

MEXICAN AMERICAN WOMEN REFLECTING ON MATHEMATICS EDUCATION,

AS MOTHERS AND AS ADULT LEARNERS

by

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## Abstract

Parents bring a wealth of experiences and mathematics knowledge than often goes untapped. The reason for this is the little information that teachers have about their students' parents and the limited communication with them. Latinx families are even more impacted by this because of prevalent deficit views about Latinx parents' parental involvement and participation in the education of their children. In order to move away from these deficit views, in this study I share insights that five Mexican American mothers offered about the mathematics education of their children and about their experiences with mathematics as learners themselves. This study addresses two research questions: (1) how do parents' experiences with mathematics influence their involvement in their children's education and their views of their children's school mathematics? And (2) how do parents' everyday life experiences influence their approach to mathematical problems? Each mother was interviewed and participated in a mathematics workshop for parents that focused on the algebra topic of interpreting graphs. The findings indicate that these Mexican American mothers used their previous experiences with mathematics education at school and at home as guidelines for their participation in their children's mathematics education. As adult learners, the mothers collectively constructed knowledge about interpreting graphs and used their day to day experiences as tools that helped them understand this mathematical concept. These findings underscore the importance for researchers, teacher educators, and teachers to take into consideration the parents' backgrounds (i.e., their culture, their education level, their expectations, their goals, and their concerns) as part of their efforts to work with parents as partners. There is a lot to learn about and from Latinx parents, and such learning can help improve children's mathematics education and parent-teacher relations.

## Chapter 1: Introduction

*You learn things at school but you reinforce them at home. I can tell you that we, the parents, have an important role. Even though sometimes we get stuck, they [our children] know that if they didn't learn or aren't understanding something, mom is there for them.*  
(Elena)

*I feel like the mother's role is not only about taking care of the home, being a wife or a mother. No! I say that one as a mother can still grow and learn new things, it doesn't matter the time, the country, or the age.* (Alondra)

The two quotes above are from two Mexican-American immigrant women who participated in the study I describe here. These quotes represent the strong desire they have for supporting the education of their children and their own interest in learning. In the first quote, Elena recognized that her children were learning mathematics at school but that their learning process did not stop there. When she said, “even though sometimes we get stuck,” Elena is referring to the number of times when she and her husband did not know how to help their children with mathematics homework. However, Elena and her husband did not give up and every time they looked for ways in which they could help their children. As a mother, Elena considered that her role was to support her children and help them so that their mathematics education was better than hers in every aspect that she could improve. In the second quote, Alondra expressed her eagerness for learning. She also expressed this in relation to her interest in participating in the mathematics workshops offered since she came to these events not only to learn about the mathematics her daughters were learning but to do mathematics herself. When Alondra said, “it doesn't matter the time, the country, or the age,” she was trying to convey that for her there are no excuses. It did not matter how old she was, living in a new country, with a

different language, with many responsibilities as a mother and as a wife, because she would keep looking for opportunities to learn.

These two comments from the mothers point to their desires and goals for themselves and their children. Their words show how they value supporting their children's learning at home as well as their own learning as adults. Students learn mathematics through their interactions with teachers and classmates at school. But school is not the only context for learning mathematics. At home, students interact with their parents / guardians, siblings, and relatives. These family members also mediate the students' mathematics learning process since they have their own mathematics experiences and ideas. This brings to my mind one question, how do we see mathematics and mathematics education through our experiences and those of the people around us?

In this thesis, I share some of the insights that five Mexican American immigrant mothers offered about mathematics education from two perspectives; as mothers wanting to support their children's mathematics learning; and as adult learners, wanting to make sense of mathematics through their everyday experiences. The two main research questions of this thesis are:

- 1) How do parents' experiences with mathematics influence their involvement in their children's education and their views of their children's school mathematics?
- 2) How do parents' everyday life experiences influence their approach to mathematical problems?

In the following section, I present a brief literature review on areas relevant to this study, in particular with respect to parents and mathematics education. Then, I discuss the theoretical framework that informed and guided this study. Next, the methods section presents the context in which this study took place, the participant selection, data collection, data analysis, and my

positionality. The methods section is followed by the findings section, which is organized around each of the two research questions. I then provide a general conclusion, implications for teacher education and future research, and limitations of this study.

## **Chapter 2: Review of the Literature**

I organized the review of the literature in three sections: mathematics education in the multicultural classroom, parents and mathematics education, and parents as adult learners and intellectual resources. Since this study took place in a bilingual/bicultural setting with a group of Mexican-American mothers, one area of the literature that was particularly relevant were studies in mathematics education in multicultural classrooms. The second section of this literature review focuses on research that informs how parents get involved in their children's education and what their views are about mathematics education in general. In addition to this, one component of this study centers in these Mexican-American mothers as learners and their interactions while doing mathematics. For this reason, the third section of the literature review looks into research around parents doing mathematics as adult learners.

### **Mathematics Education in the Multicultural Classroom**

Classroom instruction often pays little attention to students from non-dominant groups' cultural backgrounds and their constant effort to mediate two different worlds: home and school (Gorgorió et al., 2010). Children of immigrant origin bring cultures, experiences, languages, home values and morals that are likely to be different from the dominant expectations and norms historically embedded in the schools. Their parents may also have different expectations of their children and their education. Several researchers have investigated the value of taking into consideration all those differences in the classroom (Celedón-Pattichis & Turner, 2012; Hunter & Hunter, 2017; Saalbach et al., 2013; Shah & Crespo, 2018). For instance, Celedón-Pattichis and Turner (2012) saw that emergent bilingual students improved their performance and deepened their understanding in mathematics class when they were given several opportunities to solve a problem and when they were able to use Spanish. In their study, Saalbach et al. (2013)

analyzed whether there is a cognitive loss when German speaking students in bilingual programs, German and French, switch between languages. They found that when working with bilingual students, the instruction in the student's home language "extends basic cognitive functions" (p. 42) and improves the student's ability of managing information on each language, all these together with the advantage of being able to communicate in another language. Hence, it is beneficial for the student to use their home language in the classroom since it helped them to further their knowledge and their cognitive skills.

Planas and Civil (2013) analyzed the mathematics classroom in two different contexts: Barcelona with its Catalan language policy and Tucson with its English language policy in the classroom. They explained that language policies send to students messages about "their home language, the language of instruction, and who gets to participate in the mathematics classroom and how" (p. 376). Because of the language policies implemented in their classroom, students whose home language is different from the dominant language may feel segregated and start devaluing their home language. Planas and Civil argued that home language should be used as a resource because of its pedagogical value as students feel more comfortable and can then participate more in the discussions. The intersection of language policy and mathematics teaching creates a tension for both students and teachers. Students limit and devalue the use of their home language in class while teachers struggle between following the policy or welcoming other languages in the mathematics classroom.

Besides taking in consideration the students' home language in the mathematics classroom, there are other reported benefits linked to integrating the students' cultural background in mathematics instruction. Hunter and Hunter (2017), on their research with Pāsifika learners and their teachers, reported that when the students' cultural background is

integrated in the mathematics curriculum there is “an increase in student voice and agency, increased pro-social skills, enhanced mathematical dispositions, and the valuing of the mathematics within the home and cultural context” (p. 15). Taking into consideration the students’ backgrounds has been shown to improve students from non-dominant groups’ mathematical understanding and performance in the mathematics classroom (Boaler & Staples, 2008; Lipka et al., 2005; Lipka et al., 2012). For instance, Lipka et al. (2005) analyzed the effects that Math in a Cultural Context (MCC) curriculum, a culturally based mathematics curriculum, had on Yup’ik students and novice teachers. Their findings indicate that “the level of [students’] engagement in and talk about math was higher” (p. 376); the students developed a “sense of ownership and a new, more cognitively challenging connection to math concepts” (p. 377); and the Yup’ik students learning with this curriculum had better performance than those in the control group. Moreover, the novice teachers also benefited from implementing this curriculum since they deepened their content knowledge, developed a strong sense of community, and improved their pedagogy.

It is important for teachers to find ways to integrate their students’ home languages and cultural backgrounds in the mathematics curriculum. One way to do this is through having teachers learn from their students’ day to day life in their communities and at home. Students have mathematical experiences at school and at home. Through a strong communication between parents and teachers, teachers can learn from parents about the mathematical knowledge and experiences at home.

## Parents and Mathematics Education

Anderson (1998) mentioned “parents are their children's first teachers” (p. 4). Latinx<sup>1</sup> parents are no exception. When the students are not at school, they are at home interacting with their families. Researchers in mathematics education have evidence that demonstrates that we have to move away from the deficit narratives about parental involvement (Civil & Andrade, 2003; Walker et al., 2011). Civil and Andrade (2003), referring to their work with a group of Mexican-American mothers, explained that “mothers as parents are in the unique position to influence the academic preparation of their children” (p. 154). They elaborate, “For them [referring to mothers of immigrant origin and in working-class communities], there is much more at stake (i.e., their children’s academic future) in fulfilling prescribed parental roles while advocating for their children's best interest” (p. 156). Latinx parents are there to support their children and care about their future. In addition, Walker et al. (2011) found that Latino parents get involved in their children’s education and examined what factors predicted this involvement and their motivation to do so. The researchers found out that the child’s direct invitation to their parents to get involved in school activities, the teacher invitation to parents to participate in the classroom, and the parents’ time and energy level were the most significant predictors of Latino parents’ involvement and motivation.

Parents have their own experiences with mathematics and researchers have investigated how these experiences shape their views of the mathematics education of their children. O’Toole and De Abreu (2005) conducted a study in England which involved parents of ethnic minority backgrounds (Bangladesh, Indian, Pakistani, and Mixed heritage) as participants. O’Toole and De Abreu concluded that the parents’ previous experiences with mathematics inform their

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<sup>1</sup> I use Latinx in this study to move away from the gender binary in the term Latino/a. In some places, I use the term Latino or Latina because that is the term used by the author(s).

actions and understanding of the present. Their findings indicate that the parents' expectations, mathematics experiences (positive or negative), the role of the parents' parents, and highest level of formal schooling influence parents' role in the mathematics education of their children. "At times they use their past experiences to mediate internalization (reproduction of the experience), at other times they use them to promote externalization (change brought about by the experience). It is within this process that parents projected a future ideal for their child, which was either congruent or discordant with their own past" (p. 75). Parents' views of the mathematics education of their children are shaped by their previous experiences with mathematics.

McMullen and Abreu (2011) explored how the experiences with mathematics of white British university educated mothers influenced the way they got involved in the education of their children. McMullen and Abreu built on previous research about mothers from non-dominant groups and their opinion about the mathematics education of their children (Civil & Andrade, 2003; O'Toole & De Abreu, 2005; Civil et al, 2005). However, they focused on the White-British university educated mothers with and without teaching experience. Mothers with teaching experience tend to value more the different mathematical practices being taught now and preferred mathematical understanding over repetition and memorization. McMullen and Abreu (2011) found that the mathematical identities of both the student and mother were closely related to positive and successful child-mother interactions with mathematics learning. While both O'Toole and De Abreu's (2005) and McMullen and De Abreu (2011) studies were conducted in Britain with participants from non-dominant groups who were not Latinx, their findings agree with mathematics education research conducted in the United States with Latinx

parents (Anhalt et al.,2002; Civil & Andrade, 2003; Civil & Quintos, 2009; Civil & Menéndez, 2011; Civil et al, 2005).

Civil and Quintos (2009) explored the views of three Mexican American mothers on the mathematics education of their children. The authors found that the mothers' previous experiences with mathematics impacted their views, beliefs, and expectations about their children's' mathematics education. The difference between how the mothers learned mathematics, mostly through traditional mathematics teaching, and how their children were learning mathematics denoted a tension between their mathematics versus their children's mathematics. The research discussed above indicates that parents' experiences with mathematics in school and at home mediate their views and involvement in their children's mathematics education. We have to also take into consideration that besides their previous experiences with mathematics, parents possess mathematical funds of knowledge that inform their mathematics understanding.

### **Parents as Adult Learners and Intellectual Resources**

Parents bring a wealth of experience and mathematical knowledge that often goes untapped. There is research that has looked at parents as adult learners of mathematics. For instance, in Civil (2001), Mexican immigrant women in the United States built on their experience making *papel picado* (a handcraft that consists of folding paper and cutting pieces of it to make shapes) to explore the geometry involved. The author created a space in which the mothers felt comfortable, *en confianza*, and a space where they could develop confidence being learners of mathematics. Although, at the beginning, the mothers originally did not think about the mathematics involved in cutting the paper, once the geometry behind the activity was discovered, the mothers started noticing the geometrical figures and their areas which led to a

discussion about the number pi. In the activity, the mothers built on their expertise with *papel picado* to explore the mathematical questions posed.

Díez-Palomar et al. (2011) illustrate how adult learners use their day to day life experiences to make sense of new concepts and try to make connections with school mathematics. Similarly, Civil et al. (2019) have investigated the affordances of school-based type tasks and everyday based tasks with adult learners. A modeling task around sharing popcorn allowed the participants (mothers and teachers) to bring in their own experiences with this context. In this study, it was evident that the mothers as learners used their daily experiences in the modeling task. Both of these studies point to the importance of context in mathematics problems.

Several papers had emphasized the power and the possible mathematical value of people's funds of knowledge (Civil et al., in press; Civil & Menéndez, 2011; Díez-Palomar et al., 2011; Takeuchi, 2018). For instance, Civil, Been-Bennett, and Salazar (in press) describe the mothers' suggestions for a modeling task on selling cupcakes and argue for the potential of such task to give access to the funds of knowledge of the mothers and their children. The mothers knew their children's interests, so the task was developed around them. In that study, some of the mothers took the modeling task related to paper flowers that they did in the classroom into their own community. For the mothers, it was not just a task that they did in the mathematics workshop, it was a family and community project. Thus, the context of the tasks could influence both settings: the mathematics classroom and the students' communities.

Studies around the world have focused on the richness of mathematics experiences that immigrant parents can provide to their children's education (O'Toole & De Abreu, 2005; Takeuchi, 2018). For instance, Takeuchi described a multiplication method used by Filipino

immigrant mothers in Japan which uses just the fingers in both hands as tools for calculations. This method was learned at home and transferred from generation to generation. Takeuchi's study gives us a glimpse of the mathematics funds of knowledge of these participants as they shared an approach to multiplication that was different from the method their children were being taught at school. The study also discusses the value of out-of-school experiences. To further extend Takeuchi's findings, we could explore how this multiplication method was acquired and how the Filipino immigrants make sense of it and teach it to others. All this research underscores parents' mathematics experiences and knowledge; however, this also raises the controversy about what counts as doing mathematics and what does not. The multiplication method used by the Filipino parents in Takeuchi's study required the students to use their fingers which could be considered as a less advanced calculation method. Since the method was not taught in the children's mathematics classroom, the children could think that the method learned at home had less value. However, both methods arrive to the same answer, so the method learned at home should count as doing mathematics.

Although these research studies highlight the experiences with mathematics of minoritized parents, it is important to be aware of the power issues with different forms of mathematics (e.g., school mathematics; everyday mathematics) (Knijnik, 2004). Knijnik and Wanderer (2018) stated:

The mathematics produced by the mathematicians has taken a central place in contemporary technical-scientific production. This ultimately had repercussions on school mathematics education, which is positioned as the most important school discipline. (p. 129)

In doing research that attempts to explore the mathematical funds of knowledge of a community, there is the risk of only highlighting or seeing the mathematics that fit with our idea of what constitutes mathematics, the school mathematics (Knijnik & Wanderer, 2018).

This review of the literature helped to focus my study on Mexican American mothers and their families who are part of a non-dominant community which has been underserved by the education system in this country. I see these mothers as both learners of mathematics and important players in the mathematics education of their children. This study builds on the work of Civil and colleagues (Civil & Menéndez, 2011; Civil & Planas, 2010; Quintos et al., 2019) and O'Toole and De Abreu (2005) since I want to explore how these mothers' experiences with mathematics when they were young inform their present role in the mathematics education of their children. In this study, I focus on two different contexts in which they have mathematics experiences, school and home. Also, this study aims to contribute to the literature on parents as learners and how parents use their daily experiences and funds of knowledge to make sense of mathematical concepts. Therefore, I decided to explore two questions: the first question centers on the mothers' experiences with mathematics and how these may affect what they do with respect to their children's mathematics education; the second question looks at the mothers' use of their daily experiences as tools to make sense of mathematics. These two questions have the potential of unfolding who the students' parents are as parents, as teachers, as learners, and as intellectual resources.

### Chapter 3: Theoretical Framework

At the basis of this study lay two theoretical concepts: funds of knowledge (González, Moll, et al., 2005a) and parents as intellectual resources (Civil & Andrade, 2003). In this paper, both concepts function as lenses that guided my study on parental engagement in mathematics education.

#### **Funds of knowledge**

Moll et al. (2005) defined funds of knowledge as “historically accumulated and culturally developed bodies of knowledge and skills essential for household or individual functioning and well-being” (p. 72). The concept of funds of knowledge was developed from anthropological approaches, Vygostky’s cultural-historical psychology, and Vélez-Ibañez’s (1983) views of *confianza* [trust] and its importance in the relations with the Mexican population. Funds of knowledge was developed from the assumption that “the educational process can be greatly enhanced when teachers learn about their students’ everyday lives” (González, Moll, et al., 2005b, p. 6). The teachers become ethnographers who do household visits in which they have the opportunity of observing their students’ homes and their day to day practices. Thus, funds of knowledge has at its core a positive view of the students’ households since they have cultural and cognitive resources which could be used in the classroom (Moll, et al., 2005).

Civil (2002a) expanded the idea of funds of knowledge to mathematics. This author noticed that people who used their day to day experiences often had more interesting approaches to mathematics problems. Their solutions were not methodical since they reflected insight and sense making. As a result, Civil started to do research with the following questions in mind, “why is there such a gap between everyday experiences and knowledge and school mathematics and what could we do to bridge it?” (p. 136). Thus, the idea of bringing the students’ and their

families funds of knowledge to the mathematics classroom emerged. Civil (2002a; 2007) describes her collaboration with a teacher who had conducted home visits of all her students and thus knew her students' backgrounds and had constant communication with the parents. The teacher's relationship with the parents helped her access the funds of knowledge of the parents and the students. The teacher learned that some of the students' families had knowledge about construction. As a result, the teacher, Civil and other university researchers developed a learning module that included mathematical ideas present in construction (Sandoval-Taylor, 2005). The activities were more interesting to the students because they related to something they knew outside from school. Also, the students' parents had the opportunity of getting involved in the mathematics classroom. Civil (2002a) stated,

Our pedagogical orientation is to develop a participatory approach to teaching that capitalizes on children's knowledge and experience, and that in fact makes them (and their families) co-constructors of the curriculum. (p. 141)

Civil's research with students from non-dominant communities and their families stands as evidence that it is possible to include the students' funds of knowledge in the mathematics classroom and that doing so results in positive outcomes like increased students' engagement and parental involvement.

In González, Andrade, et al. (2005), the authors noted that the mathematics in the classrooms are hegemonic since it gives preference to Eurocentric and Western mathematics and excludes other kinds of mathematics, other sources of mathematics. The mathematical knowledge that parents and communities in general used in the day to day life are excluded from the school mathematics classroom, formal mathematics. Thus, it was not enough to gain access to those mathematical practices but to "involve [students and their families] in practices in which

they are not only consumers of knowledge, but producers of mathematical practices” (González, Andrade, et al., 2005, p. 269). In their daily lives there are sources of rich mathematics (e.g. cooking, construction, sewing, a family business). However, there were other tensions between school mathematics and household mathematics.

It seemed that at the moment of analyzing the mathematics involved in the daily activities there was a tension between trying to detach the mathematics from its context and how other people saw those same mathematics. González, Andrade, et al. (2005) wrote in relation to this:

Mathematics is not a possession residing within the head of the participants. It was not an immutable, fixed attribute or trait of one individual. Rather, mathematics was a practice, but we had to discover how to create a zone for the development of that practice. It is not enough to simply “possess” funds of knowledge in mathematics domains. These must be socially mediated into productive knowledge in order to be meaningful (...) human beings and their social worlds are inseparable, they are embedded in each other, thus, human thinking is irreducible to individual traits. Instead, it is always mediated, distributed among persons, artifacts, activities, and settings. (p. 266)

Therefore, as part of the exploration of a person’s or a community’s mathematical funds of knowledge it is indispensable that zones of mathematical practices are created. These zones of mathematical practices serve as a way of transforming the mathematics funds of knowledge in meaningful activities for others not familiar with the context. For example, the seamstress example in González, Andrade, et al. (2005), highlights the role of social mediation as the mathematical knowledge embedded in the practice of sewing was co-constructed within the group of participants. These zones of mathematical practices where the participants learn from each other and co-construct mathematical knowledge from their funds of knowledge are key to

ease the tension between looking at only the mathematics of a context and how other people think about those same mathematics.

### **Parents as Intellectual Resources**

Parents' participation in the schools and in the education of their children goes beyond volunteering to do busy work (i.e., making copies, cutting papers, patrolling the cafeteria, or selling food for fundraising for the school). As Civil and Andrade (2003) write, “mothers as parents are in the unique position to influence the academic preparation of their children”... “for them, there is much more at stake (i.e., their children’s academic future) in fulfilling prescribed parental roles while advocating for their children's best interest” (pp. 154, 156). Parents have a lot to offer to the classroom, to the teachers, and to the schools. This is the key idea behind the theoretical concept of parents-as-intellectual resources (Civil & Andrade, 2003).

The parents as intellectual resources framework surges as a response to the deficit narrative about parents from working class communities. In particular in the literature about Latinx parents’ involvement in the education of their children there are prevalent deficit narratives. For example, Peña (2000) explained that teachers have the perception that Latinx parents are uninterested in the education of their children because they do not attend the school events. Also, Carrasquillo and London (1993) explained that the parents’ limited education prevents them from getting involved in the education of their children. In a review of research studies that perpetuate myths around Mexican American parents and education, Valencia and Black (2002) note a prevalent deficit view of Mexican American parents’ involvement in children's education. As Valencia and Black explained, these studies attributed Mexican American parents’ lack of involvement to elements such as: language barrier (limited to no knowledge of English), low value given to education, low socioeconomic status, and cultural

background. All these deficit views blame the parents, their culture, their personal characteristics, and their values as factors that prevent them from getting involved. According to Villenas and Deyhle (1999), there is a constant comparison of parents from non-dominant groups who have different cultural backgrounds and experiences with those who “fit” the whiteness norm. This constant comparison overlooks the political-economic context in which parents from non-dominant groups live. At the basis of these deficit views stands the idea that parents from non-dominant groups need to change their behavior and ideas towards the education of their children. At the same time, parents from non-dominant groups are often being left to the side and not given the information necessary to make appropriate decisions about the education of their children.

There is research that moves away from these deficit views. In her ethnographic study, Valdés (1996) presented the case of ten Mexican American immigrant families. Valdés followed the families for three years and developed a close relation with them. Valdés discovered that in order for us to understand Mexican American immigrant families and how the education system has been failing them, we “must have an understanding from the worlds from which these individuals come” (p. 5). Teachers cannot keep comparing parents and families from different cultures with white middle class American families since it makes teacher blind to different forms of parental involvement. Galindo and Medina (2009) called researchers to do research with a focus on Latino parents’ involvement that sets aside the traditional definition of parental involvement (focuses on the parental involvement at the schools and fails to notice the parental involvement outside of schools). Galindo and Medina advocate for research to include multiple ways that Latino parents get involved in the education of their children (e.g., church activities, teaching them morals, principles, and sharing culturally related beliefs).

The parents as intellectual resources framework responds to these deficit views by positioning parents, especially parents from non-dominant groups, as sources of knowledge for the mathematics classroom.

Civil and Andrade (2003) took the concept of *egalitarian dialogue* (Flecha, 2000) and transformed it to fit into their context, doing mathematics with adults. Flecha (2000) defined egalitarian dialogue as:

A dialogue is egalitarian when it takes different contributions into consideration according to the validity of their reasoning, instead of according to the position of power held by those who make the contributions (...) both students and teachers learn, since they all construct interpretations based on the contributions made. (p. 2)

From this definition, Civil and Andrade pointed out that in order for parents to start their role as “teacher” of mathematics they have to first be considered as intellectual resources. This means that we have to recognize that parents have mathematical knowledge that should be respected and taken into account. Hence, a parents as intellectual resources framework challenges the patterns of interaction that position parents in more traditional roles as teacher aides and general school helpers.

The parents as intellectual resources framework is a participatory research approach where working with parents should be viewed as a collaboration. Moreover, the dynamics of power are in check at all times. Civil and Andrade (2003) wrote “as participants, we all brought something to the endeavor (knowledge, experience, and resources) and we participated with the intention of learning from one another as we moved closer to workable solutions” (p. 159).

During the interactions among researchers, facilitators, and parents there must be humility. There is no one above the rest or no one that has a position of power, there is no teacher and students

but a group of people that are learning from each other in collaboration. Thus, today one parent might be the expert and tomorrow it will be someone else (not necessarily the researchers or the facilitators).

Following the conceptual framework of parents-as-intellectual resources, in this study, the mothers participating were not viewed as subjects for observation or to be interviewed. The mothers were treated with respect and as individuals who had knowledge, experiences and resources important not only for the researchers but for the community in general.

The next section includes the context in which this study took place, how the participants were selected, how and what data was collected, the data analysis, validity of this study, and my positionality.

## Chapter 4: Methods

### Context

This study is part of a larger three-year project<sup>2</sup>, directed by Dr. Marta Civil, which had as its goal to bring parents and teachers together as a Leadership Team to create a two-way dialogue where both parties work together towards improving children's mathematics education. To this end over the duration of the project, a group of 6 to 10 mothers and 6 to 7 teachers constituted a Leadership Team who participated in the different activities. During the leadership sessions, mothers and teachers worked together in mathematics tasks and got to know each other. Also, they had the opportunity to facilitate family mathematics workshops together. The school where this study took place was situated in a working class Mexican-American neighborhood, in Tucson, Arizona. Throughout the decades, Mexican-Americans and others "minorities" have been displaced to the south or west of Tucson as the Anglo<sup>3</sup> people started dominating the market and business in the downtown presidio area (Sheridan, 2016). Nowadays, the majority of the population in the south and west of Tucson is of Mexican origin (Statistical Atlas, 2010).

For this study my focus is on the mothers. Even though the invitation to participate was open to any caregiver, mother or father who had a child in K-3, only mothers chose to participate. This was not a surprise for the research team since other prior parental engagement projects in this community had also had mostly mothers (or grandmothers) as participants (Civil & Bernier, 2006; Moll, 2005; Quintos, Civil, & Bratton, 2019). All the mothers were Mexican

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<sup>2</sup> The "Let's Talk About Math: Parents and Teachers Talking and Doing Mathematics Together" project was funded by the Heising-Simons Foundation, Grant #2016-065. The views expressed here are those of the author and do not necessarily reflect the views of the funding agency.

<sup>3</sup> By "Anglo" people, I refer to the definition offered by Sheridan (2012), "Anglo encompasses native-born white Americans as well as newcomers from the British Isles and Western Europe... Spanish, Italians, and other southern and eastern Europeans whose "whiteness" varied from community to community, depending on the ethnic politics of time and place" (p. 2).

immigrants or first generation. This was not a surprise either given that the school population is approximately 94% Hispanic in this school (National Center for Education Statistics, 2017).

As part of the larger project, the mothers were interviewed up to three times using semi-structured interviews. The interviews drew on those used in the Funds of Knowledge for Teaching Project (González, Moll, et. al., 2005a). These interviews focused on: the participants' background information; their general experiences at home and as a mathematics student; the mothers' description of their children's experiences with mathematics; the mothers' relations with their children's teachers; and the mothers' interactions with their children and mathematics outside of school. It is important to mention that the researchers in the project built a relationship of *confianza* (trust) and respect with the participants. These two concepts (*confianza* and respect) are very important in the Mexican culture and are the bases for a good relationship (González & Moll, 2002; Vélez-Ibañez, 1983). Hence, the mothers seemed comfortable sharing their knowledge and experiences.

Through my experience as a Research Assistant in this project, I went through the collected data as well as I had multiple informal conversations with the participating mothers. Something that caught my attention was that on several occasions the mothers commented about their experiences with mathematics when they were in school themselves and related them to the present. Thus, for my study I decided to look further into this matter and explore how those experiences with mathematics had influenced them and their relationship to their children's current mathematics experiences.

In addition, one of my main responsibilities in the larger project was to facilitate many of the workshops especially designed for parents, Math for Parents (MFP). These MFPs were largely modeled after a prior project (Civil, 2002b; Civil & Bernier, 2006). For this project, the

MFPs focused on the different mathematics strategies and mathematics practices at the K-3 level. For instance, some of these included subtraction and multiplication strategies like counting up, adding groups of, and regrouping. Some of the topics went beyond the K-3 mathematics curriculum and in particular, in the third year of the project, the MFPs addressed topics from higher grades like functions and graphs in the coordinate system. After the first two years of the project, the mothers had expressed interest in doing mathematics that were not necessarily related to what their children were learning at the moment. Some of the reasons for this were reviewing mathematics topics that their children would cover in the future, doing mathematics that seemed challenging when they were mathematics students themselves, and experiencing these kinds of mathematics in a more relaxed learning setting like the MFPs. In this study, I focus on an algebra topic, interpreting graphs, which was discussed during the third year of the project.

### **Participant Selection**

In total, five mothers participated in this study. Three of them started their participation in the larger project from the beginning and the other two joined the team during the third year. As mentioned above, all the participants are Mexican immigrants or first generation immigrants from Mexico, and have children in grades K-3. The participants' names, their relatives' names, and teachers' names are all pseudonyms. Since all the participants for this study were part of the larger project, I describe here how the initial selection of the participants happened for the larger project in general and then how the selection for this study occurred.

The principal directly invited a group of parents to participate in the outreach project. The principal took into consideration those parents whom she believed may be committed to the project and continue their participation from beginning to end of the project (which was

originally set to be a two-year project). Thus, the principal functioned as an informal gate-keeper by narrowing the participants selection (Seidman, 2013). This limited our choices for selecting participants. It also gave us a sample that may not be representative of the larger group of parents, as the ones who joined were mothers who often volunteered at the school on a daily basis or were otherwise “known” to the principal as “committed” parents. All the parents in the outreach project were invited to be part of the larger research study and agreed to participate. This study focuses on five mothers who regularly participated in the MFPs.

### **Participants**

In this project, it was customary to refer to each other by first name. Dr. Marta Civil is referred to as Marta and myself as Fany. This created a sense of community and helped level the power dynamics between the mothers and researchers. In this section, I introduce each of the Mexican American mothers who participated in this study.

Alondra was born in Mexico and attended elementary and middle school there. Her first language is Spanish. She has three daughters. One daughter is in elementary school, another daughter is in middle school, and her oldest daughter is currently enrolled in the university. Alondra has been volunteering at the school for several years. She has a small Mexican food catering business; however, she considers herself a stay-at-home mom. Alondra joined the larger project in its last year.

Elena was born in Mexico and her highest level of formal schooling is high school. Her first language is Spanish. She has two sons, both of them in elementary school. She has been volunteering at the school for several years. She considers herself a stay home mom. Elena participated in the larger project during the last year.

Lidia was born in Mexico and her highest level of formal schooling is college. She finished college and obtained a degree with a focus in finance. Her first language is Spanish. She immigrated to the US when she got married. Lidia works at a company and she is the only mother in this study who has a regular work schedule outside the home. She has two children in elementary school.

Magali was born in the US and her parents are Mexican. When she got married, she moved to Mexico and lived there for more than 10 years. She and her family decided to move back to the US when her youngest son was born. Her highest level of formal schooling is high school. However, she has taken some classes at the community college with the goal in mind of obtaining an associate's degree. Her first language is English, and her parents taught her Spanish at home. She has three children. Her oldest son and her daughter are college students while her youngest son is in elementary school.

Sandra was born in Mexico and her highest level of formal schooling is middle school. She took several vocational classes in Mexico. Her first language is Spanish. She has one son who is currently in elementary school. She has been volunteering at the school for several years. She considers herself a stay home mom and together with Alondra (they are relatives), she manages a Mexican food catering business.

Lidia, Magali, and Sandra participated in the larger project since the beginning.

### **Data Collection**

This study was intended to explore (1) how the mothers' mathematical experiences informed their interactions with their children and their mathematics education and (2) the mothers' interpretations of graphs based on their personal experiences and previous knowledge. For the first part, the data collection method that seemed to fit better was an interview since it

could be designed to go beyond descriptions and provide an insight into the participants' emotions and perspectives. The questions for the interview were designed to follow a semi-structured format so that I, the interviewer, had the opportunity to ask further questions that deepen my understanding and made the data collected richer (Corbin & Strauss, 2015). The semi-structured interview focused on the mothers' experiences with mathematics as students at school and at home, and the mothers' opinions about their children's mathematics education at home and at school. The interview protocol (see Appendix A) was based on some of the questions from the interviews in the larger project. In particular, I revisited some of the questions that addressed the participants' background, their mathematics history, their children's experiences with school mathematics, and their interactions with mathematics outside school.

The interviews were conducted at the school while children were attending school or at the participant's home. The setting of the interview was chosen by each of the mothers according to their convenience and accessibility. The participants were told that the interview could take up to 90 minutes so that the participant could plan accordingly. Over a period of three weeks, I interviewed the five mothers participating in this study. During the interview, I took notes to keep track of the conversation and to signal interesting ideas mentioned by the mothers that required further exploration. Also, the interviewees were encouraged to include commentaries that they believe were relevant to the topic in question. As a result, the interviews seemed more conversational and relaxed. All the interviews were video and audio-recorded.

All interviews were conducted in Spanish since it is the language we had been using in all the activities and interviews, as it is their and my first language. The data collected for this first part included video and audio recordings of the interviews and personal notes.

For the second part of this study, the data collected were video and audio recording of each of the three MFP sessions and the participants' written work. Each session was about two hours long. During these three MFPs, the participants worked through different activities that involved making and interpreting graphs.

### **Data Analysis**

In this study, I tried to capture the mothers' ideas as truthfully as possible. Conducting the interviews in Spanish allowed me to preserve the vivid language the participants used (Corbin & Strauss, 2015). Each interview was fully transcribed for data analysis purposes. Selected parts of the MFPs sessions were transcribed.

I started the analysis of the interviews by first fully reading each of the interview transcripts so that I could get a general idea of the data and identify segments in the data that could be of interest for closer analysis. Then, I conducted a data-driven analysis, question by question across all five interviews. Three questions from the interview protocol were selected for further analysis since those were the most relevant for my first research question. I read the mothers' answers for the same question and started to look for salient themes. While reading across the interviews, I looked for similarities, differences, and the negative case (Corbin & Strauss, 2015). As Corbin and Strauss recommended, the identification of the negative case was used to avoid overgeneralizations during analysis. During the analysis, I focused on the mothers' experiences with mathematics in different settings (i.e., school and home) and the connections of these experiences with the mothers' interactions with their children and their children's mathematics education. Some representative excerpts from the interviews were selected for each identified theme and translated to English.

The data collected for the second research question of this study was analyzed in a different way. During each session, I took notes of the interactions between the participants and their reactions to the different activities with graphs. I used these notes as a guide when I watched the videos of each session for the first time. While watching the video, I identified relevant instances that needed to be analyzed further. The videos were the primary source of data that I analyzed, and the audio recordings were used as a backup given that in some cases the audio in the videos was not clear. Having those salient instances identified, I read the mothers' written work that corresponded to each instance.

From all the activities around graphs, I chose one for closer analysis because of the richness in the mothers' reactions and answers to it. Also, this activity included several of the "to be analyzed further" instances that were identified during the first viewing of the videos. I reviewed the portions of the videos that refer to the selected activity from beginning (presenting the activity and giving instructions) to end (all mothers shared their answers and some of them gave their final thoughts about the activity). The portion of the video where the mothers shared their answers were matched with their written work. The analysis of this activity focused on the mothers' personal experiences and how they use those to make sense of the task at hand.

### **Validity**

The bigger project had been running for almost three years at the moment this part of the study was conducted. At that time, I had been keeping constant communication and contact with most of the participants. The participants and I shared the same cultural background, the Mexican culture, and being a part of this culture implied a big sense of community and close relationships with the people around us. Therefore, my long-time relationship with the mothers could have aroused some reflexivity issues during the interviews conducted for this study.

Maxwell (2013) defined reflexivity as “the fact that the researcher is part of the world he or she studies—is a powerful and inescapable influence; what the informant says is always influenced by the interviewer and the interview situation” (p. 125). Mainly, at the moment of interviewing each of them, I faced the challenge of setting aside what I already knew about them and their background, the challenge of making the familiar strange or defamiliarized (Shklovsky, 1917). Given that I had interacted with the participants for more than two years, it could have been easy for me to assume that I already knew the answer to certain questions and so not ask them during the interview.

Furthermore, as a result of our constant interactions, I developed a friendship with the mothers that went beyond discussing mathematics. They felt comfortable about asking me for help and shared some of their personal problems outside of the classroom setting. Due to this friendship, it was hard to distance myself from the participants since I had come to know them beyond the participant-researcher relationship.

In order to test the validity of my conclusion, I looked “for evidence that could challenge [my] conclusions, or that bears on the plausibility of the potential threats” (Maxwell, 2013, p. 125). The strategies that I used to test the validity of my conclusion were rich data, respondent validation, and searching for discrepant evidence. I also checked some excerpts of the data with my advisor to make sure my interpretation of the data made sense. The interviews were conducted so that the participant shared as much detail as possible. During the interviews, I constantly paraphrased or said in my own words the participant’s answer, a form of respondent validation, in order to confirm my understanding of their explanations, experiences, and opinions. While analyzing the data I constantly checked for discrepancies, and negative cases that represented crucial factors for my conclusion and challenged overgeneralization of the data.

## **Positionality**

I am a Mexican immigrant and I shared similar values and traditions with the mothers participating in this study. For the first twenty years of my life, I studied in Mexico and went through a similar education system as they did. My experience with mathematics in the classroom included teacher-centered mathematics instruction, memorization and repetition of mathematical facts and algorithms. In my case, I consider that not only the teachers, their way of teaching mathematics, and the nature of mathematics (rigorous and exact) had an impact on my education, but also the support I had at home. I believe the support of my family, especially my mother, was key for my achievements in education and motivation to continue studying. I believe that my mother's interest in reading and mathematics encouraged me to want to see what the world had to offer and look for ways that could help me achieve my goals. My mother's role in my elementary and middle school education has left a long-lasting effect in my education and I hope one day I can motivate my children just as well as she motivated me.

Since the beginning of the larger study, I started developing a friendship with the mothers participating in this study. Our relationship was not only researcher-participant. In every workshop, classroom visit, and interview, I learned not only about the mothers' experiences and their history but also, they learned about mine. We started discovering that we shared many things in common not just the language, cultural background, or nationality. Across different conversations, they learned about my day to day life, my experiences here in the US and Mexico, my work, my studies, my concerns, my achievements, my family, and my values. They made me feel and I felt part of their group. Our friendship extended outside of the research setting. For instance, sometimes I visited their homes, they invited me to their children's birthday parties, and in other occasions we went hiking together. Furthermore, I had the opportunity of meeting

all their children and their husbands while some of them also met my family. As I started to learn more about each one of the mothers, I got to know these women as immigrants like myself and caring and supportive members of their family and their community. I discovered with time all the different ways in which they are working towards the goal of giving a better education and opportunities to their children. Also, in their interactions with their children and participation in their education I saw some resemblances of what my mother did for me.

My mother was always there to support me, inspire me, and help me. But by the traditional definition of parental involvement here in the US, her support could have been interpreted as not showing involvement in my education because her physical presence at school was limited to the parent-teacher conferences. However, for me her involvement made a huge difference as a student. I had the feeling that these mothers' histories around their experiences with mathematics both as parents and as students themselves could bring depth to our understanding of Latinx parents' involvement in the education of their children. This is one of the reasons I chose the two research questions addressed in this study.

Although the participants' experiences and mine might be similar in some aspects, I am aware of the differences in educational settings, geographical location, and family composition between their experiences and mine. These are my values and personal experiences that might have had an influence on my interpretations of the data. However, being aware of them enabled me to keep them in check at all times during this study.

## Chapter 5: Findings

The findings sections of this study have been organized around the two research questions:

- 1) How do parents' experiences with mathematics influence their involvement in their children's education and their views of their children's school mathematics?
- 2) How do parents' everyday life experiences influence their approach to mathematical problems?

### **How do Parents' Experiences with Mathematics Influence their Views of Their Children's School Mathematics?**

During the interview portion of this study, the mothers reflected on their experiences with mathematics. To address the research question, I describe how the mothers' experiences with mathematics have shaped them as mathematics learners and based on these experiences how they saw the mathematics education of their children. The findings for this question are organized in four parts: (1) the mothers' experiences with mathematics at school; (2) the mothers' experiences with mathematics at home; (3) mothers' learning from past experiences with mathematics; and (4) the mothers' reflection about their children's mathematics education.

#### ***Experiences with Mathematics at School***

As each of the mothers was growing up, they experienced different situations at school and at home that led them to form their ideas about mathematics. Besides their encounters with the mathematical content, the mothers' interactions with their mathematics teachers shaped their feelings and perspectives about mathematics. All the mothers shared that they learned mathematics in a teacher-centered classroom where the teacher would impart the whole class at the blackboard and occasionally ask for the participation of the students. For Sandra and

Alondra, their mathematics teachers' way of structuring the class and recognizing the student's success were factors that shaped their feelings and opinion about mathematics.

Sandra explained that in a typical class her teacher would first explain, then check to see if most of the students understood the new topic by giving them problems to solve by themselves. Then, he would ask some of the students to share their answers and explain how they solved the problem. The practice problems were most of the time more than 10 and the teacher checked each student's answers one by one for correctness. If the students had incorrect answers, the teacher pointed out which problems were wrong and told them, "busca tu error" [look for your mistake]. After checking all the students' answers, the teacher would decide if it was necessary to go over the topic once more depending on the number of students with wrong answers. Sandra's mathematics teacher tried to use the little extra time at the end of the day to review the mathematics that still represented a challenge for the students. Even though Sandra was very shy, this mathematics class structure made her feel comfortable in the classroom because the teacher did not put students on the spot, as she explains below:

Bueno lo que tenía el maestro que era cuando, al principio cuando nos empezaba preguntar, por ejemplo, si decía 'para mañana estudien tal tabla'. Al día siguiente que nos pasaba al frente y ahí no era como que al azar. Ahí él escogía cómo que a los que él sabía que íbamos un poquito más adelantados en las matemáticas. [Well, at the beginning when the teacher started asking us questions, for instance, if he said 'for tomorrow memorize the times table of [a given number.]] Then the next day he would call on students to come to the front, but it was not random. There, he chose the students that he believed were a little more advanced in mathematics]

The teacher's strategy for choosing students gave to Sandra the assurance that he would not ask her to participate if he believed that she was not prepared to answer the question. This made Sandra feel comfortable and confident during mathematics class.

Also, Sandra's mathematics teacher assigned competence to his students when they demonstrated their knowledge. On one occasion, Sandra had to start the test after her classmates because there were not enough tests for the whole classroom. Although Sandra started the test late, she got a perfect score. Her teacher referred to her as an example of a good student in front of the whole class. He pointed out that even though she started the test late, she was able to get a perfect score. This made her feel proud about herself and reassured her confidence in her mathematics knowledge and skills. Because of situations like this one Sandra liked mathematics even more and wanted to keep learning.

Alondra also liked mathematics because of the way her teachers taught the class. Alondra shared that during the first years of elementary school her teacher required the students to do mathematics problems twice. The teacher gave them about 10 problems as homework and the students had to do each of these problems two times. Alondra reflected about this and said,

Yo sentí que para mí esa estrategia de primero y segundo grado me gusto mucho la matemática. Memorice mucho la matemática, se me hicieron muy fáciles pues de conocer los números. Como que acordarme hacía trabajar un poco más la memoria. [I feel like that strategy in first and second grade made me like mathematics a lot. I memorized a lot of mathematics and that made it very easy for me to know the numbers. Recalling them made my memory work a little more]

Alondra considered that this strategy that included repetition and memorization made mathematics easier for her. Homework would include several problems that were similar to the

problems the teacher explained in class. She worked on the problems during the morning when the teacher gave them time in class and in the afternoon when she was doing her homework at home. Alondra's teacher focused on making his students practice the mathematical algorithms constantly so that it would be easier for them to memorize them and recall them later.

For Alondra, feeling comfortable with mathematics made her value mathematics more and see its importance in her future. She explained that the mathematics basics were the most important to learn since, as she said, "de ahí ya sabes que puedes llegar muy alto" [from there you could go higher]. As Alondra progressed with her education, she kept referring to the basic mathematical concepts that she memorized in previous years. When she encountered new concepts and algorithms, Alondra felt ready because of how well she understood the basic mathematical concepts. In her own words, "mi cerebro ya estaba listo para aprender" [I felt like my brain was ready to learn]. Realizing the importance of mathematics and how they made sense to her, kept Alondra interested in learning new mathematical concepts. Both Alondra and Sandra enjoyed their mathematics class and liked mathematics.

For Magali and Elena, their experiences with their mathematics teacher changed their perception about mathematics in a less positive way than for Sandra and Alondra. Magali went to school in the United States, while all the other mothers in this study went to school in Mexico. Magali shared that one of the reasons she did not like mathematics class was because the teacher used a seating arrangement based on the students' performance and grades in the class. On one side of the classroom sat the students doing well in the class while on the other side sat students having trouble with the subject. Magali explained that she was not confident with mathematics even before taking this mathematics teacher's class, but that this seating arrangement made her

feel even less confident and *vergüenza* [embarrassment/shame]. In the following excerpt, Magali explained why she felt ashamed in her mathematics class:

Magali: Pues vergüenza porque cuando eran los parents-teacher meeting, ya en junior high, que ibas y luego que te decían. Me acuerdo de que cuando estaba en el 7, que dijo el maestro, “aquí para este lado tengo los que están batallando y los que no están bien en matemáticas (Magali mueve su mano hacia la izquierda) y para acá tengo los que están sobresaliendo (Magali mueve su mano hacia la derecha).” Y yo ahí de, “que no pregunte mi apa, que no pregunte mi apá.” [Well, ashamed because when there were the parent-teacher meetings, in junior high, you went there and they told you. I remember, I was in 7th grade, that the [mathematics] teacher said “on this side I have the students that are having problems and are not doing well in mathematics (Magali moved her hand towards the left), and on this side I have the students that are excelling (Magali moved her hand towards the right).” And I was there thinking, “don’t ask Dad, don’t ask dad.”]

Fany: “¿Y dónde se sienta mi hija?” [“Where does my daughter sit?”]

Magali: Y preguntó eso. “Allá, allá se sienta. [He did ask. “Over there, she sits over there” (Magali moved her hand indicating that she was sitting on the left side where the students having trouble with the subject sat).]

Magali felt “vergüenza” when her teacher let her father know where she sat in the mathematics classroom. She was sitting with the students who were having trouble with mathematics. The negative attitude of her teacher made Magali feel that all the students in her mathematics class were being judged and catalogued instead of being helped to succeed. While

these experiences made Magali steer away from mathematics as a learner herself, they had an impact on her as a mother in that she did not want her children to go through the same struggle as she did.

Elena mentioned that what she remembered the most from school mathematics were the teacher's interactions with the students. Elena remembered not feeling comfortable in class and sometimes even feeling fearful.

(Era) el típico que ponía el problema a veces en el pizarrón y preguntaba. "Si estamos en este problema, ¿cuánto es la ecuación de esto y esto otro?" Y si no respondías hasta miedo te daba cuando decía tu nombre así de, "¡Elena! ¡Juanita!" porque era así de "hay ya valí" porque era de un punto menos. [(He) was the classic (mathematics teacher) that would write sometimes the problem on the board and then ask us. "If this is the problem, then what is the equation of this and this?" and if you did not answer his question, you had this feeling of fear when he called your name, "Elena! Juanita!" Your immediate thought was "I'm in trouble" because you would have a point taken away].

The exchange above shows Elena's anxiety and fear of being asked to participate in class. She would make excuses like asking for permission to go to the bathroom in order to avoid participating in class. Elena described her teacher as very strict. Mostly, Elena feared the teacher's reaction and so she tried to avoid participating or asking questions in class. In the next excerpt, she explains how her mathematics teacher reacted to the students who he believed were distracted or talking in class:

Sí, y era cuando el maestro más se enojaba y les aventaba el borrador. O sea, tenía razón en molestarse porque él estaba dando su clase, pero de la misma manera te digo, de lo estricto que era no era de "¿puede explicarlo otra vez?" me entiendes. O sea, no era la

confianza. [Yes, it was when the teacher would get angrier and throw the blackboard eraser to them. I mean, he was right about feeling bothered by them because he was teaching the class, but in the same way because of how strict he was, it was not like you could ask “Can you explain it again?” you know. I did not feel comfortable].

These kinds of reactions from her teacher added a layer of fear of asking for help in the mathematics class. The teacher could think that she was not paying attention and get angry at her, so it was better not to ask. Elena did not feel comfortable asking for help. Her teacher had a particular attitude towards the students who expressed confusion in class or asked for any further explanation.

Elena: Pues se le notaba, le cambiaba bastante la cara y decía, “no has puesto atención en todo lo que lleva del año.” Y no era porque no pusiera atención, como te digo, era que no se explicaba bien para poder entender. [You could notice, his face changed a lot and he would say, “you have not paid attention during the whole year.” It was not because I was not paying attention, it was that he would not explain well so that I could learn]

The mathematics teacher’s strictness and interactions with the students created a classroom environment where the students tried to be quiet at all times. However, as Elena said, in most of the cases the problem was not that the students were not paying attention, the problem was that “que no se explicaba bien para poder entender” [he would not explain well so that I could learn]. Both Magali and Elena felt helpless when they did not understand a topic. In the quote above, Elena explained that she did not feel comfortable asking the teacher for help because her teacher was very strict. Also, Magali explained that mathematics class for her was frustrating because of the lack of help.

Magali: Porque no sabía y lo tenía que hacer. Lo tenías que hacer, no sabías hacerlo, tratabas de hacerlo, no estaba bien, te metías la duda de por qué no estaba bien. [Because I did not know, and I had to do it. You needed to do it; you did not know how to do it. You would try to do it, it was wrong, you would start doubting about why it was not right].

Fany: Y nadie te ayudaba... [And no one helped you].

Magali: Nadie ayudaba [No one helped].

Both, Elena and Magali, felt that they could not get enough help when they were confused. The way Magali described her frustration about not getting help seemed as if she was describing a never-ending cycle that led to nowhere. To better explain this cycle, consider the following example. A student has mathematics homework that is due the next day. The student has to do the homework, but the student does not understand how to do it. In an attempt to do the homework, the student tries and finds an answer, but the answer is wrong. Then, the student starts thinking about why it is not right, but the student still does not understand the concept. This leads the student to feel anxious because the homework is due the next day and has to be done. Now, the student is at the beginning of the cycle again and without help the student starts losing interest and getting frustrated.

These experiences made Magali and Elena associate mathematics with something negative and difficult, which is a feeling that they had for a long time. They studied in different education systems, Magali in the US and Elena in Mexico, yet their experiences share the same feelings of frustration and helplessness. As Elena grew up, she continued to dislike mathematics and doubted her mathematics skills. For Magali, it was not until she started her associates degree

that she discovered her command of mathematics. Elena and Magali agree on the importance of mathematics and so they kept trying to learn it.

Instead of remembering a teacher in specific, Lidia remembered an encounter that she had with mathematics. One of Lidia's experiences with mathematics at school that changed her perspective about this subject was in her accounting class in high school. She discovered the importance of exactness in mathematics in the real world. In one of the tests for this class, Lidia had to calculate the account balance of a company given that the company made different purchases and received money in different ways. At the end of her calculation, Lidia ended up three pesos short. When her teacher noticed that she did not have the correct answer, the teacher sent her back to revise her answer. She made all the calculations several times but each time she was missing the three pesos. At first, she thought "it is only three pesos, a very small amount of money (about 15 cents of a dollar)". She could have given the three pesos to the teacher since she had them in her wallet. However, she realized that three pesos were very important since it was money and any amount of money mattered for a company no matter how small. Because of this experience with the three pesos missing, Lidia discovered that the accounting career was not for her and she concluded that:

No puedo ser contadora porque la vida no puede ser tan exacta, tan cuadrada... y yo, ¡Hay no! Como que no puedo... tienes que tener un margen como de error. [I cannot be an accountant because life cannot be that exact, so squared... and I... Oh no! I cannot... you have to have a margin of error].

Lidia explained that she likes mathematics because of the exactness but at the same time this characteristic of mathematics made it difficult to work with in real life. As Lidia grew up, her appreciation and fascination for mathematics increased to the point that she enjoyed data

analysis. Lidia developed a liking for mathematics as she discovered their usefulness at work and daily life.

The mothers' diverse experiences with mathematics in school contributed to their overall perspectives about this subject. The amount of help and support with mathematics and education in general at home varied among the mothers. Next, I talk about these experiences for each of the mothers and how those also helped shape their perspective about mathematics.

### *Experiences with Mathematics at Home*

Elena considers that she had all the support needed at home to succeed in her mathematics classes. However, due to her lack of good experiences with school mathematics and lack of understanding of how important and useful mathematics were for her education and future, she did not take advantage of all the support she had at home. Elena's mom was an accountant and her sister who is older than her kept studying until getting her master's degree and was a teacher in a local school. Elena's parents, especially her mother, and her sister constantly offered to help her with her mathematics homework. In the following quote Elena talked about the help her mother offered to her:

Y ella (su madre) hacía lo imposible como te digo. Cuando fue lo de las tablas hasta casetes que cantaban las tablas. Cantaban las tablas y yo me ponía a bailar en lugar de aprendérmelas. Mi mamá me las explicaba y me dejaba haciendo y yo me quedaba dormida... Te ponían al día 10 cuestionarios, porque allá era de los cuestionarios a la hora de los exámenes, y mi mamá cuando entraba al cuarto y pues yo dormida. O sea que mi madre siempre puso todo de sí. Mi madre era contadora. [And she (Elena's mother) did even the impossible. When I was learning the multiplication tables, I had a cassette with songs about the tables. They were singing the tables and I would dance instead of

learning them. My mom used to explain them to me and she would leave me working on them and I would fall asleep... she would give me 10 questionnaires because at that time questionnaires were the way to prepare for exams, and my mom would enter the room and I was asleep. My mom put all her efforts. She was an accountant].

(...)

Pero pues era lo mismo porque yo tampoco ponía de mí. Ella desde siempre, pero yo no me daba la oportunidad. Ya cuando fue pasando el tiempo era de 'OK estás grande y tienes que ponerle las ganas porque ya estás grande.' Obviamente yo sabía que podía contar con ella si se me atoraba algo en la materia, pero realmente nunca lo hacía. No lo hacía con mi maestro, menos con mi mamá y menos con mi hermana. [But it was the same because I did not put the effort. She was always there, but I did not give myself the chance. When time passed by, she was like "Ok, you are older now and you have to put the effort because you are older." Obviously, I knew that I could count on her if I had trouble with the subject, but I never went to her. I didn't do it with my teacher, even less with my mom and less with my sister].

Since Elena did not feel comfortable asking for help at school, she felt that it was even harder to ask her mother or sister for help even though they constantly showed their support and concerns about her mathematics education. She believed it was harder to ask them for help because she was at a rebellious age where she did not care about learning and understanding mathematics. At school, she could always take a make-up test and pass the class with a low grade. Thus, she did not feel the need to ask for help at home. Although Elena thought that having this support was crucial for her mathematics education, she recognizes that she could have taken more advantage of her mother's and sister's support and finished a university degree.

During the interview, Elena reflected on her past actions and became self-conscious of how not liking mathematics truncated her education trajectory. She did not even have an interest in studying a career that required less mathematics. Elena said, “no aprovechaba las oportunidades” [I didn’t take advantage of the opportunities]. Now that she is older and also a mother, she appreciates even more her mother’s effort for helping her.

Y ahora que ya estoy grande digo ¡ay pobrecita de mi mamá! Ahora que soy mamá digo ‘ay pobrecita de mi mamá’ o sea los hijos muchas veces no entendemos hasta que tenemos los hijos. Y no aprovechamos pues todo lo que dan por nosotros. [Now that I am an adult, I say, “Oh, poor mom” Now that I am a mother, I say “Oh poor mom.” As children a lot of the time, we do not understand until we have children of our own. And we do not take advantage of everything that they [parents] give up for us].

Elena appreciated that she had moral, economical, and educational support at home, but recognizes that it was not enough to make her see mathematics in a positive way. To become better at mathematics, Elena explained that she also needed to have more interest in learning mathematics and motivation to do it.

Other mothers, Lidia, Magali, and Alondra, also shared their appreciation for having their parents’ support. The kind of support that these mothers got from their parents varies. For instance, Magali’s mother asked her every day if she did her homework but she was too tired to help her with it; Lidia’s mother kept checking if she needed something when she was studying and made sure she had the supplies she needed but let her older siblings answer her questions; and Alondra’s mother made sure that she returned safe and sound to her home every day and prepared her meals but she did not handle any education related issues. Their mothers did not help them with mathematics homework, but they made sure that they had the encouragement at

home so that they could continue studying. Their fathers were the head of their household and principal providers of economical support. While the economic support provided by their fathers was crucial for their education, the mothers in this study primarily talked about their own mothers since they were the ones at home most of the time.

Some of the mothers mentioned that their siblings were the most important sources of support with their mathematics education or education in general. For instance, at Lidia's home, her older brothers and sisters were the ones who helped her the most with mathematics whenever she had a question or needed further explanation. Depending on the topic, Lidia approached different siblings with her questions.

In the following quote, Lidia expressed how grateful she was about having siblings, “que hubieran sido nada más mis papás y yo, que amolada, no habría de donde... te digo, la fortuna fue esa, que tenía hermanos” [if it had just been my parents and me, that would have been bad, I would not have had where to go... like I tell you, my fortune was that I had siblings]. When she said, “if it had just been my parents and me, that would have been bad, I would not have had where to go,” Lidia underscored how important her siblings were for her education since without them she might not have had anyone to help her with homework. She reaffirmed this by saying “my fortune was that I had siblings.” Lidia believes that her education path could have been very different if she had not had siblings. Their presence made her realize that if she had trouble understanding certain topic at school there was someone at home who could help her.

In a similar way, Alondra's sister also played an important role in her education since she pushed her to continue studying and was constantly checking on her progress. In the quote below, Alondra gives an example of how her sister encouraged her to continue studying. When she finished 6th grade she was thinking about not continuing with her education, mostly because

her impression was that most of her friends were not continuing either. But her sister encouraged her to continue and told her “mira si estudias tú, aunque no vaya nadie, el estudio va a ser para ti. Si nadie va o no pueden ir por lo que sea, lo que tú aproveches va a ser tuyo” [look, if you study, even though no one else continues studying, what you learn is going to be for you. If no one goes or they cannot go for some reason, what you get will be yours]. And so, Alondra decided to keep studying because of her sister’s words.

Alondra reflected on her parents’ support and concluded that her parents supported her in other aspects different from school. Her father worked in the field and provided economical support. Her mother took care of the home and cooked meals for her and her siblings. However, Alondra’s sister supported her education. Thus, she considers that she got enough support at home.

On the other hand, Magali, who had two older brothers, never asked them for help because she did not feel comfortable doing so. They did not get along very well even though they were one and two years older than her. Magali explained, “se ayudaban entre ellos, ellos estaban en el mismo grado” [they helped each other, they were in the same grade]. So, she attributed the distance with her siblings to her being in a different grade. Magali did not want to bother her parents with questions about homework because she knew they were very tired during the week and believed they had other matters to deal with during the weekends. Not getting help from her siblings and not asking her parents for help made Magali feel helpless in relation to mathematics since she was neither getting help at school from her teachers nor asking for help at home.

For Sandra, her parents’ support with her education was very minimal. They supported her economically. As a member of the family, Sandra had the responsibility of doing different chores at home. Sandra shared how she managed to get her homework done every day together

with her share of home chores. Sometimes she ended up doing her homework at night with the help of a candle and finished it the next day early in the morning. She was very committed to her studies.

Sandra showed her eagerness for learning, how important it was for her going to school, and her determination to learn, when she said, “aprovechar al máximo el tiempo que estabas en la escuela [take as much advantage as possible from the time at school].” Sandra put in a lot of effort every day so that she could continue going to school even though her father believed it was not important for her to do so. Her responsibilities at home limited her time for studying so she felt that she needed to take advantage of every minute she had at school.

Since Sandra was one of the oldest children at home, she did not have other people besides her parents who could help her with mathematics. Furthermore, she soon exceeded her parents’ level of formal schooling. Hence, they could not really help her with her mathematics questions and homework. Sandra’s grandfather was the one who taught her the most about mathematics and answered her questions. He taught her mathematics through planting corn and other grains.

Even though she had her grandfather’s help, Sandra had the constant feeling that she could do more, that she could study more mathematics and continue her education because she knew it was important. However, she did not have enough support from her parents to do so. After finishing middle school, Sandra could not continue studying since she had to work.

As a result, Sandra made the effort to help her younger siblings continue their education and she changed her parents’ minds about the importance of education in any child’s life. Sandra proudly shared that her two youngest siblings were studying at the university and one of them was about to graduate. She felt very happy for them and proud that at least she was able to

convince her parents about giving her siblings the opportunity of continuing their education, something she wished others had done for her when she finished middle school.

The experiences with mathematics at home and school of these mothers were very varied. At one end, we had Sandra whose mathematics classes motivated her to continue studying and made her like mathematics while she did not have a lot of support at home to continue studying. Then, we had Alondra and Lidia who loved mathematics because of its importance in real life and their positive experiences with it at school. Alondra and Lidia had their siblings as their main source of support for their education at home while their parents supported them morally and economically in different ways. Elena's experiences in the mathematics classroom made her hate mathematics. She had a lot of support from her mother and sister at home, but that did not make her change her mind about mathematics. In the end, she could not take advantage of all education opportunities she had because of her bad experiences with mathematics at school. Lastly, we had Magali who had different discouraging experiences with mathematics at school and the limited educational support she had at home steered her away from continuing her education. This diversity in experiences points to the importance of a balance between the educational support children receive at home and at school. Magali like Sandra made sure that her siblings, in Sandra's case, and her older children, in Magali's case, would not have the same experiences as they did. They both made their goal to advocate for a better education for those close to them and make a difference in the lives of their loved ones. In the next section, I examine how the mothers' own experiences with mathematics at home influenced their relationship with their children and participation in their mathematics education in the present.

### *Learning from Past Experiences with Mathematics*

For all the mothers participating in this study, supporting the education of their children went beyond preparing meals, washing uniforms, and took them back and forth to school. The mothers' experiences with mathematics informed how they related to and thought about their children in the present. Some of the mothers wished their parents had had a stronger presence in their education. For instance, Lidia would have liked her mother to show more interest in helping her with homework.

Lidia:           Mi mamá era la que había estudiado un poco más. Me hubiera gustado que se hubiera sentado conmigo a hacer la tarea, a revisar la tarea. Ella no sabía si la hice o no. Era mi responsabilidad. [My mom was the one who studied a little more. I would have liked her sitting with me to do homework, to check my homework. She did not know if I did my homework or not. It was my responsibility].

Lidia wishes that her mother had helped her with her homework more and seems to justify her mother's distance from her education by saying that it was her (Lidia's) responsibility. For Lidia, being responsible for going to school implied attending school and doing her homework without her mother's help. Thus, every time she needed help with homework she asked her siblings directly. Sitting down with her mother while she was doing her homework, checking it after it was done, and making sure she did it are things Lidia felt were missing on the educational support she got from her mother. Therefore, Lidia did not want her children to feel the same way, to feel that their mother was not interested in getting involved in their education. She did not want them to feel alone and overwhelmed.

She asserted that even though she was sometimes tired or had a lot of work, she would always set apart time to study with her children because that was something she needed to do as a mother. Lidia remembered very well her feelings as a child and focused on supporting her daughter in ways that would prevent her daughter from feeling as she did. Lidia explained, “yo no quiero que ella pase por esas cosas difíciles... tienes que aprender a saber como son tus hijos para saber como les puedes ayudar” [I don’t want her to have those difficult experiences... you need to learn how your children are so that you know how to help them]. Lidia strongly believed that it was necessary to get to know her children’s academic level, strengths, and weaknesses in order to help them with their education. Lidia transferred some of her mother’s teaching to her daughter as she was the oldest of her children.

Lidia:           Entonces con ella (Miriam) así igual hago como una mezcla, ¿no? Entre que, “¡Oye mira! Tu única responsabilidad es la escuela.” O sea, lo que a mí también me inculcaron. Y luego con ella, “pero aquí estoy yo, dime a ver qué quieres aprender” y si no lo sé pues ya ves que te [referring to Fany] ando texteando. [Then with her (Miriam), I do like a mixture, no? In between, “Look! Your only responsibility is to go to school.” Like what my parents taught me. And then with her also, “but I am here, tell me what you need to learn” and if I don’t know, well you know that I send you (referring to Fany) a text message].

Fany:           Es de, déjame averiguar y ahorita te ayudo [It is like, let me figure it out and then I’ll help you].

Lidia was fostering the sense of school as a responsibility on her daughter but at the same time, she was making sure her daughter knew that she was there, and that she could lean on her.

She took what she thought was important from her experiences with education and her mother and added aspects she felt were missing in her experiences with mathematics education at home.

Like Lidia, Alondra wanted her daughters to know she was there to support them and that she would have liked her mother to get close to her and show interest in her education.

Me hubiera gustado que mi madre me hubiera preguntado, “¿cómo vas? ¿Tienes exámenes?” No. Ellos nada más se enfocaban en que: come, vete, llegaste bien, y haz lo que tienes que hacer. Y la tarea tú sabrás. [I would have liked that my mother asked me, “how are you doing in school? Do you have a test?” But no, they only focused on: eat, go to school, you came back, and do what you have to do and homework is up to you].

Small questions like “do you have a test?” or “how are you doing in school?” from her mother could have made a difference for Alondra. According to Alondra, there was no apparent interest from her mother in her schooling. This made her not feel comfortable or *en confianza* with her mother. Hence, for Alondra it was important to nurture *confianza* and a dialogue about their education between her daughters and her.

Alondra described a two-way *confianza* relationship where she, as a mother, felt comfortable asking questions and checking on her daughters’ progress in education. On the other hand, her daughters felt comfortable to ask their mother for help and support. She explained that even her oldest daughter who was a university student would keep trying to involve her family in her education by inviting them to academic events and keeping them informed about her progress. For Alondra, cultivating the feeling of *confianza* on her daughters was a way of showing her support and strengthening her relationship with them. With this Alondra considered that she was improving her daughters’ experiences with education at home and doing things differently from her own mother.

Sandra shared a similar opinion to Lidia's and Alondra's about the involvement of her parents in her education.

Me hubiera gustado que se (sus padres) hubieran tomado el tiempo, porque pues sí, igual y yo pienso que uno dice “no hay tiempo, no puedo” [...] Pero si tú quieres darte un poquito de tiempo para ir a la escuela de los hijos o también darte un poquito de tiempo para hacer algo para ti o eso, te lo puedes dar. Ahora yo entiendo que el tiempo hay que dárselo uno. No puede decir uno, “no, es que no hay tiempo,” el tiempo sí lo hay. [I would have liked that they (her parents) had taken the time, because yes, I think sometimes you say “there is no time, I cannot”[...] But if you want to take the time to go to your children's school or take a little time to do something for you or something like that, you can take the time. Now, I understand that you have to give yourself time. You cannot say, “No, because there is no time,” there is time].

Sandra reflected about the excuses she had heard other adults and sometimes herself say in relation to getting involved in their children's education, “I don't have time.” She explained that it has always been the same, adults were busy then, when she was young, and now that she is an adult, adults are busy also. However, she discovered that there was always time no matter what. Sandra was mainly concerned about setting time apart to go to her son's school to check how he was doing in class, to ask him how he felt about school, and to listen to him. Sandra wanted to make sure that she was giving her son the time he needed in order to feel supported. She considered that her parents did not set time apart for checking on her education and was trying to change that with her son. While Sandra's view of her parents' involvement could be interpreted as her having a deficit view towards her parents, it has to be understood in the

historical and cultural context of Sandra's experience growing up, with a view of women as having to help at home and thus not needing to pursue studies.

Magali described the lack of support when she was in school from both sides, home and school, as “dos peleas” [two fights] that she had to face every day. The use of the word “peleas” [fights] depicted Magali's constant struggle with mathematics and her feeling helpless during her schooling years. She did not want her children to have to face those battles alone. One of the events that pushed Magali to support her children was the following experience with one of her mathematics teachers:

Porque él me dijo a mí, “No entiendes Magali que tú no eres nadie y que no vas a llegar a nada.” Así el muy malcriado. Y a lo mejor y tenía razón, pero yo, que se superen mis hijos, que ellos logren lo que yo no pude. Entonces, sí era alguien, nada más que yo no lo hice, ayudé a que los otros logaran lo que tenían que hacer. [He said, “Magali, you don't understand that you are no one and you will not achieve anything.” That was what he said to me. And maybe he was right, but for me, I want my children to succeed, I want them to achieve what I could not. Then, I am someone, not the one that achieved something but the one that helped others achieve what they needed to do].

Magali remembers the words of her teacher with anger and sadness. It was such an important experience in the mathematics classroom that as of the date of this interview, decades after, she still remembered her teacher's words clearly. When she said, “y a lo mejor y tenía razón” [And maybe he was right], she showed signs that she started believing what her teacher said and accepted that she was never going to be able to be someone in life. At the end of the quote, we can see that she reconsidered her words and acknowledged that she was able to do something, she “ayudé a que los otros logaran lo que tenían que hacer” [helped others achieve

what they needed to do] referring to her children. Now as a mother, Magali took an active role in the education of her children and looked for information that would help her backing up her children and giving them a better education.

Magali said, “ahora yo miro la diferencia, ahora ya sé que buscar, ahora ya sé por donde moverme para tratar de hacer lo mejor” [now, I see the difference, now I know what to look for, now I know where I need to go in order to do the best]. Magali had been able to support her children by looking for programs and resources that could help them succeed in school, which was something that her mother was not able to do for her because of her mother’s working schedule and the language barrier. Magali’s experiences informed her about what difficulties her children could face. With this knowledge in mind, she was able to advise them and look for help and support at their schools and her community. Even though Magali felt that sometimes she could not help her older children with their homework, she made sure that they knew she was there to support them as they needed.

The majority of the mothers wished their parents had been more interested and involved in their education, so the mothers changed that with their children. They noticed what was missing from the educational support they received at home and made sure that those missing aspects were not missing in the education of their children. As we mentioned in previous sections, Elena’s mother constantly supported her in her education in general and mathematics education by helping her with her homework, providing her with the opportunity to learn and practice mathematics at home, and showing interest in her education. Thus, Elena wanted to give to her children at least the same amount of educational support she got from her mother. To this, she added that education at home should be a reinforcement of the education the child received at school, as she explains in the following quote:

Se aprenden cosas en la escuela, pero pues las refuerzas en casa. Entonces este te puedo decir que tenemos buen rol aunque a veces nos atoramos pero ellos saben pues que si no aprenden algo o si no entienden algo pues ahí está mamá. [You learn things at school, but you reinforce them at home. I can tell you that we, the parents, have an important role. Even though sometimes we get stuck, they (our children) know that if they don't learn or do not understanding something, mom is there for them].

Elena wanted to support her children and like the rest of the mothers make sure that their children knew their mother was there to help them. When Elena said “pues ahí está mamá” [mom is there], she reaffirmed her position as a source of help and support at any given time. It did not matter what the question was or what kind of help the child needed, she would always be there. Every mother had a different way of showing their children that they were supported but all their efforts came from the same place, their previous experiences with their parents and education in general. All of them wanted to be involved and increase the support they gave to their children.

Based on their experiences with mathematics at home while growing up, the mothers shared that they wanted their husbands to have a more active role in the education of their children. For all the mothers, their fathers worked long hours, were the main economic support of their homes, and did not get very involved in their children's education. Now, the mothers recognized that their husbands can help them with the education of the children, mathematics or not mathematics. Therefore, most of the mothers focused on creating opportunities for their husbands to interact with their children. For instance, Alondra explained that her husband would help her daughters with their mathematics homework, but he did not like to help them practice reading because he did not like reading. However, Alondra convinced him to do it by putting him

as an example to follow for her daughters. She said, “(leer), es una necesidad y una importancia. Si tú quieres que tus hijas no batallen con eso en la escuela... yo sé que un hijo que te ve leer, les nace por leer” [reading is a necessity and a very important one. If you don’t want your daughters to struggle with it at school... I know that a child that sees you read is going to be attracted to read also]. Alondra’s husband practiced reading with his daughters and was very patient in teaching them new words while she focused on helping them with mathematics. Having her daughters notice the involvement of both of their parents in their education was considered to be crucial for Alondra since based on experience she knew that this would be a motivation for her daughters to keep studying. As we mentioned before, Alondra’s parents were not involved at all in her education, so she wanted her daughters to have a different experience.

With the goal in mind of getting her husband to contribute to her children’s education, Elena would tell her sons to ask for their father’s help when he arrived home from work.

Sí, ya es cuando llega. Siempre le digo, ‘dile a tu papá que te ayude siempre si no entendiste algo’. Porque pues yo estoy con Samuel, estoy con los dos pero pues me apoyo en él para que participe. Porque como te digo, mi papá casi no tuvo participación por su trabajo, pues a veces tenía que salir de la ciudad y no lo veíamos en días así es que era más difícil. [Yes, it is when he arrives home. I always tell him, “always tell your dad to help you if you did not understand something.” Because I am already helping Samuel (one of her two sons), I am with both of them but he [Elena’s husband] is my support so that he participates. Because like I told you, my dad did not participate [in my education] because he worked, he sometimes had to travel and we did not see him for several days so it was harder].

Even though Elena could have helped both of her children with their mathematics homework, she would tell her children to go and ask her husband. Elena's father rarely helped her with homework because of his work but she wanted her children to take advantage of having their father at home every evening. Elena saw her husband as her support and partner since they both would study together if they could not understand or explain a mathematics problem to their children. Thus, he was not only supporting her children but also his wife, which was something Elena valued the most.

In similar ways, the rest of the mothers would ask their husbands to get involved and actively participate in the education of their children. For example, Sandra would ask her husband to teach her son about the mathematics used in plumbing, and Lidia's husband who did not like mathematics would help her son who was in kindergarten with his mathematics homework. Each of the mothers had a way to involve their husbands in the education of their children so that their children would have better experiences with mathematics and more support than the ones they had had themselves growing up.

### ***Reflecting on Their Children's Mathematics Education***

The mothers expressed that their children's education had some aspects that they liked and appreciated based on their past experiences with mathematics education both at home and school. One of the main things the mothers mentioned was the availability of help for them and their children. In the previous sections, we talked about how Magali felt when she was going to school. Magali felt helpless and recognized that she would have liked to have more support at home and at school. Magali saw a difference in the support she and her children were receiving from the school.

Ahora como te digo del Emilio, yo miro muchas cosas, mucha diferencia, veo como los maestros les ayudan y [...] ahora yo busco información para mis hijos [...] El niño desde preescolar [...] yo buscaba información. Sentí apoyo, sentí apoyo de los maestros, sentí apoyo de la escuela y sentí... Dije yo, “ahí me enseñaron cómo buscar información.” Sí, al tercer niño (Emilio), me enseñaron cómo buscar información y cómo buscar ayuda [Now, like I told you about Emilio (Magali’s son), I can see a lot of things, a lot of differences, I see how the teachers help him and [...] now I look for information for my children. The boy (Emilio) since kindergarten [...] I searched information. I felt the support, the support from the teachers, the support from the school, and I felt... I said, “There, they taught me how to search for information.” Yes, with the third child [Emilio], they taught me how to search for information and help]

[...]

Ahora ya miro la diferencia. Ahora ya sé qué buscar. Ahora ya sé por dónde moverme para tratar de hacer lo mejor. [Now, I can see the difference. Now, I know what to search for. Now I know what to do in order to do the best.]

Magali noted that there was more information on different programs and resources to help their children than when she was in school. In particular, she found the teachers and staff members at her child’s current school to be very helpful. When she said, “ahí me enseñaron a buscar información” [there, they taught me how to search for information], she showed her gratitude towards the school staff and teachers that helped her acquire the skills she needed to support her child and be involved in his education. She claimed that these acquired skills helped her to look for the best options possible for her child. For instance, Magali explained that her son started to have some trouble with his mathematics homework, and she felt that he needed more

help. With this in mind, she was able to find an after-school program that addressed her child's needs and helped her enhance her child's mathematics education experience.

The mothers appreciated the mathematics classroom environment and particularly the interactions between teacher and students. For example, when commenting on a visit to a sixth-grade mathematics class, Elena said:

Ahora muchas maestras se ponen para que los niños entiendan y no pasar el tema nada más así. Como cuando estuvimos con la Miss Pérez que te acuerdas que me encantó en la manera en la que ella enseñaba porque todos participaban y se daba el tiempo ella de que todos entendieran. [Now, a lot of teachers put effort on helping the children understand and they do not change the topic just like that. Like when we went to Ms. Perez's class, I loved the way she taught the class because all the students participated, and she took the time so that all of them understood the topic]

In the quote above, Elena shared what she loved about the mathematics class she observed. Elena's explanation focused on the way Miss Perez taught the class and the interactions between students and teacher. When Elena was attending school, she disliked participating in mathematics class and tried to avoid it. In her comment, she praised the active participation of the students in class and related this to the teacher's interest in the students' learning process.

"Ojalá me hubieran enseñado a mí así" [I wish I had been taught that way] were the first words Elena said when asked about her children's mathematics education. She believed that her children were having better experiences learning mathematics because of the teaching approach and she could see a difference in the attitude her children had towards mathematics. She noticed that her children liked mathematics which was the complete opposite of her when she was

studying. Elena said, “¡Aaah! no van a ser como yo” [Wow! They are not going to be like me], surprised and at the same time happy that her children were enjoying learning mathematics and that their experiences with mathematics were different from hers.

Elena, also, commented that mathematics seemed to be easier now. She said, “¿Por qué (el maestra/o) se la ponen tan fácil la pregunta? Y a nosotros tan difícil” [Why are the questions they [the teachers] give them so easy? The questions for us were so hard]. Elena considered that the way her children were learning mathematics made it easier for them to understand. The mathematics were the same, but the teaching approach was different. She explained that information and resources were more accessible to students because they had charts on the walls of the classroom where they could look for examples and definitions. For Elena, mathematics seemed to be more accessible to children now.

The rest of the mothers also gave detailed examples of what they liked about the way their children were learning mathematics. Lidia compared the way she learned mathematics with how her daughter was learning it.

Y todas las matemáticas que recuerdo así eran, era una estrategia, una forma de sacarla y una forma de resolverlo. [All the mathematics that I remember were like that, only one strategy, only one process, and only one solution]

Lidia learned mathematics by memorizing and using only one way to solve the problems. There was only one correct way of solving the problem for the teacher. Thus, when Lidia said, “era el resultado que la maestra esperaba” [It had to be the solution that the teacher was expecting], she referred to the little room for variation on the appropriate strategy to solve the problem and if your strategy was different from what the teacher was expecting then it was

wrong. Now that Lidia had been helping her daughter with her homework, she noticed a big difference.

No pues ahora si que lo veo de polos extremos [...] Y ahora veo que... aparte es diferente país verdad? pero pues es de que como funcionan ahora en día. Ahora les dan más opciones, les enseñan a razonar, no mecánicamente sacar, o sea desarrolla un modelo. Ya con solo hacer un modelo ya tiene uno o dos maneras y ahí le dan la forma de tomar una decisión y eso le ayuda al niño. [I see it as opposite sides [...] Now, I can see that besides being different countries, right? But it is about how it works now. Now, they give them more options, they teach them how to reason, to not procedurally get to the answer, but develop a model. With doing only one model you have one or two different ways and they give her the tools needed for taking a decision and that helps the child.]

Lidia valued that her daughter had a deeper understanding of the mathematical concepts and that she had different strategies to solve a single problem. Her daughter was not only memorizing algorithms but also understanding how those algorithms worked. Similarly to Lidia, Sandra noticed that her son was learning different strategies for solving a problem and getting the same answer. She considered that her son had more mathematical tools than she did when she was attending school and that the teachers were explaining mathematics to him better.

Alondra reflected on the benefits of teaching different strategies to solve a problem for all the children, not just her daughters.

Como la niña de segundo por un decir que una suma y como sumar, no les dan nada más una manera, sino que les den opciones para ver cual ellos pueden captar. Digo que eso está bien, porque ahí ellos están apreciando que todos los niños son diferentes mentalmente... está bien para mí, está bien que no modifiquen eso. Pero si, traten de

buscar nuevas estrategias de enseñanza porque así le dan más oportunidad a toda la clase, más facilidad porque si hay 20 niños, los 20 no van a entender de la misma manera. [For instance, my second-grade daughter gets an addition problem and is learning how to add, they do not give them only one way of adding, but they give them options to see which one they can understand. I think that is good because they are taking into account that all children are different mentally... I think that is good, I think it is good to not modify that [teaching them different strategies]. But I would like them [the teachers] to search for new teaching strategies because in that way they give more opportunities to the whole class, it is more accessible because if there are 20 children, all 20 of them are not going to learn in the same way.]

Alondra recognized the usefulness and importance of teaching different mathematical strategies to the children. She explained that not all children think and learn the same way. Thus, the different strategies would increase the probability of finding a strategy that they can understand and use. Alondra emphasized that teachers should keep focusing on developing new strategies since every class is diverse and more children would be able to understand mathematics if more strategies were available. All the mothers shared that they believe their children are learning mathematics in a different way. They mentioned that now children have more strategies that they could use to solve a problem. Thus, children could find a strategy of their preference and keep learning mathematics.

All of the mothers were taught mathematics in a different way from how their children were learning. Given the difference between how Lidia learned mathematics and how her daughter was learning them, Lidia explained, “Tengo que ponerme con ella a aprender. Porque hasta a uno ya se le puede... puede llegar un momento en que ellos pasen lo que ya sé” [I have to

sit down with her and learn because one could... there could be a time when they exceed my knowledge]. Lidia felt that she needed to learn mathematics with her daughter even though she knew how to do the problems using the methods she learned in school. She did not want to get to a point in the future where her daughter had a question and she would not be able to help her. Sandra and Alondra also took advantage of helping their children with their mathematics homework and considered this as a review and an opportunity to further their understanding about mathematics.

When the mothers were asked about how they were able to help their children with their homework even though they did not learn mathematics the same way as them, the majority responded that the internet and handouts sent home by the teachers were their main sources of information. The mothers' parents did not have these sources of information but since the mothers had them available, they were taking advantage of them. As the presence of technology increased in society, also the sources of information and benefits from technology increased. All the mothers had a smartphone or computer where they could look for any information related to the mathematics that their children were learning at school. Magali explained how she looked for information over the internet and how she used it.

Magali: Busco como keywords en lo que es la tarea, lo que está escrito. Porque ahí en las instrucciones te está diciendo que es. Sí, veo yo que es, lo pongo en YouTube, y ya me sale la información. [I search keywords in his homework, in the written part because in the instructions it is telling you what it is. I see what it is, and I search it in YouTube and the information appears.]

Fany: Y ¿cómo le haces? ¿lo ves tú primero y luego le enseñas a tu hijo? [And, how do you do it? Do you watch it first and then you explain it to your son?]

Magali: Sí. Lo veo yo primero y luego yo le ayudo. Y también le digo, “ayúdame con lo que tú sabes para no confundirnos y tú dime si voy mal, tú dime.” Porque él sabe, porque la maestra le enseñó. El sabe, nada más que necesita como que un poquito de ayuda. [Yes, I watch it first and then I help him. I also tell him, “help me with what you know so that we do not get confused. You tell me if I am wrong, you tell me.” Because he knows because the teacher taught him. He knows but he needs a little bit of help]

Magali used the information provided in her son’s homework and her son’s experience with the topic in class as a way of cross checking that the information on the internet was reliable and useful for them. Magali preferred videos since they would have more explanations. When the appropriate video was identified, she would watch it first and try to understand the procedure so that she could teach it to her son.

Lidia also used the internet to help her daughter with mathematics homework. When she got stuck in a problem and not even the handouts sent by the teacher helped her figure it out, she went to the internet. She turned to YouTube on these occasions.

Miriam tiene que verificar su trabajo. Lo hizo de una manera y luego el resultado es tanto y te tiene que dar lo que yo tengo aquí, ¿no? Entonces su forma de... o ella corroborar así. Usamos mi experiencia. Lo que me acuerdo. Y luego si ya no me cree o se le dificulta o a mí también, nos vamos a verificarlo con el YouTube. Buscamos algún video alguien que diga como hacerlo [Miriam has to check her work. She did it in this way and

her result is this and it has to match with my result, no? So, her way of checking is... we use my experience, what I remember. And then if she does not believe me or if it is difficult for her or me, we verified it with YouTube. We search for a video, someone who explains how to do it].

Sometimes, Lidia and her daughter could not get to an agreement about the correct solution, so Lidia would turn to the internet. The criteria Lidia used to choose a video was that the example needed to have a detailed explanation, so her daughter and her could follow it. Together, Lidia and her daughter would try to make sense of the video and solve the problem together. Similarly, when Elena's children did not know how to do the mathematics homework and she did not know how to either, Elena would search through the examples in videos, images, and text until she found a source that had a clear explanation.

Elena: Señor Google. Y ya después digo yo, OK, si ya le entendí más o menos empiezo... [Mr. Google. Then, if I think "Ok, I understand it more or less," I start]

Fany: Y cuando vas al Internet ¿Cómo diferencias qué es buena información de mala información? [And when you got to the internet, how do you distinguish good information from bad information?]

Elena: Viendo toda la información. Sí, porque ya ves que pones y te salen chorrromil opciones y ya le pones. Me gusta más cuando te ponen los ejemplos porque ya ves que mucho pues es de lectura. No, a mí me gusta ver cuando le picas a imágenes y que te dé el ejemplo. Por ejemplo, para sacarla el perímetro o el área de una figura y así es como me voy. Pero a veces si es de uno por uno, todo, toda la noche. Tu chamaco ahí (Elena

made a gesture with her hand simulating her child laying down sleeping) y tú despierta. [I see all the information. Yes, because you know that when you put something, you get thousands of options and then you click on them. I like it when they give you examples because a lot of them are readings. No, I like to see when you click in the image and it shows you examples. For instance, when you need to calculate the perimeter or the area of a shape and that is how I search. Sometimes I check them one by one, all of them, during the whole night. Your child is sleeping while you are awake searching.]

Like the rest of the mothers, Elena first learned and understood the material and then she approached her child and explained it to him. Elena shared that sometimes finding the correct information and understanding the material took her all night and that she was explaining the homework to her son during the morning before school. All the mothers put an effort on learning how their children were learning mathematics. They explained that the procedure of looking for information over the internet was challenging since there are thousands of sources available. They searched for YouTube videos, class notes on the internet, and examples of mathematical problems that could teach them how to solve certain kinds of problems, so that they could help their children to understand it. When their children asked them for help, they did not say “I don’t know” they said, “Let me see” These mothers have an advantage over their parents, they have all these tools around them, and they are using them for theirs and their children’s benefit.

The mothers appreciated how their children were learning mathematics and the support the school and teachers were giving to them. In addition, they understood the benefits of having different strategies to solve mathematical problems and were interested in learning these new

methods for two reasons: to help their children and to review or relearn the mathematics from a different point of view. The mothers considered that their children were having a better experience with mathematics at school than the one they had, and they were making significant efforts so that their children had a better experience with mathematics at home also. The mothers' previous experiences with mathematics informed how they related with their children at home, how they helped them with school, and how they encouraged them to continue with their education.

The mothers also talked in more general terms about the importance of education for their children, though not specific to mathematics. I include these comments here because they serve as clear examples of the mothers' interests in their children's education and what they hope for their future. The mothers had different reasons for wanting their children to exceed the highest level of formal education of their parents. For instance, Elena shared that she had several opportunities to go to university and obtain a degree. However, at the time those opportunities were available, she was not interested. As an adult, she regretted not going to the university and earning a degree. Thus, she wanted to offer her children the same opportunities she had but did not take and to advise them not to let those opportunities go. In her own words,

Elena:           No quiero que se cierre como yo y pierda oportunidades que yo perdí por no querer, por no querer hacer nada más por mi educación, te puedo decir por truncarme yo sola. [I don't want him to block himself like I did and lose the opportunities that I lost because I didn't want to, I didn't want to do anything for my education, I could tell you that I limited myself.]

Lidia, explained that she wanted her children to achieve a higher level of formal schooling:

Exigir más, más de lo que me exigieron a mí y.... lo voy a poner así. Por un lado, siento que cada generación tiene que superar la anterior... Especialmente en la educación. No, en tener dinero...Es el preparar a esa persona y solo te lo da la educación [Demand more, more than what my parents demanded from me... I would say it in this way, on the one hand, I feel that every new generation has to surpass the previous one, especially in education, not on having money. It is about preparing that person and only education gives you that].

Lidia pointed out that this desire had nothing to do with her children having big salaries or becoming rich but the fact that education would prepare them for life since she knew how important education was. It was more than a wish because she felt this was part of her responsibilities as a mother. In addition to this, Lidia believed that everyone needs someone who pushes them to continue. She said, “todos tienen la capacidad pero tienes que tener a alguien que te empuje. Y eso es en todos lados” [everyone has the capacity but you need to have someone that pushes you. And that is true everywhere]. According to Lidia, the constant support and encouragement of someone makes anyone work harder and succeed. Lidia considered her responsibility as a mother to be teaching and giving her children the basic tools and skills to succeed in life while being the motor that pushed them through their education.

For Sandra, it was very important for her that her son continue his education and go to university. She shared a conversation where she explained to him why she considered education to be important.

Yo también con mi hijo, le digo “hijo, me gustaría que tuvieras un mejor futuro que el que tuve.” Le digo, “en el aspecto del trabajo no como tu papá. Un mejor futuro.” Le digo, “tu papá es trabajador, tu papá sabe muchas cosas de trabajo, pero él tiene que

trabajar en el calor, tiene que trabajar si llueve; tú ves como a veces llega todo mojado, a veces todo lleno de lodo [...] Entonces le digo, “si tú te superas, tú aprovechas el estudio de ahorita, tú puedes llegar a ser... no sé... puedes llegar a ser un doctor, un licenciado, un ingeniero,” o sea, le doy opciones. Y le digo, no nada más que te quedes que “no, yo nomás voy a ir a middle school” o “yo nomás voy a ir a la high school.” Tu puedes llegar al colegio, tu puedes llegar a la universidad. [I also with my son, I tell him, “son, I would like you to have a better future than the one I had,” I said, “in the case of a job, not like your dad, to have a better future. Your dad is a very good worker, he knows a lot of things about working, but he has to work in the heat, he has to work if it rains. You have seen him how he arrives home, all wet, sometimes all covered in mud” [...] Then, I tell him, “if you get better, you take advantage of your studies now, you could be... I don’t know... you could be a doctor, a lawyer, an engineer.” I give him options. I tell him, don’t only say “no, I am only going to finish middle school” or “I am only going to high school.” You can go to college; you can go to the university]

In this conversation, Sandra recognized all the hard work her husband and her had been doing and how difficult it was for them. She described the exhausting work her husband did every day. She wanted her son to understand that education would give him the opportunity to get a job with better working conditions. She said, “a mí me gustaría que tuvieras un mejor futuro que el que tuve” [I would like you to have a better future than the one I had] because she did not want her son to have as many difficulties as she had. Sandra wanted her son to have all the opportunities she did not have since she considered that she lacked her parents’ support to continue studying. Sandra knew that even though she would provide support and give her son the opportunity to study, her son needed to be self-driven and motivated to continue with his

education. Thus, she had this conversation with him where she clearly stated what she wanted for him and why it was important. This showed Sandra's understanding of the importance of a balance between the opportunities given to her son and his actual interests and motivations. All the mothers knew the importance of education in life and put their efforts on supporting their children to obtain a higher level of formal schooling than theirs.

### ***Discussion***

Similar to findings in prior research (Civil & Quintos, 2009; O'Toole & De Abreu, 2005), the mothers in this study used their previous experiences in school with mathematics as a reference point that helped them build their views about their children's mathematics education. Also, the mothers used their experiences at home with mathematics not only to inform the nature of the interactions they had with their children but also as an example of what they wanted to change for them. In some cases they wanted to take a very different approach from what they had experienced as children (e.g., Sandra), while in others they wanted to make just some changes (e.g., Alondra), and yet in others they wanted to emulate what their parents had done with them (e.g., Elena). They all wanted to make sure that their children did not develop negative feelings towards mathematics and towards their parents' educational support. Thus, this study adds to the body of research on parents' from non-dominant communities and their reflections on their children's mathematics education in comparison to their own experiences (Civil & Quintos, 2009; O'Toole & De Abreu, 2005). The findings on this study offer a closer look into these Mexican American mothers' experiences with mathematics at school where they interacted with teachers and classmates and at home where their experiences were shaped by the interactions with not only their parents but also other close family members. The mothers made clear

connections between their past experiences and their children's mathematics education and their education in general.

The reflections of these Mexican American mothers and their concern with the education of their children serve as proof against negative stereotypes and deficit views that have been attributed to Latinx parents' involvement in the education of their children (Carrasquillo & London, 1993; Peña, 2000; Valencia & Black, 2002). For the mothers in this study, their participation in the education of their children was linked to their previous experiences with mathematics. For example, Lidia shared that she wanted her children to surpass her highest level of education and for this reason she felt the responsibility of getting involved and pushing her children to continue with their education. In the case of Elena, her involvement in her children's education was powered by her experiences at home with her mother's support and the memory of all the opportunities that she had and did not take. Walker et al. (2011) mentioned that the direct invitations from their children and their teachers to participate influenced parental participation in the education of their children. In this study, the participation and involvement of the mothers in the education of their children was influenced by more factors. Their involvement was not something that could be deduced from some factors like socioeconomic level and language barriers, but it was influenced by a complex web of experiences with mathematics in and out of school.

In addition, the mothers were striving to give their children the best education possible and opportunities. This finding coincides with that of Civil and Quintos (2009) about parents advocating for the education of their children and offering them better opportunities than the ones they had growing up. "For them there is much more at stake (i.e. their children's academic futures) in fulfilling prescribed parental roles while advocating for their children's best interests"

(Civil & Andrade, 2003, p. 156). All the mothers wanted their children to succeed and each of the mothers made efforts to support their children with their mathematics learning. In addition, the mothers shared their hopes for the future of their children in relation to their education. They valued knowledge, schooling experiences, and better job opportunities. For them, one of the most important aspects was to see their children succeed and continue their education.

The mothers in this study highly valued the way mathematics had been taught to their children. They valued the focus on understanding mathematics over repetition and memorization. Alondra considered that the repetition and memorization, a more traditional mathematics teaching, helped her with her mathematical knowledge. However, like the other mothers, she explained that having different strategies to solve problems represented an advantage for the children now. In their study, McMullen and De Abreu (2011) explained that “those who experience opportunities for participation in contexts of mathematics learning different from their own tend to value these practices more highly than those without these opportunities” (p. 72). Like the mothers who were teachers in McMullen and De Abreu’s study, the mothers in this study saw value in how their children were learning mathematics even though they themselves had learned mathematics in a different way. As Quintos, et al. (2019) argued, “mathematical practices need to be discussed and unpacked not only among the school staff; the dialogue must include the community it serves. These connections are critical to support children’s learning” (p. 180). The mothers in this study had the opportunity to explore the mathematics their children were learning in school. This helped them to notice the affordances of the mathematics education their children were receiving and appreciate the new mathematics teaching approaches.

For the mothers, the participation of their husbands in the education of their children was important. As students themselves, the mothers felt the participation of their fathers was missing

in their education. As a result, now they were constantly creating spaces in which their husbands could get involved in doing mathematics with their children. Also, the mothers pushed their children to ask for their fathers' help. In Civil (2001), the participants expressed that they appreciated the participation of the whole family in the mathematics education. The mothers in this study appreciated and put especial emphasis on the participation of their husbands as partners in the mathematics education of their children.

I argue that having the mothers participate in the MFPs as adult learners allowed them to engage with mathematics with a focus on understanding rather than memorization. In that sense they were able to experience some of what their children may have been experiencing in school. In the next section I focus on the findings with respect to the mothers as learners and intellectual resources, as they worked in an activity about interpreting a graph by themselves and in collaboration with the rest of the group.

### **How do Parents' Everyday Life Experiences Influence their Approach to Mathematical Problems?**

The second research questions centers on the mothers as learners themselves. The findings for this research question are organized in two parts: (1) the mothers collaborative interpretations of the graph, and (2) the mothers making the graph their own.

#### ***Collaborative Interpretation***

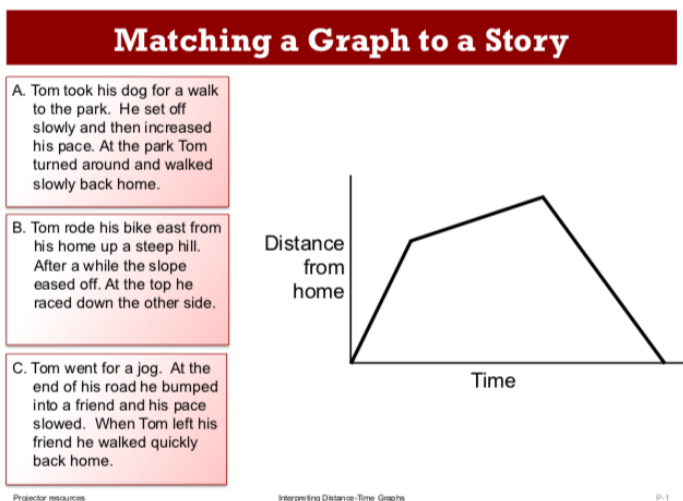
During the third year of the project the MFP sessions focused on explorations around algebra. The participants worked with the coordinate plane and created and interpreted different linear graphs for three consecutive sessions of two hours each. In the first session, the participants practiced placing points on the coordinate system and making sense of coordinate pairs. Then, they were asked to create a graph that showed the number of people at their house

during a weekday. This activity included drawing a graph and explaining it to their peers. Since this was the first graph that the mothers needed to draw fully, there was an initial discussion about how to set up this graph.

For the next activity, the participants had to create a story about a given graph. We used one of the graphs from the formative assessment lesson “Interpreting distance-time graphs” from the Mathematics Assessment Project (MARS, 2015) (see Figure 1). According to Schoenfeld (2013), the activities in this lesson are designed to develop sense making skills of the students.

### Figure 1

*Original activity from the "Interpreting distance-time graphs" lesson in MARS (2015)*



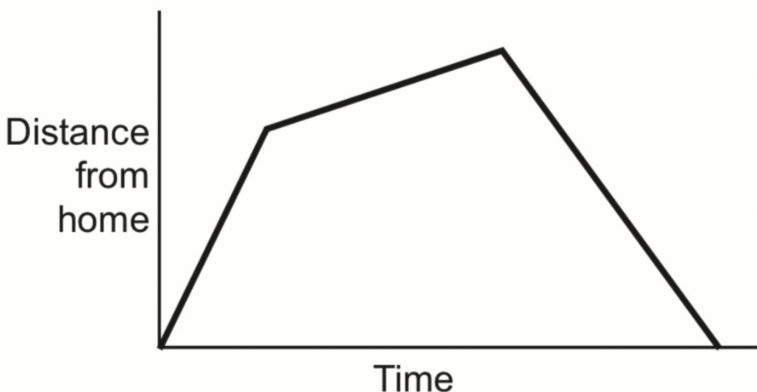
The original activity was modified so that the mothers could be more creative with their stories. The mothers only received a page with the graph including labels (distance from home and time). We renamed the activity as “Es tiempo de una historia” (Time for a story). Figure 2 shows the activity handed out to the participants.

### Figure 2

*Modified activity, “Es tiempo de una historia,” given to the mothers*

Es tiempo de una historia

Escribe una historia que concuerde con la siguiente gráfica.



The activity asked them to write a story that matched the graph and we verbally mentioned to them that they could change the labels in the axis as they saw fit for their story. This was the first time that the mothers practiced interpreting a graph. From beginning to end, the “Es tiempo de una historia” activity lasted one hour.

After the instructions were given, the four mothers present in this session started sharing their ideas about situations that could be represented with the given graph. During twenty-four minutes, the mothers worked together on making sense of the graph. At the beginning of this discussion, Magali immediately related the graph to cooking and said that it could represent the process of cooking rice.

Magali: La cocción de arroz. Lo pones, se empieza a calentar y hierve. Le bajas.  
 [Cooking rice. You put it, it starts heating up and boils. You lower it down  
 (while Magali was moving her finger along each segment of the graph and putting emphasis where the segments intersected)]

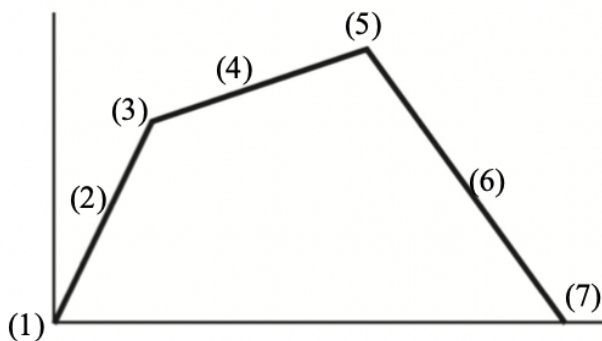
Fany (to the whole group): ¡Ah! ¿Y cuáles serían tus ejes? Porque Magali dice que podría representar como se cuece el arroz. ¿Cómo ven eso? ¿Cuál sería el nombre

en el eje horizontal? [Ah! And what would be in your axis? Because Magali says that it could represent the process of cooking rice. What do you think? What would be the label of the axis?]

According to Magali's gestures, the increasing and decreasing segments in the graph were related to the intensity of the stove's flame and the temperature of the rice and water mix. In the first part of her statement, "Lo pones, se empieza a calentar y hierve" [You put it, it starts heating up and boils], it seemed that Magali was making reference to the temperature of the water in the pot. When I prompted the question about the labels in the axis, her first thought was that the x-axis could represent time and the y-axis could represent the stages of cooking rice such as "putting the mixture of water and rice in the stove," "waiting for it to boil," "covering it so that it kept cooking a slower pace," and "waiting for it to be done." The rest of the participants seemed to agree with Magali's idea and related most of the intersections of the segments to a stage in the process of cooking rice. Thus, in Figure 3, (1) represented "putting the mixture of water and rice in the stove," (2) represented "waiting for it to boil," (3) represented "covering it," (4) represented "it kept cooking at a slower pace, and (5) represented "waiting for it to be done."

**Figure 3**

*Task graph with relevant points and segments enumerated*



However, when I asked them what the last segment (segment (6) in Figure 3) represented, they did not seem to agree. Some of them said that it was the rice cooling down. This indicated that the mothers connected the decreasing slope of the last segment on the graph to a decrease in the rice's temperature. For them, it made sense that the lines in the first two segments were increasing and that each increased at a different rate. However, when asked about the y-axis label, the mothers were not using temperature but stages of the process of cooking rice. For them, it was implicit that in each stage, the temperature of the mix increased or decreased.

After further group discussion, Magali explained with more detail how she thought the graph fit the situation (see Figure 3).

Bueno yo pensaba como... a temperatura ambiente (1), heating? ¿Qué será? Qué empieza a calentarse (2), y aquí es que ya hirvió (3), y luego aquí ya le tienes que apagar para... bueno no apagar, bajar la temperatura a lo más bajito (4) porque sino se te quema [Well I was thinking that ... at room temperature (1). Heating? It is starting to get warmer (2), and then here it is already boiling (3). Here, you have to lower the flame to the lowest level (4) because if you don't, it will get burned].

This time Magali used the word temperature in her explanation. Also, she added that in the second segment of the graph, the "temperature" needed to be lowered down so that the rice would not get burned. From the quote above, it seemed that Magali used the word temperature to refer to the stove's flame. As a consequence of lowering the flame, the rice would keep incrementing its temperature but at a much slower pace, so Magali's description matched the graph. All the mothers agreed that (5) in Figure 3 indicated turning off the flame. Yet, the graph was still missing the meaning of (6) and (7) in the graph and its axis' labels.

The conversation around finding the labels of the ordinate axis continued. The mothers came up with a new label for the y-axis, the amount of evaporated water. Thus, the x-axis represented time and the y-axis represented the amount of evaporated water. In order to give a scale to the x-axis, Sandra explained that rice takes about 20 minutes to cook. Following Sandra's comment, the group of mothers agreed that the last point in the graph (7) would indicate 20 minutes in the x-axis. At (3) only 3 minutes would have passed. At (5), 15 minutes would have passed. Since a unit of measure was needed for the y-axis, the mothers started talking about the composition of the water-rice mixture. Elena said, "2 cups of water per 1 cup of rice" which was the ratio between water and rice that she used. The rest of the participants confirmed Elena's suggestion. Therefore, the amount of evaporated water was measured in cups, and at the highest point in our graph (5) the 2 cups of water would be evaporated.

Once the labels were decided, I asked the participants to verify that each segment in the graph made sense with the quantities they chose. The first segment (2) indicated that most of the water, 1.5 cups, evaporated from the pot. Then, (3) indicated that the flame would be lowered down so the water would keep evaporating (4) but at a much slower rate than in the first segment. At (5), all the water would evaporate, and the flame would be turned off. All the mothers agreed that at that point, the heat would be turned off and that was the reason why the last segment of the graph decreased. The interpretation in the segment (6) does not match with the quantities that the mothers chose since at (5) all the 2 cups of water had already evaporated. Thus, in (6) there was no water left to evaporate. The mothers' interpretation of segment (6) seems to be related to the change in temperature of the rice as a result of turning it off. At the moment, the mothers seemed to not notice this discrepancy in their interpretation of the graph.

During the whole exchange of ideas, the mothers kept sharing their experiences with cooking rice. Some of them mentioned that it seemed unrealistic to think that 1.5 cups of water would evaporate in 3 minutes since as they mentioned before at (3) only 3 minutes would have passed. In answer to this, Sandra explained that she believed that was possible because she put hot water in the pot from the beginning, so it took less time for it to boil and start evaporating. To this comment, Elena explained that she understood Sandra's reasoning but that she was not sure about it because she always used water at room temperature. The mothers used the discussion of cooking rice as a way of sharing tips for cooking rice faster, how to check if it was ready, cooking time, adding different flavors, and preparation of the rice before cooking it. They also shared how they estimated the cooking time, which depended on the consistency of the mixture, what they meant by lowering the heat, and how each of their own mothers made rice.

Even though the conversation could seem off topic at times, the mothers always kept trying to match what they were saying to the graph. They were trying to make sense of it through their own experiences and testing if the graph truly represented what they were trying to say. Ito et al. (2013) state that the inclusion of out-school interests and social relations in a learning environment helps to develop a positive disposition towards academic subjects. They called this connected learning which integrates three learning spheres: interests, peer culture, and academic content. Connected learning "increases the capacity and value for others in their community and beyond [...] embody ample opportunities for individual contributions and development in the service of collective goals" (Ito et al., 2013, p. 48). Therefore, we can see the mothers' "off topic" conversations as connected learning that increased their interest, helped them make connections with their daily life, and helped to enhance the learning environment for the whole group.

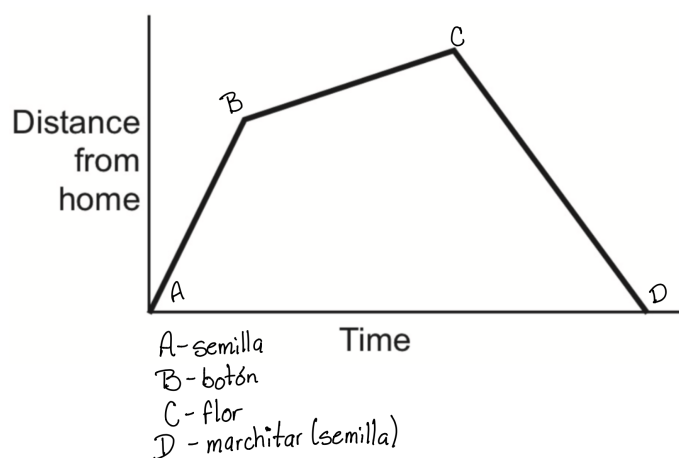
### *Making the graph their own*

After this collaborative interpretation, the mothers started working by themselves and wrote their story. All the mothers personalized their graph in a different way. Magali wrote her story about a flower.

Al empezar la primavera sembré una semilla de margaritas (A). Pasaron los días y observe un agradable botón (B). Al pasar una semana nació una hermosa flor (C). Disfruté de su belleza un par de días y al marchitar mi flor me dejó de herencia unas semillas para volver a tener una linda flor (D). [At the beginning of spring, I planted a marigold seed (A). After some days, I observed a flower bud (B). One week after, the bud bloomed, and a beautiful flower came out (C). I enjoyed the beauty of the flower for about two days and then it started to die. At the end, my flower left me some seeds that would let me have another beautiful flower (D).]

**Figure 4**

*Magali's annotated graph (graph was redrawn for clarity)*



In Magali's story, the intersection of segments (A, B, C, D) represented a stage in the flower's life cycle (A- seed, B- flower bud, C- flower in bloom, D- wither flower that becomes seeds). While reading her story, Magali traced the graph with her finger and stopped at each critical point. She did not make a specific comment about the segments in between critical points like segments (2), (4), and (6) in Figure 3. Thus, it was not clear if Magali was relating her story to the flower's height in addition to the flower's growth stages. Marta<sup>4</sup> made a suggestion about relating it to the flower's height but Magali reaffirmed that she was focusing on the stages in the flower's life cycle. The x-axis label in Magali's graph was time since the flower's life cycle was a process that happened during a certain amount of time. After this small discussion about Magali's story, Marta asked the entire group if the graph could represent a person's height throughout life. The mothers seemed to have grasped how to interpret the graph since they quickly realized that the last segment would have indicated that the person's height would decrease until reaching 0 which was not realistic at all. We could notice that with each new interpretation of the graph, the mothers were gaining confidence in their knowledge since they would quickly share their ideas.

Elena's story referred to something that happened to her during the previous weekend. She read the story to the rest of the group:

El sábado pasado a las 5 de la mañana estaba muy a gusto dormida. A las 6 de la mañana me desperté... me despertaron porque tengo que hacer desayuno. A las 6:30 que es aquí (señalando la intersección en la gráfica (5)) le hice el desayuno a mi esposo porque iba a ir a trabajar. A las 7 de la mañana se fue a trabajar, y aquí ya me volví a acostar. [Last Saturday at 5 am, I was sleeping comfortably. At 6 am, I woke up... I was woken up

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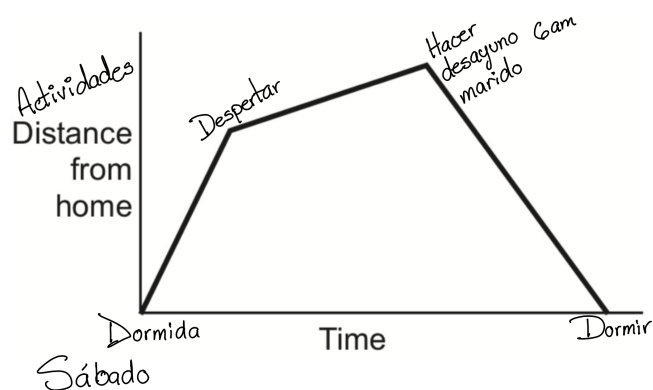
<sup>4</sup> Dr. Marta Civil, the principal investigator of the larger project, is referred to as Marta (see Methods).

because I had to make breakfast. At 6:30 am which is here (see (5) in Figure 3), I prepared breakfast for my husband because he was going to work. At 7 am, he left for work, and here (see (7) in Figure 3) I went back to bed]

In her story, Elena identified the critical points in the graph (the intersections between segments) and annotated the graph according to her story (see Figure 5). The story included information about the time at each of the critical points which indicates that Elena kept in mind the quantity in the x-axis (time) while writing her story. After sharing her story, Marta asked Elena what the y-axis label was in her graph. Elena did not have a clear idea of the label for her vertical axis and the mothers started helping her to figure it out. Lidia suggested that the vertical axis represents the different activities that Elena was doing in her story (waking up, getting up, cooking breakfast, going back to sleep).

### Figure 5

*Elena's annotated graph according to her story (graph was redrawn for clarity)*



The mothers confirmed that putting the activities on the vertical axis would still make sense, but it was not clear how the difference in slope would relate to the activities. Elena came up with the idea that the difference in steepness in each segment would indicate how awake she was. She would be the most awake while doing the breakfast but at the end she would be asleep

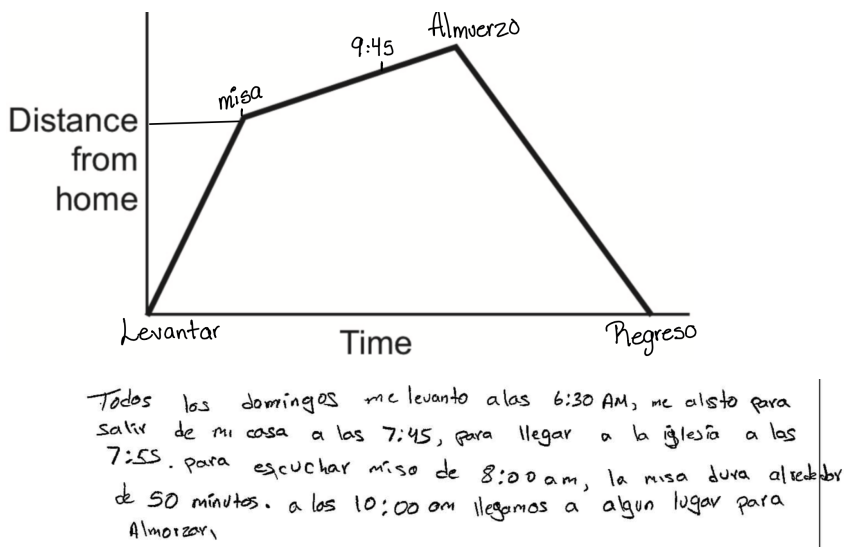
again. Elena's identification of a new label for the y ordinate axes in terms of her story showed her persistence on finding a way to make her story fit with the graph.

The mothers kept presenting their stories and now it was Sandra's turn. Sandra also wrote her story based on one of her routines. Sandra wrote (see Figure 6):

Todos los domingos me levanto a las 6:30 am. Me alisto para salir de mi casa a las 7:45, para llegar a la iglesia a las 7:55 para escuchar misa de 8:00 am, la misa dura alrededor de 50 minutos. A las 10:00 am llegamos a algún lugar para almorzar [Every Sunday I wake up at 6:30 am. I get ready so that we can leave home at 7:45 and arrive at the church at 7:55. I listen to the 8:00 am mass. Mass is about 50 minutes long. Then, at 10:00 am we arrive at some place for breakfast.]

**Figure 6**

*Sandra's annotated graph and story (graph was redrawn for clarity)*



At the moment of sharing her story, Sandra explained that her graph represented her routine on Sundays. According to the story, the segment labeled (2) in Figure 3 represented her getting ready to go to church and leaving her home, so that at 7:55 am she arrived at church indicated by point (3) in Figure 3. Because we were not sure of how Sandra was thinking of the

labeling for the ordinate axis, Marta asked Sandra what it meant that the segment (2) was “going up.” To Marta’s question, Elena replied, “in the car,” indicating that Sandra could be getting ready in the car while she and her family drove to church. Elena helped Sandra with her interpretation of the graph and Sandra accepted the suggestion. Sandra was not sure how to label the ordinate axis, so the mothers suggested labeling it as activities during the day since it seemed to fit what Sandra had in mind.

There was still an issue with Sandra’s story as the segment labeled (4) in Figure 3 indicated that she and her family were sitting at church, but the segment was “increasing.” What could this mean? It took only a few seconds for one of the mothers, Magali, to suggest that the ordinate axis could indicate Sandra’s level of excitement during the day. In that way, segment (2) would indicate that Sandra’s excitement level was increasing as she was getting closer to church. Then, once there, her excitement kept going up as she listened to mass (4). Magali’s suggestion made sense to all the mothers and everyone praised Magali’s imagination and quickness at finding a solution to the problem at hand. This new x-axis label meant that at the end of mass and going to the restaurant for breakfast, Sandra was very excited (5) and then in segment (6) that excitement went down as she had to take care of her family and get back into the typical routine of her family members demanding her attention.

The discussion with her teammates helped Sandra to figure out a different label for the y ordinate axis in her graph, she decided that it could indicate “the level of peacefulness during the day.” At the end of mass and going to the restaurant, (4) in Figure 3, her level of peacefulness was increasing and reached its maximum at (5) in Figure 3 when she arrived at the restaurant. Thus, it made sense that from there it would go down because once she returned home, she would have a lot of things to do and stress would come back to her. She explained that at home

she would not feel peaceful because she had to take care of her son, clean the house, and be in charge of having everything ready for the next day. The mothers were so involved in the activity that they kept suggesting possible labels for the ordinate axis of Sandra's graph (e.g., level of excitement; level of energy throughout the day).

Lidia was the only participant that chose to use the labels provided with the graph (time and distance from home). There was only a slight difference in the time label since in Lidia's graph the x ordinate indicated "driving time" from one place to the other.

Lidia: Mi punto original es la casa porque así como dice distancia de casa. Me lleva 12 minutos manejar de mi casa al trabajo y luego si voy a venir aquí por ejemplo hago otros 20 minutos del trabajo a aquí a la escuela. Y de escuela a la casa hago 35 minutos y ya llegué... entonces mi inicio y mi fin es la casa [My starting point is home because it is like it says here distance from home. It takes me 12 minutes to drive from my home to work and then if I am going to come here for instance it takes me another 20 minutes from work to here, the school. And from the school to my home, it takes me 35 minutes and I arrive... then my starting and final point is home].

Lidia gave this explanation while her finger was tracing the graph. Each intersection of the segments in the graph represented a place. For instance, (3) in Figure 3 indicated Lidia's work; (5) represented the school of Lidia's children. After this explanation, Marta asked Lidia, what was closer to her home, her job or the school? Lidia answered that her job was closer to her home. Hence, Lidia was able to corroborate that her story matched the provided graph. Lidia pointed out that (3) was closer to the x axis than (5). Lidia was able to figure out the numbers in

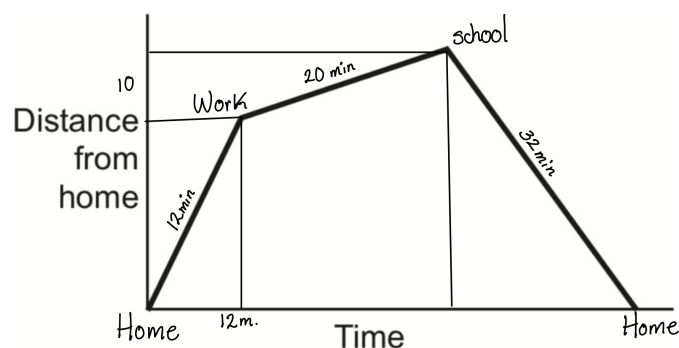
her graph based on the time it took her to go from her home to her job or the school and a previous experience she had with her car. She shared with us that at one time when she was about to leave her job to go home, her car signaled that it was almost out of gasoline. Thus, when driving back, she kept track of the miles traveled and counted 8 miles. Lidia wrote the following story:

“Todos los jueves de clase con Fany y Marta, salgo de la casa a las 8 am al trabajo, me tardo 12 min (8 mi) en llegar, esos días de clase, salgo a las 3 pm de mi trabajo y voy a la escuela para llegar a las 3:20ish (10 mi más o menos). Cuando terminamos de charlar de matemáticas, salimos a las 5:30 pm y regreso a la casa para llegar 32 minutos después (18 millas). [Every Thursday that we have class with Fany and Marta, I leave home at 8 am to go to work. It takes me 12 minutes (8 miles) to get there. On those days, I get out of work at 3 pm and drive to the school so that I can get there at about 3:20ish (10 miles more or less). When we finish talking about mathematics, class ends at 5:30 pm and I arrive home after about 32 minutes (18 miles) of driving.]”

Lidia used her previous experiences as a source of information for annotating her graph and indicating the distance traveled in between places (home and job, job and school, and school and home). Figure 7 shows Lidia’s annotated graph.

**Figure 7**

*Lidia's annotated graph (graph was redrawn for clarity)*



Lidia's annotations in her graph made clear what she was trying to convey in her story. However, the scaling of her graph seemed to be off. For instance, in reference to the y-axis labeled as distance from home, the first segment (going from her home to her job) indicates 8 miles while the second segment (going from her job to school) indicates 10 miles. The interval of the second segment in the y ordinate should be bigger than the interval of the first segment. Thus, the intersection indicates the school should be located higher in the graph. A similar issue happened in the intervals of time in the x ordinate since the last interval should be bigger than the second interval of time. Lidia did not seem to notice the mismatch scaling of her graph. However, it looks like there was something bothering her in her interpretation since she kept checking both her graph and story.

Lidia analyzed her graph further and asked herself and the rest of the group why it took her less time to go to her job from home (8 miles in 12 minutes) than going from her job to the school (10 miles in 20 minutes) if the distance was almost the same. To this question, Magali reassured Lidia and said that her time calculations were right since she should take into consideration traffic lights and people crossing the street, which made traffic slower depending

on the hour of the day. These were factors that would increase the driving time of going from one place to the other.

With each interpretation of the graph that the mothers suggested, they took into consideration if it was realistic or not. They were worried about the graph fitting to their day to day experiences. For instance, Lidia could not believe that one and a half cups of water could evaporate in 3 minutes and Elena and Magali could not believe that the graph could represent the height of a person throughout life either. Most of the mothers re-labeled the y-axis of their graphs and kept the x-axis as time. These new labels for the y-axis were activities, stages a flower life cycle, and level of peacefulness. Elena, Magali and Sandra changed the label so that they could make their stories reflect their personal experiences or interests. Even though Lidia used the labels of the ordinate axis that were provided (distance for home and time), the story that she shared included details that reflected her routine during those days. The mothers were not afraid of changing the graph axis labels and making it their own. The labels that the mothers used move us away from the well-known distance-time example and situated the graph as meaningful for the participants. Also, tasks like this one put the mothers as experts since they had the knowledge about cooking rice and situations in their day to day life.

Moreover, at the moment of presenting their stories to the rest of the group, the mothers helped the person presenting and encouraged her. These situations were very common in this group of mothers. I constantly saw demonstrations of camaraderie and unity in this group of participants. I believed it made it easier for all the mothers to participate in the discussions because they knew the rest of the group would help them in case they needed it.

## *Discussion*

The mothers in this group had been participating in several MFPs together for quite some time. They had joined the larger project with the idea of learning mathematics so that they could help their children with homework. As time passed, the mothers were learning a more advanced mathematics topic (interpreting graphs) because they were interested in doing algebra. It was more for their own learning, not necessarily tied to the immediate need to help their children. Civil and Andrade (2003) faced a similar situation in which the parents in the mathematics workshops expressed their interest in learning more advanced mathematics. In this study and in Civil and Andrade's (2003) the parents strived for learning and understanding more mathematics for themselves, as adult learners. The interest that these mothers showed in learning mathematics topics such as algebra serve as a counter argument to research that points out that Latinx parents do not care about education (Peña, 2000; Valencia & Black, 2002).

In this study, the task about interpreting graphs could be considered a typical mathematics task; however, my main focus is not to discuss how the mothers solved it. I am interested in how the mothers made the task their own and used their day to day experiences to find a solution. This perspective of the school task serves "as an avenue to explore questions around whose knowledge gets valued" (Salazar & Civil, 2020, p. 1). I strive for empowering the participants by "enriquece[r] la identidad regional, al admitir que ellos mismos y sus iguales son sujetos con capacidad de instruir y educar a otros, a la vez que se preservan costumbres y tradiciones" [enriching their regional identity by acknowledging that themselves and their peers can teach and educate others while preserving customs and traditions] (Martínez, García, Chavarría, & Gavarrete, 2020, p. 51). We cannot deny the presence of mathematics in what these mothers did, in their experiences, and in their collaborative reasoning through the task. As

González, Andrade, et al. (2005) pointed out, “this concept of what we count as being mathematics is related to our values and beliefs about what mathematics represents” (p. 265). The acknowledgement of the different ways in which the mothers made sense of the graphs opens the space to expand our values and beliefs around what it means to do mathematics.

Together the mothers built their knowledge about interpreting a graph and even though they did not always use the “appropriate” mathematical language when sharing their ideas, they gave evidence of understanding the mathematics involved. As González, Andrade, et al. (2005) expressed “it is not enough to simply ‘possess’ funds of knowledge in mathematical domains. These must be socially mediated into productive knowledge in order to be meaningful” (p. 266). The mothers helped each other with their graph interpretation and sought the input of those around them when not sure whether their stories matched the graph. For example, Sandra’s constant effort at finding the right label for the y-axis contributed to her increasing understanding of graph interpretation. It was not mere trial and error but a construction of knowledge with every bit of information discovered or given.

The open-endedness of the task allowed the mothers to take different routes on their interpretation of their graph and allowed them to use their daily experiences as a point of reference for their interpretation. Civil et al. (2019) discuss the potential of open-ended mathematics tasks for accessing the participants’ day to day experiences and their mathematics knowledge. Similar to other research (Díez-Palomar et al., 2011), the mothers in this study constantly used their daily experiences when trying to make sense of the mathematical problem at hand. In terms of their experiences and day to day lives, the mothers were the experts and so they were the ones who were best positioned to interpret the graph in these contexts.

It is important to mention that the learning environment in each of the MFPs let the mothers feel comfortable sharing their ideas and at the same time not feel discouraged or upset when someone made a comment about their work. The MFPs happened in a space where the mothers felt in *confianza* (Vélez-Ibañez, 1983). A friendly environment was key in each of these activities. Sandra could have felt uncomfortable when the rest of the group started joking about the level of excitement reaching its highest level at the moment of leaving church and going to a restaurant to eat breakfast. However, Sandra could not contain her laughter and went along with the discussion. In fact, it is while joking and discussing the labeling of the y-axis that the idea of the level of peacefulness came in. The mothers were part of a community in which we aimed for an egalitarian dialogue (Flecha, 2000) although we are aware that issues of power about whose knowledge is valued are always present; those issues were addressed as best we could (Civil & Andrade, 2003; Knijnik, 2004).

## Chapter 6: Conclusion, Implications, and Limitations

### Conclusion

The mothers' experiences with the support they got at home and their experiences at school give us a scope of different ways in which school and home interact in students' lives. Also, the mothers shared what they consider their role in the education of their children as parents and their views about the current mathematics education. This diversity in experiences points to the importance of a balance between the educational support children receive at home and at school. Given the amount of time that children spend at home versus at school, it is almost impossible to negate that the experiences at home can mediate and be part of the mathematics education of children. Certainly, teachers can have a better understanding of their students' backgrounds by getting to know their students' parents, their concerns, their abilities, their feelings about mathematics with respect to themselves and their children, and their eagerness for helping their children to succeed (Civil, 2011; Civil & Andrade, 2003; Civil et al., in press; Civil & Quintos, 2009; Díez-Palomar et al., 2011; McMullen & De Abreu, 2011; O'Toole & De Abreu, 2005). Civil (2011) stated that "to pretend that the cultural, social, language, and political contexts of non-dominant students can be put aside when teaching mathematics is educationally irresponsible" (p.22). At home, parents can be a support and an ally of teachers towards children's mathematics education.

The graphing activity ("Es tiempo de una historia"; see Figure 2) seems like a regular school task; however, the activity was reformulated intentionally so that it could give us an insight into the mothers' daily experiences. The scenario chosen by the mothers in the group (cooking rice) was such that they could all contribute. Thus, the activity encouraged a joint construction of knowledge. Equally important is how this activity gave insights into the mothers'

views on what doing mathematics looks like. For instance, when creating her own scenario, Lidia did not change the labels and provided a more school-type story, which corresponds to what she did in some other tasks, while the other mothers were less focused on the “mathematics” and prioritized their story. Moreover, this activity positioned the participants as experts because they chose the topic being described by their graphs. Using their own scenarios that were of interest to them supported the mothers’ engagement with the mathematics involved in the task. All the mothers made themselves the main characters of their stories. Even in Magali’s story about the stages of growing a plant, she described herself as the observer of this process. Hence, her story was still related to her, as being part of that context. These spaces where the mothers could share their interests, see connections between them and the mathematical content, and work towards building the knowledge of the whole team can be considered spaces where connected learning takes place (Ito et al., 2013). In these spaces, the mothers remain interested throughout the activities and work together towards a common goal which is to make sense and understand the mathematical concepts.

### **Implications for Teachers’ Education**

Teacher preparation programs and teachers’ professional development could provide pre-service teachers and in-service teachers with tools and experiences that help them to build meaningful connections with their students’ parents. What could the concept of “parents as intellectual resources” in the classroom look like? For practicing teachers one suggestion for starting to build a stronger relationship with the students’ parents is inviting them to come and observe their mathematics class (Anhalt, et al., 2002; Civil & Menéndez, 2012; Civil & Quintos, 2009). In Anhalt, et al., three Latina parents shared their opinion about the changes in the mathematics classroom with respect to the role of the teacher, the role of the students, and the

mathematical content itself. The parents' visit to the classroom helped them realize that the mathematics taught to their children were in some aspects clearer and better explained than the mathematics they had themselves learned at school. For the parents, the classroom visit served as a gateway to understand how their children were learning mathematics.

Parents have shown to be very interested in visiting the mathematics classroom. For instance, Elena visited Ms. Perez's mathematics class and at the end of this visit she came out fascinated. This visit made such an impression on her that at during an interview later in the year, she still remembered the experience:

"I like that the teacher took the time to explain the concepts to the students. Also, I like all the charts she had in the walls. Those had the concept, and example, and a detailed explanation... I like that the children were in groups because that let them share their ideas and talk about math"

Elena took the time to reflect on all the effort the teacher made for her students. As the parents feel comfortable in the mathematics classroom, they could contribute to the teaching by helping students and identifying students that bring different approaches to the mathematical tasks. Mothers could offer a different perspective on the classroom environment. For example, Magali's experiences with mathematics education and the experiences of her children give her an insight of how a student who is struggling with mathematics might feel. Also, her experiences could give her a good sense about how to help these students and identify students with mathematical ideas that might be unnoticed by the teacher. Parents do not only care about the education of their children. They could offer insight about other children' mathematics experiences in the classroom based on their own experiences with mathematics.

In this way, parents are coming to the classroom not only to do busy work (cutting paper, staple pages, help the teacher prepare material) (Civil & Andrade, 2003; Quintos, et al., 2019). As a result of the parents' active participation in the mathematics classroom, the students might start to recognize and value the knowledge of their parents. The students whose parents participate in the mathematics classroom could feel proud of their parents being considered as a helpful and intellectual resource by the teacher.

One teacher who was participating in the larger project shared her experience with inviting parents to her classroom:

“I had parents where they just... we will sit at the table and work with certain groups and then they'll move around. They don't necessarily just sit with their own child and that's when actually, where I tell them when they do come in as a volunteer. I always tell if they could also help with other kids. You know and sometimes even give them specific, maybe want them to work something specifically and you know they are pretty good about doing that.”

Parents as partners in the education of the students is possible. Teachers should create spaces where they can get to know what support their students are getting at home and get to know the persons (i.e., parents, older siblings, close relatives, grandparents) who have the child for the rest of the day. Teachers need to start visualizing the community surrounding them as sources of knowledge and invite caregivers to come to the mathematics classroom.

On the other hand, parents' participation in the mathematics classroom does not have to be limited to them coming to the classroom. Many parents may have work related responsibilities that do not make it possible for them to visit a mathematics classroom or come to the school during their work hours. In this situation, the wide use of technology like cell phones,

internet, video recorders, video conferences, and live streaming videos could represent an opportunity for these parents to get involved without being physically present. Some parents might know already how to use this kind of technology. For example, at the school where this study took place, the teachers and other school personnel communicated with parents via an app for cell phones, as I describe below. Other parents may not be familiar with how technology can support a dialogue with their children's school; however, we know that parents put the time and effort on helping their children and like Lidia, Magali, and Elena, they could become experts in this matter with the help of internet sources. Parents are spending time supporting their children's education but for teachers it may be hard to see their efforts because these happen at home. Thus, we have to start thinking about how to bring what parents do at home into the mathematics classroom.

How can teachers take advantage of the technology available and use it to discover the parental involvement in education that happens at home? One option is asking parents to make a short video in which their children and them are doing an activity (i.e., cooking, gardening, cleaning, washing the dishes, etc.). Teachers could use this video in class to introduce a mathematics topic or give context to a mathematics problem. For example, parents could make a video record of their family making tamales (i.e., preparing the dough, preparing the different fillings, and putting together each tamale). The teacher could use this video in class to introduce or contextualize mathematics topics such as measurement, proportions, or counting. In this way, parents who cannot visit the classroom can get involved.

Another way in which parents who work during the day could participate in the mathematics class is making a short video call during the mathematics class. During their video call they could describe their work and the different mathematics they use. For example, parents

that work in construction could share how they install the tile in a bathroom. The teacher could refer to the tiles patterns in class and make a connection with the parents' work. Furthermore, the parents could share how they use patterns at work and how they calculate the number of tiles needed of each figure or color. The parents' participation in the mathematics discussion with the class would make the students value and appreciate their parents' mathematical knowledge.

Lastly, there are several schools that use an cell phone app to get in contact with the parents. Parents could use this app to talk with their children's teachers and share some pictures that show the different activities that their children do during the weekends. In this way, teachers could strengthen their communication with parents while learning more about their students. Teachers could use these pictures for making activities or giving examples that connect to the students' lives. The teachers' regular communication and exchange of information with parents through this app would send the message to parents that their opinion and input are important. These are some suggestions about how to support parents' participation in the mathematics classroom, especially for parents who cannot come to school during school hours. We need to modify our ideas around what counts as parental involvement. The ways we relate to people and how we communicate with them are changing and technology could be one of the tools that helps us expand our traditional definition of parental involvement.

For preservice teachers, the teacher educator could invite a panel of parents from the local schools to come to their university course. The idea would be to have this panel share their expertise ("parents as intellectual resources") with the preservice teachers. While not discussed in this thesis, we did this with a group of four mothers from this project. The teacher educator asked the preservice teachers to come to class prepared with questions for the mothers. The preservice teachers' questions focused on how to overcome the language barrier, what the

mothers would like a teacher to do for them and their children, and how they can be a better support for parents. Even though at the beginning the mothers were very nervous about talking in front of the preservice teachers, in no time they took the stage, shared their experiences and their concerns. They enjoyed interacting with the preservice teachers. For the mothers, the fact that they were invited to this panel meant that these future teachers valued their input and the teacher educator was taking an active role in preparing them.

### **Implications for Future Research**

Further research which goes beyond the general ideas (i.e., socioeconomic status, education level, and time availability) about Latinx parents' motivation to participate in the mathematics education of their children is needed in order to withstand against deficit views and negative stereotypes associated with this non-dominant group. More research that takes in consideration Latinx parents' previous experiences and their identities as factors that influence their participation and decisions in mathematics education may shed light on how teachers can make connections with Latinx parents and work together.

While in this study only mothers participated, it is important also to take in consideration, what are the mathematics experiences of Mexican American fathers and how those influence their views about their children's mathematics education. What is the experience of children with respect to mathematics education at home? What is the role of close relatives (i.e., siblings, uncles, aunts, grandparents) in the mathematics education of children? How do the interactions with these family members shape children's mathematical experiences?

In order to expand our views on what it means "to do mathematics", researchers could look further into how parents make sense of mathematical concepts, how they relate those concepts to their day to day life, and how the input of other parents helps them to build on their

understanding. Future research could also explore how what may seem as “off topic” conversations among the adult learners while doing mathematics contribute to their overall understanding and sense making of the mathematics concepts.

### **Limitations**

There are some aspects that limit the generalizability of this study. First of all, the number of participants in this study was small (five participants). This study was designed to further our understanding of some elements related to Mexican American mothers and their experiences with mathematics education, rather than describing a whole population. Also, as explained in the participant selection section, the sample is not likely to be representative of the larger parent population at this school, given that we had a small selection, largely chosen by the principal. The mothers participating were already very involved in their children's education since most of them were volunteering at the school and had good communication with the teachers and administrative staff. Furthermore, the group of mothers who participated in this study had been learning different ways of doing and thinking about mathematics which might have shaped their opinions about their participation in the mathematics education of their children. Thus, the conclusions of this study can only be internally generalizable, meaning that the conclusion is only within the case, setting, and group studied.

### Appendix A - Interview

1. Describe how math classes were when you were in elementary and middle school.
2. What is something you remember the most about mathematics when you were a student?
3. How would you describe your experience learning mathematics in two words? Why did you choose these two words? [probe: ask for feelings while learning]
4. As you think back about some of your friends when you were in school, do you think they had similar feelings about mathematics as you have? [probe] How do you know?
5. What role did your parents play in your mathematics education?
6. How do you feel about their role in your mathematics education? Do you think it should have been different? Why or why not?
7. How have your experiences with math shaped you as a math adult learner? As a mother? [give some examples]
8. What do you think about the way your children are learning mathematics? [probe: good, bad, too complex, too long]
9. How would you compare your experience with mathematics with that of your children's? [probe: similarities, differences]
10. When you are explaining mathematics to your child, what tools/examples/ strategies do you use while explaining it? Do you think that your experiences have an influence on the way you teach mathematics to your children? Can you provide some examples? [probe: memorization, repetitive practice, mental calculation, etc.]
11. What role do you think you play in the mathematics education of your children? [probe: provide support, teacher at home, responsibilities as parent]

12. Do you have an example about how your participation in this project has been useful when you are helping your child with mathematics?

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