, Lily did okay in mathematics up until Grade 8 where she had many difficulties in school. Her confidence went down in high school and she still struggles with it today. Lily's parents and one older brother also struggled in mathematics, so she could not ask for any help from home. Lily's mother worked evenings, so she often did not see her when she needed to complete her homework. In high school, Lily was on her own to figure out school.

When Lily graduated from high school, she decided to become a correctional officer for the Manitoba justice system. She prided herself in working with people and chose a career where she would not have to do intensive mathematics while on the job. After having four children, Lily realized that her lack of confidence in mathematics from high school affected her ability to help her children. In her house, Lily would do mathematics homework with her children, but would not talk about numbers or mathematics at all. When her older children needed help in mathematics, she relived her math anxiety from the past and struggled in knowing how to help them. She was worried for her four children in mathematics as she felt like she could not help them especially as they were nearing Grade 9 as that is when she struggled herself. She attended the workshops to learn about different strategies.

Overall, Lily underwent some major changes on her journey from feeling unconfident due to her negative feelings about mathematics to venturing out of her comfort zone and trying number talks with her children. She had a significant moment of change during her first number talk which was followed by her noticing the zone of her children and being brave enough to try different talks. Lily changed significantly on her journey even though she would still need ongoing guidance. Overall, Lily had developed a more positive attitude towards mathematics which transformed into more of a mathematical mindset. (Dweck, 2016)

Lily's Experiences and Fears

Before the workshops began, Lily shared her high school experiences in mathematics where she started struggled when she was in Grade 9. Since, I wanted to know more about her difficulties, I asked her during the interview to explain more about her experiences and confidence level in mathematics. Part of our interview is below where she explained her experiences, lack of confidence and negative feelings about mathematics. She stated:

> LILY: Well I know that I felt that I was good in math. Additions and multiplications. I didn't struggle with that. Once I got to Grade 9, I felt that math was more involved and more intricate. The Formulas. That kind of stuff. That's where I struggled. I went from being a very strong student in math, to just barely passing Grade 9 math. Confidence shot. Then I went to general math after that.
>
> INTERVIEWER: So, you said your confidence was shot. Explain that. Were you scared of math? Like what?

> LILY: Honestly, I felt stupid. When I understood addition, multiplication…I felt very confident anything with formulas anything more involved…terrible. After Grade 8, I lost all confidence that I was any good at math. (Interview, Lily, December 18, 2018)

This part of the interview demonstrated that Lily lost all of her confidence as soon as mathematics became more intricate and the result was her feeling stupid. After Grade 9, she switched to a more generalized mathematics course, but that Grade 9 year affected her confidence immensely.

The Grade 9 negative experience translated into Lily's lack of confidence with her children when they needed help. She wrote to me "I am not confident when I try to help my 11 or 13 year old with their math. I have no problems with simple calculations but second guess myself when the questions get a little more complicated" (Interactive Writing 1, October 7, 2018). To me, Lily's negative experiences in Grade 9 affected her ability to help her children in mathematics. So, I asked her if she was scared or worried about her children being on the same path as her and Lily replied with:

> Absolutely. Yeah… I have trouble helping her (older child) already…I am thinking once they get to high school…how am I going to help?...She is good right now in math…but my fears is like where I was…I was still strong at that point and then as I got…as I say in Grade 9, I felt that it fell apart. My fear is with the same with her. (Interview, Lily, December 18, 2018)

Lily referred to her eldest daughter who is currently in Grade 8 and how she fears that she will have a negative mathematical experience in Grade 9 just as she had. Because of her fears, Lily attended my workshops and hoped that she could "develop some strategies to assist me with figuring out some math problems in instances when I don't know what to do" (Interactive Writing 1, October 7, 2018). To me, Lily was seeking help and was willing to learn, so I was confident that she would embrace number talks.

My hope for Lily was that she would "gain some confidence through the workshops and know that yes, you can help your kids and enjoy it. I am also hoping that you will be able to transfer what you learn to your older children" (Interactive Writing 1, October 7, 2018). With my email to Lily, I was trying to show her that I had listened to her nervousness about her older children and reassure her that I would teach strategies that would help her older children too.

Lily Begins to Change

Throughout the interactive writing, I noticed that Lily had embraced the learning of number talks from the very beginning and the positive experiences with her children had contributed to many small changes. In her final email, she wrote that the talks were more natural and her confidence level had increased. I wanted to know in the interview if there was a key defining moment for her and if the first workshop and experience with number talks about clock was where the change started. I included a part of our interview below:

> INTERVIEWER: Ok. So, what is contributing to that change? You mentioned, fun, natural, I find it easier. The more talks I had, the less she complained. It's not weird anymore. So, what contributed to that? Was there a key defining moment?
>
> LILY: I don't know if there was a key moment. Just a repetition. But the first couple (number talks) were like a chore. They were saying "I don't want to" or she wouldn't understand why (we had to talk about clock). Honestly, I never spoke about math. If she had homework, we would do the homework together, but I would never bring it up. But now after the first couple of times bringing it up, whether it was the money thing, or the time, now it's natural. I brought up (number talks) multiple times now and it's easy for me to bring it up. She understands why I am talking about it.
>
> INTERVIEWER: Ok. Ok. So, would you say that was part of that change? Or the workshops specifically?
>
> LILY: Yep.
>
> INTERVIEWER: And then the trying of the talks to see the change?
>
> LILY: Yes.
>
> INTERVIEWER: Or like a balance between both that helped to start the change?
>
> LILY: Well definitely a balance right. If it wasn't for the workshops, I never would have even brought up any of the talks.
>
> INTERVIEWER: Right.
>
> LILY: But definitely a balance for sure.
>
> INTERVIEWER: Because you were probably afraid to start those talks?
>
> LILY: I didn't even know how to. Like how do you even initially talk about math to your kids unless it is specific homework?

> INTERVIEWER: So, describe that first talk? Were you nervous? Was your heart beating? How did you leave the first workshop? I am not sure what to do still? Or was it, Oh. I am going to try that talk…
>
> LILY: Actually…it was pretty easy. Because it was the fact that I had the clock in my hands. It was actually, when I came home, she saw the clock and she was like, what is that? She didn't know what it was. It was easy to go right into. Right that same night, I did a couple of talks, like what time is it? She took pretty quick to it. 5 minutes. It was really quick. She understood it pretty quick.
>
> INTERVIEWER: So, your confidence boosted up right after the first one?
>
> LILY: Cause she had interest right away.
>
> INTERVIEWER: So yeah. It was the interest in the resource that helped the first talk. (Interview, Lily, December 18, 2018)

Lily explained in the interview that the change was a process for her and there were combined factors at play. She stated right away that repetition had helped her build more confidence as her children were hesitant to participate in the number talks. As she kept up with the talks, her children became more involved and the talks became more natural. For me, the fact that Lily understood that repetition was important, showed me that she had listened in the workshops. I had explained that children won't learn with just one talk, that the talks have to be repeated in different ways many, many times. Lily understood this.

I also noticed that when I asked for other factors that caused change, that she had difficulty articulating them, but when I asked her about the workshops, trying the talks and the balance, she said yes to them all. She definitely attributed these things to the changes in her own confidence, but could not articulate them without being prompted in the interview. I believe that the defining moment of change for Lily was the very first number talk. She eluded to the fact that she did not know how to start the first number talk, but with the actual clock, the resource, it occurred naturally.

Once Lily realized that her daughter had interest in the clock talks, it increased Lily's confidence. Again, she did not articulate this exactly, but confirmed it with me during the interview when I asked her directly about the number talk about telling time that boosted her confidence. I could also tell through her second email that she was pleasantly surprised after the first talk. She wrote:

> I thought it went very well. My daughter thought it was fun and was attentive for about 3-4 minutes before we had to take a break. We took a couple days off before we went back to the analog clock/minute hand. Once she got it, she liked telling me what time it was when I moved the hands. (Interactive Writing 2, Lily, October 16, 2018)

Lily's email showed that she understood how to complete a number talk with her daughter about telling time. Lily did not push her to understand, rather she allowed the learning to come naturally at her child's own pace. She even took a few days break before going back to the clock. I believe that the first number talk helped Lily realize that she could guide her children in number talks thus building both her and children's confidence. After the first talk, Lily's journey continued with a few other key learning moments.

Lily Noticing the Zone

Another key moment on Lily's journey was noticing when her children were ready for number talks. This was in relation to the teaching of the zone during my workshops. The following section of our interview outlined how Lily was able to notice if her children were ready to learn during a number talk. I asked:

> INTERVIEWER: …How do you know when to start, when to stop? What's your timing?
>
> LILY: Definitely, I could tell if Max is in a good mood, cause right away…if he just woke up…forget it. Or if he is tired…forget it. I think the best time, is right after a meal, lunch or supper…right before he settles down to play a game or watch tv. That is the ideal time for him. But pretty quickly within a minute…if he is going to…
>
> INTERVIEWER: So, you are reading his body language and what he is saying?
>
> LILY: Yes, body language…what he is saying for sure…Max is very obvious and very verbal too. He will have a big sigh and you know…he will basically tell you he doesn't want to.
>
> INTERVIEWER: His facial expressions too?
>
> LILY: Yes, his facial expressions too. (Interview, Lily, December 18, 2018)

In essence, Lily understood how to discover the best time for number talks and teachable moments with her children by reading their body language, facial expressions, mood and level of fatigue. Lily had not mentioned her learning about the zone in the workshop and if it contributed to her knowing when to start or stop a number talk. However, I could tell Lily learned about the

zone as she described exactly how to notice if her youngest son was ready for a talk. This learning was crucial for Lily as she had never spoken about numbers before in her house. If she wanted to keep the experiences positive for her children, she had to be able to notice when they were in the zone.

Lily's Number Talks

To continue on Lily's journey after the first workshop, I was interested to find out if the second and third workshops about money and temperature were going to have the same impact as the first one. After receiving her emails, I realized that Lily's examples of number talks that she tried, showed me that she was really understanding how to implement the talks with her children. Below are a few examples of her talks:

> We went to the store with my daughter's allowance ($5.00) and got her to select three different items at 3 different prices that were under $5.00. I then got her to think about change and how much she should expect back from the cashier. I also got her to make up her $5.00 allowance in as many different combinations as possible. She seemed to enjoy the concept of money more than time (wonder why) so it kept her attention longer. She started to really get the hang of what $5.00 could get her. Figuring out the change was tougher but she is starting to be able to 'ballpark' it pretty good. Ex: cost $3.15, she knew she would get back more than a dollar.
>
> Yes, we did several temperature talks. I started my daughter on my phone looking at the different temperatures around the world. She used the play thermometer to then show me the temperature. We also used the real one and placed in the freezer and watched as it rose. (Interactive Writing 4, Lily, November 23, 2018)

The number talks that Lily tried demonstrated that she used the interests of her daughter as well as real-life experiences such as allowance and time to springboard her talks. This was an important learning step for Lily as she engaged her children in a way that kept their attention.

In Lily's last interactive writing, she reflected about all the number talks and explained to me that:

> We continue to do clock and money examples almost on a daily basis. We use the clock to ask my daughter what time is practice or how long it is until it starts, how many more minutes until bed, etc…Getting up in the morning…how many minutes until the bus comes that type of thing. For me, we do that every day. Especially when I am working

> cause I get up and I make sure they get to the bus. It is so easy to do. The money talks seem to happen more often using her allowance money. She is always trying to buy treats so we get her to try and figure out how much she needs to buy it. The time and temperature talks seem to be easier for my daughter - money a little tougher so I can see us working more on that in the future...expanding maybe about wages, bills, taxes etc... (Interactive Writing 4, Lily, November 23, 2018)

In Lily's last interactive email, she was able to reflect about the three concepts and knew that money was more challenging to learn for her daughter. Her number talk examples showed me that she really understood how to do them as she used real-life examples and the interests of her children. Learning how to do number talks, was an important step for Lily in her journey as she could see how to integrate them easily into everyday life especially talks about allowance and time.

Lily Requires Further Guidance

An important thing to note is that even though Lily had changed throughout the workshop experience, the interview demonstrated that she would benefit from more guidance. Throughout the interview, I found myself offering suggestions to Lily on how to enrich the number talks that she was already doing and Lily was very receptive to my suggestions. Below are some parts of the interview that show how I guided Lily about the concepts of time and money. Lily seemed to have a good grasp about the problem solving number talks regarding temperature and that part of the interview is included as well:

> Time:
>
> INTERVIEWER: Do you have the clock somewhere around? Like the analog one?
>
> LILY: We have a clock upstairs, but it doesn't show the minutes. It's kinda got the hours. So, we've brought it out a couple of times.
>
> INTERVIEWER: So. It would be good to just have it in your living room somewhere, so you can say, what time is it? So, you can keep practicing.
>
> LILY: I never thought about that.
>
> INTERVIEWER: Even prop it up in front of a plant or picture or something, so they can practice those minutes.
>
> LILY: That's a good idea.

Money:

INTERVIEWER: I like your email about she now knows about 3.15 and ballpark she will get more than 1 dollar. Can she count out the coins in different amounts?

LILY: Well quarters she's good. I would say, dimes and nickels she still struggles with. The toonies and loonies she is fine. The quarters, the 10 cents and 5 cents she needs work on. She usually feels pretty good. She will ask for something. We will send her to the canteen to see what she wants and how much it is. She will come and say, "If it costs 2 dollars and I have 5 dollars, how much would I have left?"

INTERVIEWER: When you pay him 5 dollars, could you pay him in a different way? Instead of paying him the $5 bill, you can say, how do you want to get paid today? Ok, so you can get loonies, or just quarters, dimes or nickels, because that will pull out the dimes or nickels learning. "Ok. You can get paid in only dimes or nickels today. Ok let's count them out."

LILY: That's a good idea actually.

INTERVIEWER: Like a little pocket or something or Ziploc bag. And that's what increases their understanding and value of something, especially if they have to count it out. If they are buying something, if they only have dimes and quarters, if they want it, they have to count it.

LILY: That's a good one.

Temperature:

INTERVIEWER: What about your temperature talks and problem solving specifically. If it is 5 degrees today and it drops 10 degrees, what temperature would it be? Are you doing those talks?

LILY: Um. Well you know what. Maybe not specifically those…but like we ask every morning and if today is minus 5, you know my daughter asked if she needed the neck warmer. And I said what do you think? It's -5. And then she said that she thinks she will be okay. Great yeah. Perfect. Last week, we had a cold day. It was -25. She asked do I need my neck warmer and she heard -25 and right away she wanted it.

INTERVIEWER: So that's awesome! So just add a few more questions like what would happen if it were 10 degrees colder. What temperature would that be?

> LILY: Ok. For minus 5, it was 10 degrees colder or warmer.
>
> INTERVIEWER: Yes. Cause then you are passing the zero and they have to say it's plus 5. Well why? Because it's plus 5 to make zero and then another plus 5 to make 5 degrees. Cause we want to go into the later steps in all those topics is the problem solving.
>
> LILY: Right. We did do one similar to that. And it was actually right around the freezing marks. We had a conversation. Do you know what temperature is when water starts to freeze? If it is 10 degrees warmer what would it be. So, it would be plus 10.
>
> INTERVIEWER: Great.
>
> LILY: So, we started from 0 and we did a little bit with that.
>
> INTERVIEWER: So, you are doing this already.
>
> LILY: But we can expand.
>
> INTERVIEWER: There is always a next step, but that's fantastic. (Interview, Lily, December 18, 2018)

These parts of the interview showed how Lily was open to suggestions on how to help her children learn. With temperature talks, it appeared that Lily had learned how to extend her daughter's learning into problem solving. On the other hand, for money and telling time, without my guidance, she may not have thought about how to develop and lead her daughter to problem solve during number talks. To me, this suggested that a few parents may need ongoing guidance to continue their journey to enhance their children's understanding in the future.

Shifting Mindset

Even though Lily seemed to need further guidance, she had transitioned for the better and had shifted her mindset. In essence, Lily's interactive writing emails and interview reiterated how she felt after the workshops were complete. I included some of Lily's final thoughts as she referred to her own attitudes about the workshops and number talks. Her thoughts were:

> I find it easier and more natural to talk to my kids about math…It's no longer a weird conversation or topic to bring up. They know, and they understand why I am asking because of the workshops. But it's not a job for them anymore. They definitely see it as more fun and more enjoyable. So, we have transitioned to these talks…The more we've had these talks the less they have complained. As they started to understand it more they

> got more confident and wanted to do it more. (Interactive Writing 4, Lily, November 23, 2018)

Lily explained that the number talks became more natural and part of their family life especially since her children were having fun and gained confidence too! For, me when children become more confident, they feel success, thus they want to continue to do what makes them feel good. For Lily's children, the number talks were what made them feel good. Another comment Lily wrote was:

> I'll be honest with you. My attention span when it comes to math is minimal. I honestly engaged all through the talks (workshops). I thought they were entertaining that you used your own family and your own kids allowed me to try to relate to your kids. I honestly wouldn't change a thing. It kept my interest the whole way through. The concepts were obviously very basic for us to understand to bring home. I thought it was really good. Sarah. I really did. I did. I've always had a negative perception of math but my outlook has definitely changed. I'm not so fearful about it. I honestly thought it was beneficial and it was fun. Thanks! (Interactive Writing 4, Lily, November 23, 2018)

Lily described the learning through the workshops as being beneficial. She was surprised that she was able to stay engaged in the learning, but she did. What helped her learn, she explained, was me talking about my own children and showing the videos during the workshops.

Thanks to the workshops, Lily found that her outlook about mathematics had changed and she was not afraid of it anymore. To me, this showed that her attitudes regarding mathematics had changed and that her mindset had shifted from being fearful to embracing the learning for number talks to be more natural in her everyday life.

Overall, I am pleased with Lily's journey, but she will need more support as her children grow older and mathematics become more difficult in school. During her journey, Lily went from being worried about mathematics, to facing a fear, to trying the number talks to being more natural and spontaneous. Lily still had fears, but her fears were not as strong as they were before the workshops. She said that her confidence about teaching mathematics before the workshops increased but only for her younger child. It appeared that she was still concerned for when her children learned mathematics in high school as that was where her own negative experiences began. I wonder where Lily's journey will take her in the future, and I hope for the best as it will remain unknown.

In terms of my research, Lily has helped me to address my research questions and objectives in Chapter 6. The fact that Lily had shifted her mindset, but still required ongoing guidance, has allowed me to see themes in her journey as well as possibilities for the future.

Narrative 4: Eric's Journey

Eric's Background

Eric was born and raised in Winnipeg and became a teacher despite his negative experiences in mathematics when he was in school. When Eric was nine years old, he recalled missing two weeks of school due to an illness, and then he was never able to catch up in mathematics after that. He continued to struggle in mathematics, and when Eric was in high school, one teacher even called him stupid. Eric thought that he would not be able to go to university, but he persevered and graduated from education and taught in a few different schools in Winnipeg.

Throughout the years, Eric had several teaching opportunities. However, he was afraid to teach mathematics. To cope with his fear, he would learn the mathematics he was supposed to teach to the students a few days before the lessons. He would make sure that his lessons were very structured and would never leave his lesson plan due to his very low confidence. Eric would not teach in any different way as he was afraid of teaching anything wrong. He refrained from being spontaneous and the result was that Eric had a fixed mindset about teaching mathematics.

A few years after teaching, Eric had three children ages five, seven and nine including one child with learning difficulties. At home, with his children, Eric found that he did very little in mathematics with them due to his low confidence caused by his previous experiences. When he saw my workshops offered, he wanted to participate to help his children to become more confident in mathematics through learning new ideas. He wanted to provide them with different opportunities unlike the ones he had when he was younger and possibly change his mindset.

Throughout his journey, from the very first workshop, Eric embraced learning and constructed an alternate path of teaching mathematics to both his students and his children. He had been afraid to impose his own negative experiences on his students and children. Through the workshops, he became open to new possibilities and he found them! Eric went from being fearful of teaching mathematics to embracing the newfound strategies. His mindset changed with a number of factors at play including the workshops and experiencing number talks. When

he started trying number talks, he saw an increase in confidence and potential in himself, his students and his children.

Shifting Mindsets

Eric's emails and interview explained that after the very first workshop, he began to change his mindset. His emails were filled with examples of him and his children when they interacted positively and learned together. After the very first workshop, Eric wrote that:

> I was very inspired by your story because I also had some existential angst in university that was cured by travelling. I learned that I am not the only person intimidated by the M [math] word. When we were working through the steps I realized that though I like to be very planned out with my lessons at work that the moments I enjoy most at home with my kids are the spontaneous learning we do that feels like a new discovery for them. (Interactive Writing 2, Eric, October 20, 2018)

With Eric's newfound inspiration, he tried clock number talks and his children were engaged, motivated and excited to learn. Eric's wife watched him interact with his children when he came home from the workshop the first night. She was so impressed that she wanted to try number talks with her children too and tried the talks the very next day! Number talks soon became part of the family culture.

It appeared to me that Eric had developed a new mindset about mathematics after the very first workshop and embraced the new learning whole-heartedly. When I asked Eric when the changes started to occur, he reiterated that it in fact was after the first workshop. Below is a part of our interview that described what happened after the first workshop that night. I asked:

> INTERVIEWER: So, was there a specific defining AHA moment where you said, "Oh my gosh. Now I can do it." Where your confidence just flew up?
>
> ERIC: When I went home (after the workshop), and I did the time talk, that night…Because I saw how quickly they could pick it up…It's so nice to just be able to look at your real world….and go, oh, there's a clock there, what's that number? What's that number? And that was so easy. You don't have to go buy a whole bunch of stuff. You use the real world stuff around you. So that was when…I was like this is awesome. You know. And then the next day, I went to try it with my kids at school (laughing)…. cause I was like this worked!!! And I was amazed that really…some of them could get it. And it made me rethink what their capabilities are because sometimes we have in our

> head…oh, well they aren't going to get that. We don't allow them access to that…which is not really fair…as an educator we should learn as much as they can.
>
> INTERVIEWER: So, Yeah. Ok. And then so would you say the workshop got you motivated. Then you tried it at night with your kids, you were more motivated, and then you tried it at school, with success. (Interview, Eric, December 19, 2018)

It appeared that as soon as Eric tried the time talks with his children and realized they worked, he opened his eyes to an alternate mathematical mindset than he had previously. He was so excited about the possibilities that he tried it at school and once again shifted his mindset. When Eric said, "It made me rethink what their capabilities are because sometimes we have in our head…oh, well they aren't going to get that," he was defining his fixed mindset about teaching mathematics. When he stated right after "we don't allow them access to that…which is not really fair…as an educator we should learn as much as they can," he was explaining how he opened his eyes to more of a growth mindset way of thinking and was redesigning how he looked at mathematics. In essence, Eric had described a key defining moment of his learning.

Additionally, there were other factors that contributed to his changes throughout the six-week process. Another part of our interview is below:

> INTERVIEWER: Were there other moments along the way…did you think it was like a steady increase?
>
> ERIC: Yes. It was definitely a steady increase. And then…with the next workshop…Right, um, with money and that was really cool too because I got to pull in like it was just very motivational for the kids. They responded so positively to it. Right. But I was like ok, this is great. You know.
>
> INTERVIEWER: You said, "I've had growth in my own confidence. I feel like I'm not going to teach them the wrong thing." Can you explain a little bit more about that?
>
> ERIC: …So, I think that, that taking that fear and that anxiety away of like saying I'm going to say or do the wrong thing…it can help.
>
> INTERVIEWER: So, what helped you take the fear away? What specifically was it?
>
> ERIC: I think just your attitude towards us as a group…like the fact that you did those icebreakers…whatever, you built a little bit of trust there…and just the factor that I felt that I could ask you any question…you know what I mean? I think that that made a big difference for me.

INTERVIEWER: What about trying the talks with your kids, and seeing the results, was that also a contributing factor?

ERIC: Yes, definitely.

INTERVIEWER: Ok. Resources? That would be another one?

ERIC: Yes, those were great. Yeah, the money was really good for them. They loved the money. And the clocks. They really liked them.

INTERVIEWER: Would you say the front matter before we did the icebreakers, like the zone, the number talk, that that information was also key? Or was that another factor?

ERIC: Yes. The explanation. For sure. Yes. I think so for myself too, because even though I know a lot of that stuff from university, it was good review for me…and I think for non-educators, that's important for those people, because they probably have never heard of some of those concepts. Like,

INTERVIEWER: And the way I explained it, was simple enough? I think everyone kinda understood it.

ERIC: Yes. People totally got that. And you know that, even when you are talking about your children about anything. Like, it's time to go to bed. You know. They are not in the comfort zone.

INTERVIEWER: Exactly. And then the brain information, you felt that helpful too?

ERIC: I love brain information. Anything I can get. Because of the work that I do. I know, to me, it's really helpful to know what some of my students are going through, and also understand what their strengths and their deficits might be. You know what I mean. I thought that was…a little bit of science in there too…just to…you know… help us out a bit.

INTERVIEWER: Like research based.

ERIC: Yeah. Exactly. (Interview, Eric, December 19, 2018)

What I was asking Eric to do was to reflect on what caused his learning. He was able to name the night after the first workshop after he tried the first talks with his children, the way his children responded positively after trying the money talks, the motivation that the children had, the real-life resources he used and the easiness of the talks. Eric also mentioned that the fear and anxiety he had about teaching his children the wrong thing went away in part due to my attitude, building trust through the icebreaker activities and welcoming any questions. I also asked Eric

about more specific aspects of the workshops to see if they helped his learning too. When I asked Eric about trying the talks, the resources, the zone, the number talks, neuroplasticity and the simple guidelines, he told me that all of it helped him to change and reduce his fear of talking about numbers to his children. Other factors that Eric mentioned in the interview that helped him were:

> The videos, the different resources, the videos and the little worksheet, was really, really good… and I think just your enthusiasm for math, your love of it, you can tell, and your story, and just being able to relate to that…is really important. And I think too, sharing those, I appreciated you sharing your stories that weren't always a success. Right? (Interactive Writing 2, Eric, October 20, 2018)

Eric appreciated the videos and the step-by-step guidelines that I showed and provided during the workshop. He also referred to the non-successful number talk videos that I showed of my children and me and how helpful they were to him. Many participants told me that it was great to see that if a child is not engaged in a talk, such as my five year old son during the thermometer talk, that it was completely ok. The talk was not wasted, as it was still exposing him to vocabulary.

It appeared to me that the change for Eric occurred during the whole experience and that there was not one factor that caused the changes. The beginning of the transformation was during the first workshop followed by the first number talks with his children. This led to Eric noticing his children becoming more engaged and confident in mathematics, which was another motivating factor for Eric.

Finding the Zone is Easy

Through Eric's learning in the workshops as well as his teaching background, Eric knew instinctively how do to number talks, knew how to break down the steps and look for the opportunities. He also identified that the perfect time for number talks is before bed, but that he also knew when the time was right to start a talk and when to end a talk. He said that he did not:

> ERIC: Feel the pressure to do it all at once… Like just do 1 step at a time, do it really well. And get them into it. And you don't always do it in that order too. Sometimes you go there. And then, they want to go there, so you go with them. Right. And you are like ok, yeah.
>
> INTERVIEWER: Ok. And then what do you look for in an opportunity.

> ERIC: Just, just um, a little bit from them, like if they are willing to talk about something, like that zone stuff.
>
> INTERVIEWER: So how would you know if they're willing?
>
> ERIC: Because if they are asking questions or if they are looking at something, like, like a situation pops up and then I'll be, oh, ok. So, let's talk about this now…You know, I think a lot of it is because that we do a lot of activities during the week, so by the time they come home, they are tired. But I find that we're kind of doing it right in that zone before bedtime. Because they are calming down, so we had been doing it right before. And then if they got to stay up a little bit, that was a motivator. Right. Oh, yeah!!! We get to stay up!! And then, so that's when we did it. It was just easier. And then of course when they got too tired, of course, that's when we would stop. So, if they were getting like too silly, or they weren't interested, oh they were like…ohhhhh (kids complaining), then I'm like nope! Time for bed. Good job today. We're all done. (Interview, Eric, December 19, 2018)

What Eric described was teaching his children through number talks during teachable moments. For example, when his children asked questions, he kept his children in the zone during the talks. He was also very aware of when to stop the talk such as when his children were tired or silly. It was easy for Eric to recognize the zone due to his teaching experience. However, he said that the zone teaching was helpful for him to review and would definitely be helpful for parents who were non-teachers. I appreciated Eric's opinion about the zone teaching during the workshops. He reiterated for me, that the zone of proximal development teaching was essential for parents to be able to notice when their children were ready for learning.

Teaching a Child with Learning Difficulties

One of Eric's daughters in Grade 2 has learning difficulties. Through the workshop and number talk experience, Eric saw a change in his daughter. He noticed that his daughter's self-esteem and confidence improved through number talks. Eric wrote in his third email that:

> I enjoyed the workshop. I liked the affirmation that repetition of these concepts can take a long time, especially for younger folks. My little girl has been having a difficult time in school and this has given us time to be together, which is really good for her self-esteem. (Interactive Writing 3, Eric, November 6, 2018)

I was pleased with Eric's email that there seemed to be such positive interaction between him and his daughter. I responded to Eric's email by saying:

> My favorite part of your email is when you said your little girl is having a difficult time in school and you are spending more time with her which is good for her self-esteem. You have basically outlined the purpose of my research. It is to help kids feel better, more confident and start to enjoy math!
>
> Keep up the great work!
>
> Sarah (My Interactive Writing Response 3, November 7, 2018)

I wanted to reiterate to Eric that the time together with his daughter was to help her build more confidence and was special for both parent and child. During the interview, I asked more about his daughter with learning difficulties. The interview showed that Eric understood his daughter's needs, her struggles at school as well as Eric's appreciation of number talks. He explained:

> ERIC: But the thing I like about this…the number talks is that for me, like, like, I've always found, like the teachers are always saying… oh, she does this at school, oh, she does this and that and I'm like, you know. I'm sorry we don't see it at home. You know? And the reason is, is that, we have time, and patience…To sit with them, and she needs that. Like on the lap, hugging,
>
> INTERVIEWER: Closeness.
>
> ERIC: Let's read this story together, let's do this…let's play this math game together, let's do something fun. You know. And she really needs that buy in too. And that's what I like about it (number talks) with her is that it's not really like doing work. It's like having fun with mom and dad. You know. Like my wife actually did some of it with us too.
>
> INTERVIEWER: Oh good.
>
> ERIC: Yeah. So, it was really good, in that way. It [number talks] was really easy for both of us to do. It was really easy for us to sit and it provided what she needed it to work which is that security and just us being there one on one. And I think a big issue with her and her learning is that with a lot of time at school…she just gives up.
>
> INTERVIEWER: So, are you noticing her improve since number talks?
>
> ERIC: Yes. Yep. Definitely.
>
> INTERVIEWER: In terms of numbers?

> ERIC: Numbers, and language. Just talking about learning has made a big difference for her. Cause she's, even just sitting with the family and sitting down with the family. We've been playing math games too with cards and she really likes that. And all my kids actually, since we started doing number talks, have identified math as their favorite subject.
>
> INTERVIEWER: Ok. So. For your daughter's self-esteem, is that just because the cuddling and what you were describing?
>
> ERIC: Yes. Well I think too, just, just for her to feel like she could be successful at something, because she was having a really hard time. And she hated school. So, the whole transition has been constant, but I think also, just having the support and knowing that she could do that, she can do these number talks and feel good about it…You never know what kind of teacher you're going to get, and unfortunately, it's very dependent of that. As I know from my experience. Self-esteem is affected by your teacher and they are sometimes the main, important factor in that learning of that concept. (Interview, Eric, December 19, 2018)

Eric explained that the close relationship that he had with his wife and children during number talks actually improved all of his children's love for mathematics. The physical and close interaction of Eric and his daughter with learning needs such as sitting on Eric's lap and cuddling while doing number talks and playing games, was integral for her to learn mathematics and enjoy it! Eric also credited number talks for improving his daughter's self-esteem and feelings of being successful especially since she had hated school before. I could tell that Eric really understood his daughter's feelings as he himself went through it when he was younger.

Eric's story with his daughter with learning disabilities was another inspirational moment for me. When I started my research, I never would have imagined that it could have made such an impact on learning for a child with learning disabilities. Eric's story gave me hope that my workshops could possibly help other parents with children with learning disabilities too.

Newfound Confidence

Throughout the journey, Eric transformed which resulted in an increase in confidence not only for himself but also for his children as well. To see how much of a transformation in mathematics they had, during the interview, I asked Eric to rate their confidence in mathematics from before the workshops to afterwards. For himself, Eric rated his own confidence to teach his

children mathematics before the workshops was at a five and after, he rated himself as a ten. He explained his confidence in an email as "I have seen growth in my confidence. I feel like I am not going to teach them the wrong thing. I am also much more excited by numbers" (Interactive Writing 4, Eric, November 30, 2018). Eric explained that his confidence in mathematics was from knowing how to teach his children the right way.

In terms of rating his own children's confidence in mathematics, Eric gave two of his children a seven in math confidence before the workshops and it went to a ten after! As for Eric's daughter with learning difficulties, Eric rated her from a three for confidence in mathematics before to a ten afterwards. What a transformation! Eric explained that for his children, mathematics is:

> ERIC: Their favorite. I couldn't even believe it. I was talking to…their teachers, and I said…math was their favorite subject, and they go, well it's not their strongest subject. I'm like, it doesn't matter. They love it. (Interview, Eric, December 19, 2018).

Even though Eric's children's teachers did not feel like mathematics was their strongest subject, it did not matter. The number talks in their home translated into newfound confidence in mathematics for every member in the house. To me, it seemed like the change in confidence for Eric and his children was yet another factor for shifting from a fixed mindset to a growth mindset. From what I saw in school was that if children have confidence, positive attitudes and a growth mindset in mathematics, then together they are the keys to success.

Foundational Experiences

Eric embraced the workshops and learning that he did about foundational experiences throughout his journey and found a new outlook about mathematics. It was evident that the number talks were providing a solid foundation for his children. Eric's last email discussed a few examples of the foundational experiences that he did with his children regarding the three topics of time, money and temperature. He wrote that:

> We played with the "therbopeters" as my five-year-old called them. They were very excited. I also showed them the real thermometers. We looked at the weather app and compared our temperature here in the city to what it was at the lake, it was a two degree difference. We also compared it to what it was in Houston, which was a 30 degree difference, and Australia. They decided that it might be nice to visit Australia this winter…I was able to find a book that had a clock in it. It has a bunch of different times

> in it so I used the two clocks to have them guess the different times. They were able to guess to the hour, which is a step in the right direction…We have also been consistently giving them allowance for the chores they have been doing. They are investing it heavily in the slime market. (Interactive Writing 4, Eric, November 30, 2018).

Eric demonstrated that he had really been guiding and integrating the three topics into the number talks with his children at home and they seemed really engaged. The talks about going to Australia during a winter in Manitoba were motivating for his children because they referred to the cold here and compared it to the warmth there. The fun in the talk was imagining being in a hot place during a cold Manitoba winter.

Another thing that Eric did was to motivate his children to earn money, so they could buy slime, the item they were interested in. Through his children's interests, Eric realized that the topics of time, money and temperature were essential to their learning. He commented by saying that:

> ERIC: The thing that I like about the three subjects you picked, is cause those are real life situations that we need to know. And that's why it's important to my kids because in real-life, they could be really taken advantage of if they don't know those concepts. (Interview, Eric, December 19, 2018).

Eric appreciated the three topics as he could relate to them being a part of his own life. He had a certain comfort level with all three topics and told me that he understood the steps and how to break them down to teach them to his children. To me, Eric described the three concepts as key to foundational learning since he was referring to real life situations. He viewed the topics as essential to learning so that his children would not be taken advantage of in life.

Eric's final thoughts about his learning were that "I believe the number talks have made a big difference. They gave us a focus each week and with dice and card games that provide fun family time while helping with learning math concepts" (Interactive Writing 3, Eric, November 6, 2018). Eric demonstrated his ease with number talks and his willingness to extend mathematics teaching to his children with games and other activities. Eric's intent was to continue number talks with the concepts of time, money and temperature.

Eric's journey was inspirational as he embraced his learning throughout the workshop sequence and replaced his fears with new confidence. He not only transformed by discovering a whole new way of teaching and learning to help his children at home, but he also became a better

teacher and saw teaching opportunities that he had never seen before. Eric, his children and his students became more confident and excited about mathematics! I hope that Eric can continue to transfer his knowledge as the concepts become more difficult not only for his children, but also for his students!

For me, Eric's realizations through teaching his students and children have helped me to interpret themes in Chapter 6 to answer my research questions and objectives. His journey through teaching his own child with learning disabilities could mean that other children with learning disabilities could benefit from parent number talks as well. I will discuss this more in Chapter 6.

Finding Inspiration

Anna, Diego, Lily and Eric's stories of bravery, courage, determination and willingness to reach outside of their comfort zone paid off and they were all able to shift their thinking and develop new mindsets about mathematics. I have interpreted the four narrative stories along with the data from my other participants, and have noticed common themes. In chapter six, my themes and sub-themes have answered my research question and addressed my objectives.

Chapter 6: The Parent Experience

My research led me to study and understand my parent participants and the journeys they have been on through number talks with their children. When I analyzed my data, the themes became apparent and have led me to address my research question and objectives. My original research question and objectives were:

When parents engage in number talks, what are the aspects of their experience that they consider to have contributed to their children's development of mathematical problem solving and number sense?

The objectives of this research are:

1. To determine how parent participants learn to support their children's mathematics growth through participation in workshops.
2. To determine what factors affect parents as learners (with regard to noticing opportunities, engaging learners, attitudes, and use of problem solving) while leading their children during number talks.
3. To develop recommendations about how to support and guide parents to help their children develop number sense.

In this chapter, I will discuss the first objective of my research of how parents learn. I will then describe the three themes that will answer the research question and address the second objective of my research. At the end of this chapter, for the third objective, I will provide future recommendations for parents and teachers.

First Objective

The first objective of my research was to determine how parents learn to support their children's growth in mathematics through participation in workshops. What I have determined is that all my participants were on their own unique journey and how they learned was a combination of many factors. Each parent's individual journey was dependent of their own past experiences, feelings and attitudes toward mathematics, and they were influenced by their children's thoughts toward mathematics as well. Even though each participant's journey was different, there were common aspects and factors that affected learning which I will explain when I address the research question and second objective.

Research Question and Second Objective

I was interested in determining the aspects of parents' experiences that they consider to have contributed to their children's development of mathematical problem solving and number sense. What occurred during my interviews was that a few participants were able to identify some aspects, but as I prompted them with more possibilities, they agreed with anything I suggested. For example, Diego told me that it was all aspects together that helped him. Eric said yes to all the factors I mentioned. This led me to believe that the aspects for parents was a combination of many things that they may or may not have been able to identify. Thus, instead of writing the themes that the parents considered to have contributed to their children's development, I determined the aspects of parents' experiences myself through reading, analyzing, and interpreting my research data.

To directly answer the research question, three main themes represented the aspects of parents' experiences emerged : (1) developing a growth mindset through building parent confidence, (2) foundational experiences, and (3) the relationship that parents developed with me. The second objective was to determine what factors affect parents as learners (with regard to noticing opportunities, engaging learners, attitudes, and use of problem solving) while leading their children during number talks. What occurred to me was that each theme could be divided into different factors that affected parents as learners that directly related to the main themes. Below is an outline of the three main themes and the sub-themes.

1. Developing a Growth Mindset Through Building Confidence
    - Fixed mindsets
    - Learning through workshops
    - Learning to do number talks
    - The role of child confidence
    - Defining moments of change
    - Overcoming fears
    - Change is a process
2. Foundational Experiences
    - Actual number talks
    - Parents noticing the zone
    - Resources
    - Step-by-step guidelines

3. Relationship With Me
    - Learning through my journey
    - Videos
    - Icebreakers
    - Interactive writing
    - Interviews

The next three sections of this chapter each present a different aspect of the parents' experiences, as themes that directly address the main research question. As well, each factor listed above under each theme is developed.

Theme 1: Developing a Growth Mindset Through Building Confidence

Many of my participants' journeys led to the development of a growth mindset where they became confident in guiding their children in number talks. A few parents already had a growth mindset before the workshops began and found new strategies that they could implement at home. However, for most parents, even if they had positive or negative experiences in mathematics before the workshops began, they had to shift their thinking from a fixed mindset to a growth mindset. For a growth mindset to occur, parents needed to build their confidence which led to the first aspect of parents' experience that appeared as I read through my data. It became apparent, after the workshops, emails and interviews that there were a few key factors that helped parents build confidence, develop a growth mindset and overcome their past experiences so they could begin to teach their children about time, money and temperature. The factors were: fixed mindsets, learning through workshops, learning to do number talks, the role of child confidence, defining moments of change, overcoming fears and realizing that change was a process

Fixed mindsets. The first factor for parents to develop a growth mindset and build confidence was starting to shift fixed mindsets. I noticed it in the first email before I started my workshops that negative attitudes, memories and fears as well as a fixed mindset were what my participants were facing when it came to teach their children mathematics. For my participants to be able to help their children in mathematics, they had to overcome their negative memories and start to shift their mindset in order to build confidence. My responses to many parents with

negative attitudes towards mathematics was to encourage them and thank them for their courage to challenge their negative perceptions.

For parents who had positive attitudes about mathematics, they also went through a journey as they learned new skills about how to teach and guide their children. For example, even after the first workshop, a few parents who had positive attitudes during the first email developed a fixed mindset about teaching their children about how to tell time and that it took too long or that it was difficult. One example is during Anna's story where she had confidence before the workshops began and realized that teaching her daughter was very difficult. She had to learn that she had to guide her daughter at her own pace. Another example from a participant named Minnie, who had positive attitudes, thought that because her children did not understand how to tell time quickly, it reflected on her ability to teach. I had to reassure her that learning takes time and that it was not her fault.

For all parents, whether they had negative or positive attitudes or previous negative experiences in mathematics, their first step in building confidence was to start to shift their fixed mindsets so they could learn how.

Learning through workshops. The second factor of the development of a growth mindset and building parent confidence was learning through the workshops. During the workshops, I taught about number talks, zone of proximal development, neuroplasticity, step-by-step learning, mathematics gaps in older children as well as the links to the curriculum. I also explained each step of how to teach time, money and temperature and supported the steps with videos of number talks with my own children as well as step-by-step guidelines. Many participants referred to one or more of the aspects that I taught to demonstrate their learning. A few examples include: Lily mentioning the zone, Abigail discussing the videos, Anna realizing the importance of teaching one step at a time, and Eric explaining that the workshops and teaching were part of many factors that helped in his transformation.

In addition, I also discovered that talking about the gaps in mathematics that I see in older children's learning was crucial for many parents as they mentioned this idea in their second email to me. As well, other participants explained what they learned after the Money Talks! workshop which clearly helped them to see new possibilities for guiding their children. It was evident that parents learning through the workshops was definitely essential to building confidence and developing a growth mindset.

Learning to do number talks. Another key factor that helped parents build confidence was the realization that number talks could be easy. Many parents left the workshops excited to start number talks with their children right away as they realized that the talks were simple! After they tried number talks with their children, they reiterated that talking numbers while interacting with their children was actually easy! A few participants such as Anna did not find the number talks as easy at the beginning, but they became easier and more natural for her by the end. Once parents had practiced the talks numerous times and saw their children learn, they gained confidence and for many, their fixed mindsets started to shift.

The role of child confidence. Another factor of parents building their own confidence was when they were able to teach their children successfully and noticed them becoming more confident because they understood the concepts easily. For example, when Diego noticed his children becoming more confident, he then became more confident himself. Another participant named Abigail talked about her children becoming more confident too. Eric explained that it was through number talks and the close, positive physical interaction with his daughter that helped her to increase her confidence and actually learned to love mathematics. When my participants saw their children becoming more confident through learning with number talks because of how they guided them, this inevitably led to an increase of parents' confidence as well and helped towards developing a growth mindset!

Defining moments of change. For parents to build confidence and develop a growth mindset, another factor seemed to be during key moments of change. Many defining moments occurred when participants began to change their perspectives about mathematics and started working with their children differently. It did not seem to matter whether parents had negative or positive experiences, all of them experienced new realizations and revelations. One participant named Leigh specifically told me that she was going to take her children to the store more often! Other parents with older children realized that money talks didn't have to be stressful and could actually be fun and simple! A defining moment for Abigail was when she realized that her own attitudes about money could affect her children's perceptions about money too.

Diego, Anna, Lily and Eric, the interview participants, described their defining moments during the interviews when I asked specifically what helped them change during their journey. Diego's defining moment occurred in the first ten minutes of the first workshop whereas Anna's

moment was when she realized that her child's learning had to be at her own pace. Lily's moment occurred during the first number talk and Eric described his moment as the whole experience especially the first workshop and the first number talk. When the participants had key moments of change that they could describe in detail, I realized that they were building confidence and shifting their mindset!

Overcoming fears. Another factor of building parents' confidence and shifting to a growth mindset was overcoming fears. Many participants overcame their own fears and negative experiences in mathematics and replaced them with newfound confidence due to the workshop and number talk experiences with their children. Ted wrote to me that he even feared and panicked when he had to do mathematics in the workplace, but through the workshops, he became more confident and his children had an increase in their self-esteem as well! Through their interviews, Diego, Lily, Anna and Eric all overcame their fears as well. Lily explained at the end of her journey that she certainly had changed her negative perceptions of mathematics and that number talks became natural and very easy for her to do. Eric overcame his past experiences and told me that he was very confident in teaching his children mathematics. Anna talked about removing the pressure off herself and realized that the number talks had to be at her daughter's pace. Lastly, Diego overcame his past experiences and saw the transformation in himself and became more confident too. Many of my participants increased their confidence and overcame their fears, but a few participants like Lily, would still need continual guidance in the future especially as their children grew older.

Change is a process. The final factor of developing a growth mindset theme is that parents realized that the change in themselves and their children regarding mathematics was a process. During their journey, parents tried multiple number talks about the same concept and noticed their children's understanding increase!

There were many examples where parents recognized that change took a long time. For example, Minnie realized that it was going to take a lot of time for her daughter to understand how to tell time on a clock. As well, Eric, even though he was a teacher, appreciated the affirmation that learning the concepts was going to take a long time. For Anna, I had to explain to her that telling time on the clock was going to take up to a year to help her lower the expectations on herself. I know that my explanation helped as Anna realized herself that the money number talks were part of a long process. The examples demonstrated that parents really

understood that the number talks were meant to occur on a daily basis for an extended period of time.

For a growth mindset to develop through number talks with their children, parents needed to realize that change takes time and that many number talks about the same concept are essential to children's understanding. This is supported by neuroplasticity and that repetition with understanding is necessary for learning. In addition, all of my participants expressed their intentions to continue number talks in the future which indicated that that they knew that change was a process. Nancy summarized this understanding about change being a process by saying that number talks have become part of her family culture. Parents developing a growth mindset through building confidence was the first essential aspect that contributed to the change in parents, so they could guide their children in number talks and lead them towards problem solving. For parents to have shifted their mindset about their own capability, there were seven contributing factors that were essential pats of their journey: fixed mindsets, learning through workshops, learning to do number talks, the role of child confidence, defining moments of change, overcoming fears and realizing that change is a process.

Theme 2: Foundational Experiences

The second main theme and aspect of parents' experiences that contributed to their children's development was foundational experiences both through informal and formal activities. As described in Chapter 2, foundational experiences during number talks allow for parents and children to interact positively in an informal way without focusing on the arithmetic (Mason & Erickson, 2015). The actual number talk experiences, parents noticing if their children were ready for the talks, the hands-on resources and the step-by-step guidelines were all factors of the experiential learning of number talks for parents. One mother described the foundational experiences of number talks as the building blocks to help children increase their confidence in mathematics.

Actual number talk experiences. One of the key factors of parents learning through foundational experiences was the actual trying of number talks while interacting positively with their children. The workshops helped parents to know what number talks were and why they were important, but without trying number talks with their children, parents would not have changed during their journeys. For example, Abigail used her analog clock very well to teach her children about screen time and commercials. Another example is when Lily had a revelation

during her very first number talk with her child and realized how important it was for her daughter's confidence. Diego discussed many examples of number talks in the supermarket and how they opened his eyes to the many possibilities of teaching mathematics. As well, Eric explained how the number talks helped changed everyone's confidence including his, his children's and his students'. Eric also mentioned that the number talk interactions with his daughter had a positive impact on her self-esteem. It was clear in the data that number talks were part of the change in parents. However, there were other factors that contributed to the number talks that helped parents expand their learning further.

Parents noticing the zone. Another factor of the theme of foundational experiences is how parents noticed when their children were ready for a number talk, in other words, when they were in the zone of proximal development. During the first workshop, I explained to parents about the zone of proximal development and how to teach children a concept that is not too easy or too difficult. Most parents understood the concept of the zone. For example, Abigail talked about noticing when there were natural learning opportunities and kept her talks positive and short to prevent any negative feelings about mathematics. As well, Lily showed that she grasped an excellent understanding of the zone as she described how to tell if her daughter was in a good mood for a number talk. Furthermore, Eric explained that he knew when to stop number talks with his children and it was usually when they were tired. It was evident that parents understood the concept of the zone as they knew when to start and stop to keep the discussions positive. Anna, on the other hand, had to learn throughout her journey not to put pressure on her daughter as it prevented her from learning. As soon as Anna came to that realization, she understood the zone and that learning was at her daughter's own speed. The zone was a very crucial concept that I taught for parents to understand how to notice when their children were ready for learning and when to stop when their children had enough.

Hands-on resources. Another aspect that seemed to be vital for children to learn through foundational experiences and number talks was the hands-on resources that I provided such as the actual clocks, coins and thermometers. I knew during my first workshop how crucial they were as parents responded very positively to them and the interactive writing indicated their usefulness as well.

At the beginning of their writing, many parents wrote to me saying that after leaving my workshops, that they were not sure how to start the number talks and how to teach their children

the steps. However, their nervousness about the first few number talks disappeared due to the curiosity of their children asking about what the resources were! The first number talks about time, money and temperature occurred when children simply asked their parents "What is that?"

Most of the parents wrote positively to me about using the hands-on resources. For example, many explained how they used the hands-on resources when they tried number talks with their children especially the clocks. One example that Lily told me about in our interview is when her child asked what the clock was and the number talk happened naturally. More specifically, Abigail found hands-on resources so useful that she decided to use plants as a resource to teach about temperature and humidity! On the other hand, Anna questioned the use of the actual coins as a resource since we live in a digital world. I had to reassure her that the coins would help her daughter progress conceptually and with more practice, she would be able to problem solve without the use of the resources. Even though Anna questioned the use of coins, she embraced the use of the thermometers and clocks and mentioned that the temperature talks were "fairly straight forward" as there was something in her daughter's hand. It was clear that due to the foundational hands-on resources, the informal number talks occurred in a natural way and children were more engaged in the talks.

Step-by-step guidelines. Another factor of the foundational experiences theme was the step-by-step guidelines that I provided during the workshops. To model most steps, we watched number talk videos of me and my own children interacting positively during the talks while I guided them towards the next step. My goal was to provide direct guidance to parents so that they could scaffold for their children during the talks and advance them to the next step. The result was that when parents tried the informal number talks at home, they were able to lead their children to more formal, intentional mathematical discussions with the help of the guidelines.

There were many parents who referred to the importance of the steps in their writing. For example, Suzanne talked about how excited she was to have clear guidelines and Eric's email demonstrated that he understood the steps to teach his children. On the other hand, a few parents like Anna, found the step-by-step teaching more difficult, but learned by the end of the workshops, when to advance her daughter to the next step. It was apparent that the step-by-step guidelines were necessary for parents. What I discovered through interactive writing was that once parents attended the workshops, most parents seemed to be able to guide their children through number talks intuitively. Many parents learned the steps in the workshops so well, that

they did not refer to the handouts very much after the workshops. One mother did find the handout helpful and even posted in on her bulletin board to refer to. Nevertheless, I was happy that I provided the handout so parents could refer to the steps in the future.

It was clear during my study that foundational experiences was a key aspect of what parents considered to have contributed to their children's development. The factors that influenced the experiences for parents varied. However, through practicing number talks, noticing their children ready for the talks, the hands-on resources and the step-by-step guidelines, parents were able to help guide their children to understand the concepts of time, temperature and money. The theme of foundational experiences can be summarized by what Diego wrote to me in an email. He stated that "I totally understood the principle of foundations. As my kid learns the solid bases [foundational experiences], she will be able to learn better as the concepts get more specialized" (Interactive Writing 4, Diego, November 21, 2018). What Diego explained was that number talks provided a strong foundation to his daughter which allowed her to learn more difficult concepts later.

Theme 3: Relationship with Me

The third main theme and aspect of the parents' experience that was crucial for them to change was the relationship that they had developed with me. If I were to ask my participants to attend all three workshops, try number talks with their children and write me four emails, then I had to create a welcoming, trusting atmosphere during the very first workshop and continue the relationship through emails. I felt like I succeeded!

Throughout the process, I listened to my participants through their emails and adapted my workshops and teaching as necessary to help them continue on their journey. I realized the value of our relationship after the third and final workshop and how easy it was to plan and present the Experiencing Temperature workshop. That workshop was the most fun as we had already established our relationship and were able to interact with each other easily. Through teaching about my own journey, showing videos of my family, the structure of the workshops, my reassuring and guiding emails as well as the continued support during interviews, my participants felt reassured and supported through a trusting relationship with me.

Learning through my journey. The first factor of the relationship with me was parents learning through my own journey during the workshops. During my first workshop, I shared information about my family and my journey. Some of that information included; my teaching

experiences around the world, my experiences with my own children, as well as my passion for teaching children with difficulties in mathematics.

One story I told the participants was where I lacked confidence in physics and how that is where my journey in mathematics ended. It was at that point when I tried to blame my professor for my lack of understanding in his class. By sharing my personal story, it helped the participants relax and begin to trust me. I knew that my story was an important factor of building the relationship with me as after the first workshop, a few parents told me that they could relate to that experience. Another example of relating to me was when Abigail shared that when I talked about my own children, it helped her understand how to teach to her own children. Once the participants felt like they could relate to me, they relaxed. Thus, learning through my journey in the first workshop, helped them to become active learners right from the very beginning.

Videos. Another factor that contributed to developing the relationship with me was the videos that I showed during the workshops. Together, we watched actual number talk videos of my children and me in real-life situations modeling steps of telling time, money and temperature. I filmed the videos of my own children when number talk opportunities occurred naturally. The variety of videos represented real-life situations where my children were frustrated, uninterested, grumpy, interrupted by siblings, and sometimes learning.

I showed many different videos to parents, however there were two videos that really helped them. By showing the video of my five year old son where he was uninterested in the thermometer, many parents said that it was extremely helpful to relieve pressure off of themselves and to know that number talks don't have to be perfect! Another video I showed of my seven year old daughter, demonstrated that I was pushing her too far out of the zone where she did not know the concept and then she became frustrated. This video was essential for parents to really understand the zone and when children become frustrated, it is not the time to continue a number talk. Many parents appreciated the two videos because they could relate to the experiences.

Through the videos, parents realized that if number talks do not go well, then there is always another chance the next day. By sharing the reality of my own life through the imperfection of number talks, parents were able to relax, take risks and try the talks with their children.

Icebreaker activities. Another factor that I felt was essential for me to build the relationship and trust between my participants was the icebreaker activities that I organized during each workshop. For each workshop, after I welcomed my participants and taught key concepts, I organized an icebreaker activity to allow them to get to know one another as well as have a chance to feel comfortable with me. The second icebreaker activity was where all parents stood in a circle and one by one, they said their name with an adjective and an action and everyone else had to repeat to help us all remember who we were. Many parents told me after the workshops that they really enjoyed the icebreaker activities. For example, Eric directly referred to the icebreaker activities in the workshops as being helpful as they started to build trust with me. In addition, I referred to the icebreakers in my own reflective journal as one of the best parts of my workshops. I realized that they were essential for the participants to have fun, interact with the group, and get to know me better.

Interactive writing and interviews. The last factor of how I built trust with my participants and developed our relationship was how I responded to them in the interactive writing and interviews. For a few parents, I answered questions and provided links to articles to read if they had questions. For others, I provided continual encouragement and reassurance and commented on their bravery and courage throughout the process especially at the beginning.

There were many examples where my responses in the helped to further develop a relationship with the participants. For example, many parents were overwhelmed after the Money Talks! workshop and I wrote back to them to show that I had listened and reassured them that they were still on the right track with their number talks. As well, during many emails to my participants throughout their journeys, I showed my continual guidance and reassurance where I encouraged them to continue their learning. For example, I reassured Anna that teaching clocks was going to take up to a year and encouraged her to continue to be patient. Through the interactive writing, I was able to support all parents on their journeys and respond to them individually to meet each one of their needs.

For Anna, Diego, Lily and Eric, the four interview participants, our trusting relationship had already developed during the workshops and interactive writing. The interviews allowed me to continue to offer encouragement and reassurance. In one interview, I provided ongoing guidance to Lily where I offered her ideas to promote her children's thinking about problem solving especially regarding the concepts of time and money. Lily demonstrated that she

improved her confidence in guiding her children through the workshops, but still required additional suggestions to help continue her children's problem-solving ability. The interviews allowed the participants and I to develop our relationship even further. I was also able to learn more about their experiences and continue to guide and reassure them based on what they were telling me. Most importantly, the interviews provided me an opportunity to continue to learn from their journeys, all in thanks to the relationship that we had already built.

The relationship with me was the third aspect of my participants' experience and it was essential for the participants to feel safe enough to share their thoughts and experiences with me and to trust that I would guide them to help them on their journeys. The factors of the relationship that affected parents as learners were: learning through my journey, videos, icebreaker activities and interactive writing and interviews. I had many participants thanking me for helping them and that they appreciated my passion for mathematics. One example is when Anna wrote "thank you for being such a wonderful guide to us, all your talks were well thought out and engaging" (Interactive Writing 4, Anna, November 20, 2018). I felt that the relationship that I developed with my participants was exactly what I had intended on doing and was at the core of all of our learning together!

Third Objective

Through my own research journey, I transformed. Since my goal was to help as many parents, teachers and children in mathematics as possible, I plan to continue presenting my workshops. The third objective of my research was to develop recommendations about how to support and guide parents to help their children develop number sense. I have developed two main recommendations.

1. I recommend parents to start a number talk journey
2. I recommend for me to continue to help and guide parents and teachers while working alongside teachers.

Starting a Journey

My first recommendation is for parents to start a number talk journey. Since all of my participants responded positively to the workshops, implemented the number talks easily with their children, and saw a positive change in their children, I believe that every parent could benefit from this learning. Thus, I am recommending parents take workshops when they are offered and start on a number talk journey. This content is for any parents who are:

a) Wanting to learn how to work with their child in mathematics.
b) Willing to be brave and courageous to possibly face their own fears and negative memories.
c) Willing to attend workshops and learn.
d) Willing to spend time interacting positively with their child during number talks.
e) Seeking and accepting feedback and guidance to continue on their journey.
f) Transferring their understanding to other mathematical concepts.

If parents embark on a number talk journey, my hope for them is to face their fears, embrace the learning and create a positive impact for their family.

In addition, my research suggested that there may be a possibility of helping parents with children with learning disabilities. For Eric, he found that number talks helped his child with learning disabilities to become more confident and embrace mathematics in a positive way!

Also, my research suggested that number talks could work for people who speak another language at home. For example, two of the families were able to transfer their learning into their own language and help their children learn, effectively introducing culturally relevant pedagogy. Thus, my workshops could possibly help many parents and children from any cultural background and language.

To summarize, I would welcome a chance to continue teaching my workshops so parents could start on a number talk journey. It is important to note that if I do continue to teach workshops, my research has indicated that some parents may need ongoing guidance especially as their children grow older. However, if I had the chance, then I could develop other workshops to help parents with older children as well.

Reaching a Bigger Audience

My second recommendation is for me to continue to help and guide parents and teachers while working alongside teachers in Manitoba. Through my study, my participants have led me to believe that other parents and teachers would be interested in attending my workshops. One example is when I spoke with Leona, a teacher, and she told me that she could see my workshops and step-by-step guidelines being a part of school programming. She suggested that for children who are behind in mathematics, that the school could help guide parents with what to do at home to help their children learn foundational concepts. I realized at that point and at many other

times during my research, that I could help a larger community including parents, teachers and most importantly the students. Dahlia summarized her thinking about what I taught and how it could develop in the future.

> You know I think you rock Sarah! In so many ways, educator, mom, pioneer, key note speaker / presenter. Thank you for your profound contribution you've made to move math off the taboo list and for the tools to move away from melt downs and ill feelings because I didn't know how to help / reach my son in those struggles. (Interactive Writing 4, Dahlia, November 21, 2018)

Dahlia touched my heart as she was able to encompass my passion in her words. I do see myself as an "educator, mom, pioneer, key note speaker and presenter" and I will continue to strive to make a difference. My drive originated from the anxious, frustrated children that I would see while teaching and to know that Dahlia's journey through number talks helped her son to overcome his struggles has made my research worth it! I am excited about the possibilities in the future.

My research has led me to study parents and their experiences through number talks with their children. Through the interpretation of my data, I learned how to support parents, determined the factors that affect learners and developed recommendations to continue supporting not only parents, but teachers as well. I have presented my research a few times, and I have received positive feedback from many people. I have had many parents and teachers ask me to come and present to the teachers in their schools as well as to their parent communities. Others have asked when my next workshops are so they can refer them to their friends. As well, a few people who had family in other countries, wanted to send the video links to them to try. The positive feedback has led me to realize the need for my research and how many parents want help in guiding their children in math. Since my life goal is to help as many children, parents and teachers as I can, I plan to continue presenting number talk workshops in Winnipeg and Manitoba. My hope is that I can make an even bigger impact in the future for parents, teachers, and most of all children.

Synopsis

In this chapter, I have presented answers to the research question and three objectives. To summarize, the first objective was to determine how parent participants learn to support their children's mathematics growth through participation in workshops. For this objective, I realized

that parents were on their own individual journey. For parents to learn, it depended on their own past experiences, feelings, and thoughts regarding mathematics. A few parents required many experiences during and between the workshops to overcome their fears. Others were quick to learn and were able to implement the talks with the children right away. Lastly, a few parents would require ongoing guidance to keep them on the right path.

To address the research question and second objective, I answered them jointly. The research question was: When parents engage in number talks, what are the aspects of their experience that they consider to have contributed to their children's development of mathematical problem solving and number sense? In terms of the research question, I realized that parents were unable to identify all of the aspects of their experience that affected them. Thus, through the analyzing of my data, I was able to develop three themes that emerged to represent the aspects of parents' experiences. The three themes were: developing a growth mindset through building confidence, foundational experiences and the relationship with me.

The second objective was directly related to the research question and was meant to determine what factors affect parents as learners (with regard to noticing opportunities, engaging learners, attitudes, and use of problem solving) while leading their children during number talks. Since the second objective addressed the factors that affected parents as learners, I was able to develop sub-themes that represented the key factors for each of the main themes of the research question. For the first theme of developing a growth mindset, six factors emerged from my data. The sub-themes or factors which led to a change in mindset over time were: fixed mindsets, workshop learning, number talk learning, child confidence, defining moments of change, and overcoming fears. For the second theme of foundational experiences, five sub-themes/factors became apparent. They were: the actual number talk experiences, parents noticing the zone of proximal development, the hands-on resources, the step-by-step guidelines, and recognizing that change is a process. As for the third theme of the relationship with me, four sub-themes/factors developed. They were: learning through my journey, the videos, the icebreaker activities, the interactive writing, and interviews.

The third and final objective was to develop recommendations about how to support and guide parents to help their children develop number sense. My two recommendations are for parents to start a number talk journey and for me to reach a bigger audience through more workshops all while working alongside teachers.

To summarize, each of the parents' stories was unique, with varying factors that affected their journeys. However, the main commonality of their learning was parents developing a growth mindset through the foundational experiences of number talks. To help parents continue on their journey, I was able to develop a relationship with them and provide encouragement and reassurance along the way. My research has allowed me to answer the research question and objectives in a meaningful way and my hope is to continue to work with parents in the future.

Final Conclusion

To conclude, my research has been a phenomenal journey for me. The parents in my study have taught and impressed me, made me cry and touched my soul. I am forever grateful to all of them for their bravery and courage to have come on this journey with me. Many of my participants thanked me, but I feel the need to thank them. Diego thanked me by writing

> Nothing more than thank you, million "thank yous" for sharing your passion with us and making us finding and discovering simple ways to talk and love math for kids. Keep doing what you do with that passion, it's positively contagious and inspiring. I love your spirit and your energy. And the world is all really lucky to have you. Teaching, your teaching experience, your personal life experience, how you faced the numbers through the years, that was one thing. And the other thing. Your commitment. And the last one, and I would say the probably and the most important thing is your passion…When I finished it, and it was with you, I was like, I am the luckiest in the world. I feel blessed, and lucky and honored. (Interactive Writing 4, Diego, November 21, 2018)

Diego felt honored to have attended the workshops, and I felt honored by Diego's words. He explained that the workshops, along with my personal life experience, my commitment to help others in mathematics along with my passion had transformed his life. For me, Diego along with all the parents who participated in my study, have encouraged me to keep going so that others can experience what they did. Many parents' final words were to thank me, but since I get the final word, I wish to say thank you to them from the bottom of my heart and soul.

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Appendix A: Participant Consent Form

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time and remove any statement from the consideration of use in data, and/or refrain from answering any questions you prefer to omit, without prejudice or consequence by emailing the primary researcher at _____. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

The University of Manitoba may look at your research records to see that the research is being done in a safe and proper way.

This research has been approved by the Education and Nursing Research Ethics Board at the University of Manitoba. If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Coordinator at _____ or by e-mail at _____. A copy of this consent form has been given to you to keep for your records and reference.

I understand that my participation is the following:

<u>Parent Participation</u>

Read information letter, sign consent form and email it (15 minutes)
Three workshops, 90 minutes each
Three math discussions (Number Talks) with your child (5-10 minutes each)
Four emails to me (Approximately 30 minutes each)

Total Approximate Time Commitment without Interview: 7 hours 15 minutes

<u>Optional Follow-up Interview Participation</u>

45 minute interview
Interview transcript review (Approximately 30 minutes)

Total Approximate Time Commitment with Optional Follow-up Interview: 8 hours 30 minutes

Childcare will be offered at the location of the workshops. Please fill out the below form and indicate how many children and their ages will be in attendance to allow for the correct ratio of caregivers to children. If any changes occur, please email me before each workshop.

_____No childcare required
_____I am unsure at this time. I will email you before the workshops to let you know.
_____Yes childcare required.
_____ (Yes/No) Thursday, _____ _____Number of child(ren) _____Ages of child(ren)

_____ (Yes/No) Thursday, _____ _____Number of child(ren) _____Ages of child(ren)
_____ (Yes/No) Thursday, _____Number of child(ren) _____Ages of child(ren)

Once you have signed the consent form, you may take a photo of the form and email them to me, scan and email them back to me at _____ or send me a hard copy to the following address: _____.

Participant's Signature: _____ Date: _____

Researcher's Signature: _____ Date: _____

Appendix B: Final Interview Consent Form

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject in a forty-five minute in person interview. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time and remove any statement from the consideration of use in data, and/or refrain from answering any questions you prefer to omit, without prejudice or consequence by emailing the primary researcher at _____. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

The University of Manitoba may look at your research records to see that the research is being done in a safe and proper way.

This research has been approved by the Education and Nursing Research Ethics Board at the University of Manitoba. If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Coordinator at _____ or by e-mail at _____. A copy of this consent form has been given to you to keep for your records and reference.

I understand that my participation in the Follow-up Interview is the following:

Optional Follow-up Interview Participation

45 minute interview

Interview transcript review (Approximately 30 minutes)

Please fill in the form below and I will try my best to accommodate the interview at the location, date and time that you request. Please indicate whether you require childcare.

Preferred Interview Location : _____
Preferred Interview Date: _____
Preferred Interview Time: _____

_____No childcare required
_____Yes childcare required _____Number of child(ren) _____Ages of child(ren)

Your signature gives consent to be interviewed by me, the principal researcher, and to allow use of any interview answers to be used in my work, unless otherwise indicated. All answers will remain confidential. Once you have signed the consent form, you may take a photo of the form and email it to me, scan and email it back to me at _____or send me a hard copy to the following address: _____

Participant's Signature: _____ Date: _____

Researcher's Signature: _____ Date: _____

Appendix C: School Division Permission Form

Your signature on this form indicates that you have understood to your satisfaction the information regarding this study. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw your permission for the study at any time without prejudice or consequence by emailing the primary researcher at _____. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information at any point throughout the study.

The University of Manitoba may look at your research records to see that the research is being done in a safe and proper way.
I hereby give permission for the research study, *Parent Journeys Through Number Talks with their Children*, to be conducted at _____ School in _____ School Division. I give permission for the school to send the recruitment letter to parents through the school's parent email addresses, to host the parent workshops in the school library and to provide an additional room in the school for childcare on three evenings during the months of _____.

This research has been approved by the Education and Nursing Research Ethics Board at the University of Manitoba. If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Coordinator at _____or by e-mail at _____. A copy of this consent form has been given to you to keep for your records and reference.

Superintendent's Signature: _____ Date: _____

Researcher's Signature: _____ Date: _____

If you have any further questions regarding this study, please feel free to contact:
Principal Researcher: _____
Telephone Number: _____
Email Address: _____
Thesis Advisor: _____
Phone Number: _____
Email Address: _____